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John Muellbauer

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John Muellbauer, Nuffield College, Oxford and CEPR

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Centre for Economic Policy Research  
90–98 Goswell Rd, London EC1V 7RR, UK  
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999  
Email: [cepr@cepr.org](mailto:cepr@cepr.org), Website: [www.cepr.org](http://www.cepr.org)

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## **ABSTRACT**

### Housing, Credit and Consumer Expenditure\*

Many factors have contributed to the development of credit markets, easing access of households to credit. This paper considers the implications of easier credit for the influence of higher house prices on consumer expenditure. It argues that with poorly developed credit markets, the effect is likely to be negative, but becomes positive as access to housing collateral increases and down-payments for first time home buyers fall in relation to values. The implications for differences between countries and changes in consumer behaviour over time are explored. Previous studies are reviewed: the omission of credit liberalization and other controls has often biased estimates of housing 'wealth' effects on consumption. New empirical estimates for the UK and US suggest that there was no housing 'wealth effect' before credit market liberalization, but that the housing collateral effect is now significant, larger than the stock market wealth effect, and about twice as large in the US as the UK.

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John Muellbauer

Nuffield College

Oxford

OX1 1NF

UK

Email:

[john.muellbauer@nuffield.ox.ac.uk](mailto:john.muellbauer@nuffield.ox.ac.uk)

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## **1. Introduction.**

One important channel by which developments in housing markets affect the macro-economy is through changes in consumer behaviour. More favourable access to credit has raised household debt levels in many countries and house price appreciation has led to increased household wealth. Several factors underlie the improved access to credit, including changes in prudential and wider capital market regulations, technological change and reductions in the cost of information technology, developments in the sharing of information on credit histories, and the deepening of markets for securitized contracts and derivatives. The increased ability of households to extract or borrow against their home equity has altered consumer spending and saving behaviour in many countries. New types of mortgage contracts have made housing more affordable at given home prices; but while lenders have often succeeded in spreading their risks through the financial system, the risks for many borrowers have increased.

The aim of this paper is to discuss housing wealth and other asset effects in the context of life-cycle consumption theory, augmented for credit channel effects and taking account of credit market liberalization. In Section 2, it is argued that there is some justification from simple life-cycle permanent income theory for the Bank of England's view that there is no effect on consumption from a permanent increase in house prices. However, as soon as credit constraints based on asymmetric information between borrowers and lenders enter the picture, the implications for consumption alter dramatically. Where mortgage credit markets are poorly developed, potential first-time buyers have to save a significant fraction of their income for a housing deposit, while existing owners have limited access to home equity loans. When house prices rise, potential first-time buyers have to save yet harder, while the owners do not increase their spending much given limited access to the extra collateral. The overall effect of the rise in prices is then to reduce consumption. However, liberalization and improvements in the efficiency of mortgage credit markets change both dimensions: the young save less and housing equity becomes more collateralizable. When house prices rise, there is then only a small negative effect on the spending of potential first-time buyers, and a larger positive effect on that of existing owners as their collateral values increase. In Section 2, the consequences of institutional differences in credit

markets for consumer behaviour through time and in comparisons between countries are discussed. Various nuances of credit market and other institutional differences are explored.

In practice, there is widespread disagreement about the role of housing wealth in explaining consumption. Much of the empirical literature (briefly reviewed in Section 3) is marred by omitted controls for the common drivers both of house prices and consumption, including income, income growth expectations, interest rates, credit supply conditions, other assets and indicators of income uncertainty (such as changes in the unemployment rate). Omitted controls are likely to be correlated with house prices, thereby making estimated wealth or collateral effects liable to bias. For instance, while the easing of credit supply conditions is usually followed by a house price boom, failure to control for the direct effect of credit liberalization on consumption can over-estimate the effect of housing wealth or collateral on consumption. Further, models formulated entirely in quarterly differences, as some are, may not well measure long-run responses.

This paper explores the consequences of credit market liberalization through the lens of a modern version of the Friedman-Ando-Modigliani ‘solved out’ consumption function. An extended framework for modelling the consumption effects of housing wealth, collateral and credit is presented in Section 4, encompassing traditional features of life-cycle theory such as income growth expectations, but building in the main elements of the household credit channel. This gives rise to an empirical model that allows the consequences of shifts in credit supply conditions for consumer spending to be tested, as well as checking for differences in the marginal propensity to consume out of different types of assets. It takes account of the long run information in data on consumption, income, assets and debt which is thrown away in the alternative (differenced) Euler equation approach. The model is also more robust than the Euler approach to deviations from the latter’s extreme assumptions about household rationality and information processing capacity.

This extended model has been applied in the UK, the US and other countries, including South Africa and Japan, though the results for the US and Japan are still preliminary.<sup>1</sup> The results are discussed in Section 5. Key to this work is the

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<sup>1</sup> The UK results are from joint work with Janine Aron (Oxford) and Anthony Murphy (Oxford); preliminary results for the US are from work with John Duca (Dallas Federal

development of an indicator of the shift in credit market supply conditions. For the UK, we have a sophisticated index developed in Fernandez-Corugedo and Muellbauer (2006), consistent with a large credit market liberalization beginning in 1980. Liberalization significantly raised the consumption to income ratio and significantly altered the response of consumption to several drivers, most importantly to housing wealth. The evidence is that before 1980, there was no housing ‘wealth effect’ on consumption, but that this effect now somewhat exceeds the effect on consumption of illiquid financial wealth. Evidence also points very strongly to a larger marginal propensity to consume out of liquid assets (minus debt) than that of all other assets. Further, in a separate model, the Bank of England’s estimates of housing equity withdrawal are well explained by this credit conditions index and its interaction with housing wealth. However, housing equity withdrawal has no explanatory power in our extended consumption function.

For the US, we use a proxy for credit supply conditions based on the Federal Reserve’s Senior Loan Officer Survey question on banks’ willingness to make consumer loans for durables purchases. To ensure robustness to the possible omission of long run influences on consumption coming from demography, rising inequality and other factors, the consumption model includes a smooth stochastic trend. The key findings are the same as for the UK: the easing of credit market conditions has caused a significant rise in the consumption to income ratio and a positive shift in the housing collateral effect. As in the UK, we find a higher marginal propensity to consume out of liquid assets minus debt than out of illiquid financial assets. However, our preliminary evidence points to the US housing collateral effect now being larger than in the UK and significantly exceeding the illiquid financial wealth effect. For the US, this supports the claims of the widely cited paper by Case et al. (2005) and research by Carroll et al. (2006) among others.

Further support for these findings and the extended consumption model comes from work on South Africa, with large wealth and collateral effects. South Africa has long had a sophisticated financial system and UK style mortgage markets, with credit market liberalization in the 1980s and 90s. In contrast, research on consumption in Japan points to very different conclusions. We find no evidence that there was any important easing of credit conditions for consumers between 1980 and 2000. Using

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Reserve) and Anthony Murphy; results for South Africa are from joint work with Janine Aron; and those for Japan draw on joint work with Keiko Murata (Cabinet Office, Japan).

residential land prices as a proxy for house prices, we find a negative effect from higher prices on consumption consistent with the view that the young save harder when prices rise, offsetting any wealth or collateral effects for existing owners. Since Japanese inheritance tax favours residential housing, there are good reasons why older households are less likely to downsize or withdraw equity.

There are important implications, discussed in Section 6, for household vulnerability of the high debt levels that have been reached in many countries. The evidence that many households have poor information or understanding of financial matters suggests that, while most households have adequate net equity and cash flow cover for their debts, significant proportions could find themselves in difficulties in only somewhat less benign economic conditions. This has been exacerbated by some poor lending practices that have come to light as the sub-prime loans crisis has unfolded. A recent OECD review by Girouard et al. (2006) raises mild concerns about household vulnerability, but rather more disturbing is a study by Lunde (2007) using a remarkable micro data set for Denmark (the world champion for high levels of household debt).

Section 7 concludes by discussing some of the implications of the analysis and empirical findings of this paper. It draws parallels between the partial and temporary retreat from liberal credit conditions in the UK in the early 1990s and current prospects in the US. It examines implications for world growth of credit and house price developments in emerging markets. It also discusses wider government policies to deal with some of the issues raised by credit and housing market developments.

## **2. Housing Wealth Effects and Credit Availability.**

In this section, the housing wealth effects implied by the life-cycle/permanent income theory of consumption, in the absence of a credit channel, are examined and shown to be small or even negative. However, introducing credit constraints radically alters these conclusions. The implications of differences in credit and other institutions across countries and across time are explored.

## 2.1 Housing Wealth Effects.

Linguistic confusion abounds regarding ‘housing wealth effects’ for consumption. We need to distinguish the effects of higher housing wealth due to fixed capital formation from those effects due to price rises. Given the focus in the literature on the role of house price rises, we examine here increases in real housing wealth resulting from a permanent rise in the relative price of housing. It is important to make two further distinctions. We need to distinguish the classical wealth effect on consumption implied by life-cycle/permanent income theory where the channel credit is disregarded, from housing collateral effects via greater access to credit. We must also distinguish non-housing consumption from composite real consumption including imputed housing services. As we shall see, for the latter, there are good reasons to doubt any wealth effect stemming from a permanent relative price change.

In life-cycle permanent income models, a permanent increase in the real price of housing has income, substitution and wealth effects. These can be analysed in the following simple model of consumer choice. In the model,  $c$  denotes non-housing consumption,  $p$  is the relative price of housing,  $H$  is the stock of housing,  $\delta$  is the rate of deterioration of housing,  $r$  is the real interest rate,  $y^p$  is permanent real non property income, and  $A$  is real financial wealth. The consumer maximises life-cycle utility defined on the flows of  $c$  and on the stocks  $H$ , in each period.

Assume that the consumer expects the future relative price of housing to be constant. Then the multi-period inter-temporal optimization problem reduces to a two-good problem (by the Hicks aggregation theorem, see Deaton and Muellbauer, p.121)) with the following budget constraint for housing and non-housing consumption:

$$c + p(r + \delta)H = y^p + r(A_0 + pH_0) \quad (2.1)$$

where  $r(A_0 + pH_0)$  effectively measures permanent property income. The standard view is that housing services are defined by  $(r+\delta)H$ , and the real user cost is defined by  $p(r+\delta)$ , see Poterba (1984) or Deaton and Muellbauer (1980, pp.107, 348).

The effect of a permanent rise in the relative price of housing on non-housing consumption is given by

$$\partial c / \partial p = rH_0 - (r + \delta)H - p(r + \delta)\partial H / \partial p = rH_0 - H(r + \delta)(1 + \varepsilon) \quad (2.2)$$

= wealth effect minus income and substitution effect

Here  $\varepsilon$  represents the own-price elasticity of demand for housing. The value of  $\varepsilon$  is generally thought to be in the region of -0.5 to -0.7, moderately inelastic, see Meen (2001), Cameron et al. (2006). The overall effect of a price rise in housing could be positive or negative, but is more likely to be positive. For example with a real interest rate of 4 percent, a rate of deterioration,  $\delta$ , of 2 percent, an elasticity,  $\varepsilon$ , of -0.7, and assuming  $H$  is approximately equal to  $H_0$ , the overall effect on non-housing consumption is  $0.04 - 0.06 \times 0.3 = 0.022$ .

However, we are more usually interested in the effect of a price-induced housing wealth increase on a constant-price index of *aggregate* consumption (including imputed consumption from housing services,  $h=(r+\delta)H$ ), than only on non-housing consumption. The effect on the index of total consumption<sup>2</sup> from equation (2.1) is

$$\partial c / \partial p + p(r + \delta)\partial H / \partial p = rH_0 - (r + \delta)H \quad (2.3)$$

But with  $H \approx H_0$ , the right hand side of equation (2.3) is bound to be negative in this simple model, since  $\delta$  is positive. In countries where the housing services are incorrectly measured as  $\delta H$ , which omits the real interest cost, the effect would usually be positive. This is because one would expect the real interest rate generally to exceed the deterioration rate of housing. It is important to be cautious in these circumstances, for the finding of a positive housing wealth effect might be due to the mis-measurement in the National Accounts of housing services. Even in the circumstances of a mis-measurement of housing services, the theory suggests that the housing wealth effect ( $r-\delta$ ) is smaller<sup>3</sup> than the financial wealth effect ( $r$ ).

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<sup>2</sup> Such an index would usually take the Laspeyres form, taking base prices as given. Thus, the LHS of equation (2.3) measures the response of such an index to the relative price of housing.

<sup>3</sup> This point seems to have been overlooked in the classic work by Modigliani and Brumberg (1954), Friedman (1957, 1963) and Ando and Modigliani (1963).

The above is a stylised model assuming an infinitely lived representative consumer. In finite life models, by contrast, one can argue about distributional effects, for example if the marginal propensities to consume out of wealth of older consumers downsizing to release housing equity are large compared to the income effects for younger consumers increasing their stake in housing.<sup>4</sup>

This analysis has also abstracted from taxes, and liquidity considerations due to transactions costs and capital uncertainty. The lower are transactions costs, which include some taxes, and the lower are the charges of real estate agents and lawyers, the more liquid and so potentially spendable, is housing wealth. The tax system can have other effects: for example, if housing is tax advantaged for inheritance tax (as is the case in Japan), older people will be less inclined to reduce their housing equity to maintain spending. This will reduce any housing wealth effect.

Another aspect of liquidity, high home ownership rates, could also be a factor increasing the housing wealth effect. Over half of German households are renters, for example. While the household sector directly or indirectly owns much of the rental stock, for example, via pension funds, a rise in the value of the rental stock has a smaller wealth effect than a similar rise in value of the owner-occupied stock, in part because pension wealth tends to be less liquid. This makes it quite unlikely that there could be a positive wealth effect rationalized by life-cycle consumption theory for Germany, but less implausible that there could be one for the UK.

The Bank of England view that there is no housing wealth effect is based on the classical theoretical view of consumption that ignores the credit channel. If there is a large 'housing wealth effect' of the kind so widely discussed by policy makers and popular commentators, then the traditional life-cycle permanent income theory looks like the wrong theoretical foundation. We must turn to the credit channel to understand the consumption effects of housing wealth increases induced by house price rises.

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<sup>4</sup> In the RHS of equation (2.3), significant downsizing would see  $H$  smaller than  $H_0$ , giving a positive overall effect on consumption, while for first time buyers, for example,  $H_0$  would be zero, leaving only the negative income and substitution effect.

## **2.2 The Role of Credit.**

As Bernanke (2007) recently re-emphasised, the asymmetric information revolution led by Stiglitz and others is fundamental to understanding the credit channel. With moral hazard, the possibility of adverse selection and other agency costs, lenders typically limit unsecured lending (even with good information on the credit history of borrowers), and impose limits on the fraction of housing collateral up to which they will extend mortgages. However, there are large differences between countries and over time in the restrictiveness of these limits. There are two distinct ways in which credit markets matter for the effect of house prices on consumption (as argued in Aron and Muellbauer (2000)). The first concerns first-time buyers and the second those already possessing housing collateral.

### **2.2.1 Relaxing Credit Constraints on First-time Buyers.**

The first point concerns young credit-constrained households saving for the minimum deposit required to get onto the owner-occupied housing ladder.<sup>5</sup> Suppliers of mortgage credit set upper limits to loan-to-income ratios and loan-to-value ratios (LTVs) to reduce default risk. Such households will consume less than income, the difference depending on the ratio of house prices to income and on the minimum deposit as a fraction of the value of the house. A reduction in credit constraints in the form of a rise in the maximum loan to value ratio (i.e. a reduction in the minimum down-payment as a fraction of the value of the house), or in the maximum loan to income ratio, will raise the consumption of young households relative to income (see Japelli and Pagano (1994) and Deaton (1999), and micro evidence in Engelhardt (1996)).

In terms of differences across countries, countries where loan to value ratios offered to first-time buyers are low, will tend to have high aggregate household saving rates. Moreover, higher house prices relative to income lead to those aspiring to own

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<sup>5</sup> Owner-occupation offers advantages in many societies, for example a preferred tax status, lower long-run costs than renting and the elimination of agency costs of landlords. One of the earliest models of saving for a deposit necessary to buy an illiquid asset is by Jackman and Sutton (1982). In their model of no borrowing without collateral, the household saves to overcome a transactions cost hurdle, but the authors recognize, see footnote 1, that the model is easily extended to cover the case where the LTV is less than 1.

a home to save a larger fraction of their income. Even renters who do not have such aspirations are likely to face higher rents in future when house prices rise and should therefore rein in their consumption. This negative effect of higher house prices can, in the aggregate, easily offset any small ‘wealth effect’ defined by equation (2.3) above. Evidence from Italy is consistent with this negative effect (Kennedy and Andersen (1994), Boone et al. (2001) and Slacalek (2006)), while the high personal saving rate and the high average age of first time buyers in Italy are stylised facts, linked to the failure of the mortgage market (Chiuri and Japelli, 2003). Though household debt as a fraction of income has risen sharply in Italy in recent years, it remains close to the bottom of the OECD league table of household debt/GDP. Domestic credit markets have become more competitive, but there is little evidence of major progress towards addressing the institutional impediments, such as the failures of the legal system and inefficiencies in title registration, that impede access to collateral by lenders.

In terms of shifts in behaviour over time, in the many countries where LTVs and loan to income ratios available to first-time buyers have risen, we should expect the personal sector saving ratio to have declined and the negative effect of higher house prices on the consumption of the young to have diminished, leaving more scope for a positive overall effect of house prices on consumption.

It is important to note that most of the potential first-time buyers of housing, saving for a housing deposit, are not credit-constrained in the sense of being unable to smooth consumption. The savings they are building up for a future housing deposit can be run down or increased in anticipation of shorter-term income fluctuations and in response to changes in real interest rates. This mechanism by which credit market liberalization affects consumption by relaxing down-payment constraints is therefore quite different from the classic treatment of the reduction of credit constraints for inter-temporal consumption smoothing, see Flemming (1973), Hayashi (1985b).

### **2.2.2 Relaxing Access to Housing Collateral.**

Looking first at the cross-country differences, the relaxation of rules and spread of competition in many countries have made it easier to obtain loans backed by housing-equity (see Poterba and Manchester, 1989). A rise in house prices then makes it possible to increase debt or to refinance other debt at the lower interest rates made possible by collateral backing. The latter is equivalent to a reduction in the real

interest rate faced by a household and is thus not really the removal of a credit constraint. However, for households who were previously credit constrained, new access to home equity loans does relax credit constraints in the manner analysed by Flemming. This increased access can occur because of an institutional shift in behaviour by lenders or because of a rise in house prices for a given regime governing access to home equity loans. Effectively, the liberalization of credit conditions in terms of access to home equity loans increases the “spendability” or liquidity of such previously illiquid housing wealth.

The size of the housing collateral effect depends on a number of factors. As noted in the introduction, one institutional feature affecting the efficiency of credit markets concerns the sharing of information on individuals’ credit histories by financial institutions, thus reducing the problem of asymmetric information which impedes lending. The USA, for example, is highly developed in this regard, and moreover has national institutions, such as Fannie Mae and Freddie Mac, which reduce loan risk for individual lenders. Different banking and regulatory histories have generated large differences between countries in the linkages between mortgage and capital markets, as Richard Green and Susan Wachter (2007) explained. For example, securitization through the capital markets is more developed in the US and Australia, while deposit banks, linked to international money markets to different degrees, are more important elsewhere. Transactions costs are another important factor governing the spendability of housing collateral. Another is the home ownership rate, and the degree to which rental property is owned by pension funds. Because pensions cannot usually be used for collateral and are less liquid than other assets, countries with small home ownership rates are likely to have smaller housing collateral effects. The UK and US score high on all these characteristics: liberal, competitive credit markets, legal systems giving mortgage lenders easy access to housing collateral in the event of default, home ownership rates around the two thirds level, and relatively low transactions costs. As discussed below, the US system has some distinctive features – full tax relief for mortgages, low interest rate risk, and a relatively generous treatment of mortgage defaulters.

Maclennan et al. (1998, 2000) and Muellbauer (2003) argued that such differences, which imply important asymmetries in monetary transmission between the UK and the Eurozone, would create serious problems for the adoption of the Euro by the UK, as well as tensions within the Eurozone. HM Treasury agreed that housing

market differences were a key impediment to entry (HM Treasury, 2003). The recent study for the OECD by Hoeller and Rae (2007), and Roubini et al (2007), confirm that these remain live issues between current members of the Eurozone and highlight a number of policy concerns, discussed further in the conclusions below.

It has sometimes been argued that the rise in personal wealth that results from an increase in house prices, is illusory, see Miles (1994). In a closed economy with a fixed population, if households in general tried to make use of their capital gains on housing by selling their property, they would force down house prices. While at the individual level, housing wealth appears spendable, the argument is that for the economy as a whole it is not. However, the collateral function of housing wealth destroys this argument: with the internationalization of credit markets, as long as foreign lenders are willing to advance credit to households on the basis of domestic collateral values, these values will be far less constrained than was once the case by domestic income and domestic saving<sup>6</sup>.

In terms of changes over time, Fernandez-Corugedo and Muellbauer (2006) explain the liberalization of UK credit markets in the 1980s (and to a smaller extent in the later 1990s) in terms of institutional and legislative changes. These began with the elimination of exchange controls in 1979, which integrated the UK into global capital markets, themselves going through dramatic growth (e.g. Lane and Milesi-Ferretti (2003) and Rajan (2005)). Domestically, the policy constraints on bank lending were relaxed with the abandonment of the special deposits scheme, the ‘corset’, in 1980, which permitted the banks to enter domestic mortgage markets on a major scale for the first time. This led to a competitive response and a relaxation of constraints on the existing mutual mortgage lenders, the building societies, later formalised in the 1986 Building Society Act. A new breed of mortgage lenders (the ‘centralized mortgage lenders’) acting through financial intermediaries and real estate agents began to enter the market in 1985 and by 1991 accounted for 9 percent of outstanding mortgage debt. It became apparent in the subsequent downturn that default risk insurance to the major mortgage lenders had been under-priced and the rise in insurance premia led to a partial retrenchment of credit conditions in the early 1990s. Later, improved credit

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<sup>6</sup> Moreover, with international migration, national housing markets are far from closed. For example, in the cases of Ireland and the UK, immigration has been an important contributor to the rise in house prices of the last decade, while significant numbers of UK retirees have capitalized on their housing wealth in choosing to live abroad.

scoring methods, better systems for handling arrears, the reduction in costs of information technology and the rise of internet banking led to a renewed expansion in credit conditions.

The UK experience of financial liberalization must be seen in the wider international context. It is noteworthy that measures of globalisation in financial markets, such as the ratio of gross capital flows between OECD economies, divided by OECD GDP, expanded rapidly in the 1980s and 1990s. Many countries abandoned controls on international capital movements in the 1980s and eliminated interest ceilings and other deposit and credit market restrictions. Allen and Santamero (1998) argue that the deepening of financial architecture illustrated by the development of markets for financial futures, options, swaps, securitised loans, and synthetic securities have altered the roles of financial intermediaries. In particular, they have allowed far more sophisticated risk management, including by financial intermediaries directly or indirectly lending to households. Transactions costs and asymmetric information declined with costs of IT and telephony, and data management and quality have improved. Calem et al. (2005) argue that lower consumer switching costs in the credit card market have increased the degree of competition in these markets. A similar case is made for other unsecured household debt markets in the United States (Lyons (2003)). In the United States, the automation of many of the steps in the lending process resulted in the cost of originating a mortgage declining from 2.5% to 1.5% (Bennett et al. (2001)). Risks have been reduced by improved initial credit scoring and case management, and transferred to other market participants via securitization and hedging through the derivatives markets, but spreading the incidence of risk into the international financial system, see Green and Wachter (2007).

The 2005 Jackson Hole Symposium paper by Raghuram Rajan, his discussant Hyun Shin, and Alan Blinder among the other participants, took a cautious view of the systemic risks posed by the incentive structures faced by many financial sector participants and their tendencies towards herding behaviour. The 2007 financial crisis appears to have validated these concerns. In view of the burgeoning incidence of bad loans in the US sub-prime market in 2007, risks were clearly under-priced in recent years.

To summarize, credit market liberalization has improved access to unsecured credit and to secured credit. Two important aspects of the latter must be

distinguished. The first has consequences for first-time buyers given access to higher loan to value and loan to income ratios thereby lowering the saving rates of the young who are saving up for a housing deposit and reducing the negative impact of higher house prices on their consumption. The second has made it possible for existing home owners to make more use their housing collateral than before and so has raised the spendability of housing wealth. A ‘credit crunch’ can contract these two aspects of access.

The second aspect, easier access to home equity loans, was emphasized by Muellbauer and Murphy (1989, 1990)<sup>7</sup>, Miles (1992) and by the recent literature on the household credit channel, see Bernanke et al. (1999), Aoki et al. (2004), Iacoviello (2004, 2005), and Disney et al. (2006). However, much of the recent literature looks at the consequences of credit market liberalization through the lens of Euler equations, in other words, the first order conditions for inter-temporal optimization, so missing the first aspect of credit market liberalization discussed above.

The theory of inter-temporal consumption choice suggests that the relaxation of credit constraints has other consequences: households should be more responsive than previously to substituting consumption now for consumption in the future in response to lower real interest rates and higher expected income growth. Models of choice under uncertainty when there are credit constraints emphasize the role of buffer-stock saving, e.g. Deaton (1992), Carroll (2001), and suggest that with easier access to credit, there should be diminished buffer-stock saving since ready access to borrowing can more easily take households through temporary downturns in income or temporary rises in consumption needs.

Section 4 will examine the consequences of credit market liberalization using a modern version of the Friedman-Ando-Modigliani ‘solved out’ consumption function. This makes it possible to take a wider perspective incorporating credit channel effects, and also to take account of the long run information in data on consumption, income, assets and debt which is thrown away in the Euler equation approach.

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<sup>7</sup> To quote from the 1990 paper with Anthony Murphy: “With the sharp rise in house prices, residential property became more than half of personal sector wealth. Financial liberalization allowed households to cash it in as consumer expenditure financed by borrowing.” We placed more weight on this than on the shift in income expectations preferred by our distinguished discussants.

### 3. Literature review

The housing-consumption link has received renewed attention in recent empirical research with macro data.<sup>8</sup> Recent evidence is reviewed by the Congressional Budget Office (2007) and by Greenspan and Kennedy (2007). The latest view from the Bank of England, in Benito et al. (2006), argues that there is no long-run effect of house prices on consumption. This is reflected in the Bank's model, which contains only a short-term effect of house price changes on consumption. However, this effect is very unstable, falling to one third of its 1998 estimated value by 2005, causing difficulties for the forecasting ability of the model.<sup>9</sup> The omission of the credit channel via housing is a widespread feature of the macro-models founded on efficient financial markets and rational expectations in which many central banks outside the US have invested in the last decade, as these banks have become increasingly aware. As Governor Stefan Ingves of the Swedish Riksbank remarks in his Jackson Hole talk, modelling efforts are under way to try "to understand how credit markets can be integrated with our general equilibrium approach to fluctuations in output and inflation". Iacoviello (2005) and Calza et al (2007) offer steps on the way.

Case, Quigley and Shiller (2005) claim, in contrast to the Bank of England, that for a panel of US states and a panel of 14 countries, the housing wealth effect is larger than the stock market wealth effect. However, the international part of the study omits controls for the effects of interest rates, the unemployment rate, and income growth expectations. In addition, the equilibrium correction specification of their model excludes long-run housing asset and stock market wealth. Further, pooling 14 countries denies the heterogeneity between countries implied by their institutional differences discussed in Section 2 above. Shifts in credit conditions are also omitted from the OECD country data though, for example, Finland, Norway, Sweden, the UK and the Netherlands all went through revolutions in credit availability. The rise in house prices is highly correlated with the omitted shift in credit conditions and is liable to be biased up.

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<sup>8</sup> These empirical studies include Case, Quigley and Shiller (2005), Catte et al. (2004), Iacoviello (2004), Barrell and Davis (2004), Dvornak and Kohler (2003), Byrne and Davis (2003), Ludwig and Sloek (2002) and Boone et al. (2001). Earlier studies include Brodin and Nymoen (1992), Kennedy and Andersen (1994) and Muellbauer and Murphy (1995).

<sup>9</sup> The MPC seems to have placed more weight on other information and the suite of other models used at the Bank so that its interest rate decisions have been hard to fault.

In principle, given reliable data, the concept of a panel study of US states is an excellent one, and should overcome many of these problems. Case et al. construct data for 51 US states for the period 1982-1999. The US has integrated financial and credit markets so that time dummies should be able to pick up any national intercept shift due to credit market liberalization and macro shocks due to changes in interest rates, aggregate unemployment, shifts in average income growth expectations and in aggregate demographic changes. Unfortunately, there are doubts about data reliability. State retail sales data are based on sales tax data where these existed and on employment in the retail sector where they did not. At the national level, retail sales account for only around half of consumption. As the authors point out, retail sales at the state level also depend on sales tax rates relative to those in neighbouring states and on levels of tourism. The personal income data at the state level do not correspond to the non-property income concept that one desires for the study of consumption (see theoretical framework in Section 4).

In joint research with Anthony Murphy, we have recently re-analysed these data<sup>10</sup>. In equilibrium correction specifications with a complete set of time dummies and state dummies, we find no long-run relationship between sales and income. Just as peculiar, the long-run effect of housing wealth on retail sales is *negative*, though the contemporaneous short-run effect is positive. Furthermore, even in the first difference specification reported in their Table 3, the results are fragile. In column 3, for example, Case et al. report a panel regression of the log change in sales on the log change in personal income, log stock market wealth and log housing wealth with respective coefficients of 0.274 (11.1), 0.003 (0.5), 0.038 (3.9), where t-ratios are given in parentheses. This is evidence for their claim that the housing wealth effect exceeds the stock market wealth effect. However, they do not use general time dummies in their estimates. Instead, they use year dummies plus seasonals, which are the same for all years, which limits the degree to which the dummies can capture macro shocks. Re-estimating the equation with 68 time dummies (for the 68 observations from 1982Q2 to 1999Q1) gives the following coefficients: 0.245 (10.1), 0.064 (4.4) 0.023 (2.8). In other words, the stock market wealth effect is apparently bigger and more significant than the housing wealth effect. We find an R-squared of 0.4160 while theirs is reported as 0.1458. Clearly, general time dummies radically

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<sup>10</sup> Data available from John Quigley's website. Results available on request.

change the conclusions, consistent with the general criticism that most studies in this area omit relevant controls. The finding that the stock market effect exceeds the housing wealth effect is robust to the use of longer lags. Using 4 lags on all variables, and summing the stock market effects and the housing effects, gives coefficients of 0.038 for the former and 0.015 for the latter.

A further criticism of the Case et al. study is that they use *current* wealth data. The budget constraint over which households optimise in standard consumption theory, see equation (2.1) and Section 4, is conditional on end of previous period assets and current income. This turns out to make a major difference to the results. For example, regressing the log change of sales on its own lags and on the log changes in income, stock market and housing wealth with 4 lags and excluding current stock market and housing market wealth gives a sum of coefficients on the former of 0.009 and on the latter of -0.030. These results appear to match the finding of a long-run negative housing wealth in equilibrium correction specifications mentioned above, but do not seem at all plausible.

Carroll et al. (2006) have examined aggregate US consumption data from 1960 to 2005. They argue that theory and evidence do not support the existence of a long-run cointegrated relationship between consumption, income and wealth. Hence they argue for differencing the data, but note that first differences may miss longer term effects because of habits, adjustment costs or other reasons for lags. They break assets into two, stock market wealth and net worth minus stock market wealth. The latter is close to housing wealth plus liquid assets minus debt. Allowing for the lagged response of consumption, leads them to find a marginal propensity to consume out of net worth minus stock market wealth (i.e. including housing wealth or collateral) of around 0.09 and effects for stock market wealth of around half that magnitude or less, broadly consistent with the conclusions of Case et al. (2005) and also with Benjamin et al (2004). Their model includes the short term nominal interest rate and unemployment expectations.

Catte et al. (2004) rightly note institutional differences and find major heterogeneity for the parameters in different OECD economies. They estimate models which have long-run wealth effects, as well as interest rate and unemployment effects. However, they do not control for income expectations explicitly or for the effects of financial liberalization, and this is liable to bias up the estimated housing wealth or collateral effects on consumption. This is also true of Kennedy and

Andersen (1994) who study consumption in the form of saving ratios. Nevertheless, this study confirms the heterogeneity of wealth effects across countries, including an apparently negative housing wealth effect for Italy. As noted above, the need by the young to save more for a housing deposit with higher house prices, should dominate any wealth or collateral effects for owner-occupiers where mortgage markets are poorly developed.

Slacelek (2006) analyses 16 OECD countries using the difference formulation also used in Carroll et al. to cumulate the wealth effects over four quarters. Differencing makes the results more robust to structural breaks and evolving trends. His controls include changes in unemployment rates, interest rates and interest spreads. He confirms a negative 'housing wealth' effect for Italy, but positive effects for countries with liberal credit markets, including the US, UK, Australia, the Scandinavian countries, Spain, Ireland and the Netherlands. He also finds evidence for an increase in the marginal propensity to consume out of housing wealth after 1988, particularly for pooled Euro area countries where it had earlier been negative.

Boone et al. (2001) are sensitive to the potential importance of credit market liberalization and find some evidence for shifts in long-run relationships, particularly for the UK, US and Canada, using dummies for credit market liberalization. They control for interest rate and unemployment dynamics. They also find a negative housing wealth coefficient for Italy. However, they do not attempt to control for income growth expectations or the effect of credit market liberalization on the long-term consumption/income ratio.

For UK micro data, Campbell and Cocco (2005) and Attanasio et al. (2005) reach diametrically opposed conclusions. The latter use micro data from the Family Expenditure Survey for 1978-2001 to explain consumption spending in terms of age and cohort dummies, household demography, housing tenure, regional house price growth rates and the level of house prices. They find house price growth rate effects are largest for the young, followed in order by the middle-aged and the old, with similar effects for home owners as for renters. They argue that since housing wealth increases with age, these findings suggest that house prices are just a proxy for omitted income expectations and have no independent role to play in explaining consumption. However, consumption is likely to be strongly influenced by current

income<sup>11</sup>, by financial asset ownership (increasing with age and differing by region), by access to credit, variations in unemployment rates and by interest rates. The failure of this study to control for these variables implies that no definite conclusions about the effects of housing assets on consumption can be drawn. The consumption of the young is likely to be more sensitive to current income. Further, regional house prices are correlated with current income. The relaxation of credit constraints in the 1980s would have had the largest effects on the consumption of the young while at the same time driving up house prices, so inducing the correlation found puzzling by Attanasio et al. The collateral role of housing wealth also suggests that young house owners, who are more likely to be credit constrained, could well be as sensitive as older owners to increases in house prices.

Campbell and Cocco study micro data from the UK Family Expenditure Survey from 1988-2000, after credit market liberalization had largely occurred. They explain changes in consumption per head for different cohorts classified by region, controlling for income growth, regional unemployment, interest rates as well as housing tenure, mortgage debt and regional house prices. They find, by contrast with Attanasio et al., that the largest house price effects are for the older home owners and the lowest for renters. The fact that the national house prices affect the consumption of renters, clearly not a wealth effect, suggests that house prices contain a general 'confidence' or expectations effect. However, it is hard to interpret their findings in terms of medium run housing collateral or wealth effects, given that they analyse changes and not levels. Moreover, Cristini and Sevilla (2007) suggest that their findings are quite strongly affected by the household specific consumer price indices they employ.

A related study on panel data for US households for 1968-99 from the PSID, Lehnert (2004), finds the largest consumption growth rate in response to the growth rate of house prices for the 52-62 age group, contradicting Attanasio et al.'s findings. Lehnert also finds the youngest households to be more responsive than middle-aged households, to which he gives the interpretation of a relaxation of credit constraints. While his study includes time dummies, and is therefore largely protected from the criticism of omitted controls, he does not check whether the estimated responses evolve over time.

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<sup>11</sup> Cristini and Sevilla (2007) show that controlling for income, despite measurement errors, sharply reduces the house price effects on this data set.

Bover (2005) and Bostic et al. (2005) studied housing wealth effects, respectively on Spanish and US cross-sectional data. Bover uses a sophisticated instrumental variables methodology to estimate a marginal propensity to spend out of housing wealth in Spain of between 1 and 2 percent, a result that seems both robust and plausible. Bostic et al. use pooled cross-sections merging CEX and SCF data. However, their parameter estimates grossly violate the basic presumption that if permanent labour income and assets both double, consumption should roughly double, which compromises their interpretability.

In summary, the robustness of some of the micro evidence is questionable, while in aggregate time series data, it appears that the failure to control for shifts in credit conditions is often likely to be critical. Although the implications of financial liberalization have aroused interest, controversy and a large literature (such as Bayoumi 1993a, 1993b; Schmidt-Hebbel and Serven 1997; Bandiera et al. 2000; Honohan 1999), there has not been an entirely satisfactory applied analysis of these implications in the consumption literature. One major difficulty has been to find an indicator of credit market deregulation with which to model the direct and interaction effects of financial liberalization.

#### **4. Framework for Modelling Housing Wealth, Collateral and Credit**

The aim of this section is to derive an equilibrium correction model (ECM) for consumption to answer questions about the impact on consumption of financial wealth, credit market liberalization and of housing wealth, and whether the latter has shifted with liberalization. The model also includes controls for income, interest rates and proxies for income growth expectations and uncertainty. In principle, shifts in the effects of such controls with credit market liberalization can be examined.

##### **4.1 Theoretical Foundations**

Since the seminal paper of Hall (1978), the permanent income hypothesis for an infinitely lived representative agent endowed with rational expectations has exerted a powerful influence on empirical work on consumption. Under a number of

simplifying assumptions<sup>12</sup> Hall derived a martingale property for the intertemporal efficiency condition on consumption, or the Euler equation: at t-1, the consumer plans future consumption levels to be the same as the current level.

Combining this planned smoothing of consumption with the life-cycle budget constraint, gives the standard solved-out form of the consumption function

$$c_t = rA_{t-1} + y_t^P \quad (4.1)$$

where  $y_t^P$  is expected permanent non-property income,  $r$  is the real rate of return, and  $A_{t-1}$  is the real asset stock at the end of the previous period. In more general life-cycle models with finite life times, (4.1) becomes a general linear expression,

$$c_t = \lambda A_{t-1} + \lambda y_t^P \quad (4.2)$$

where the coefficients are age dependent at the micro level. A solved out consumption function of this type is different from an Euler equation in several ways. First, an explicit income-generating mechanism is needed to estimate equation (4.2). Second, unlike the Euler equation, the solved-out consumption function does not discard long-run information in the data on consumption, income and assets. The literature on ‘equilibrium correction models’ and cointegration, (e.g., Davidson et al, 1978; Engle and Granger, 1987; Johansen and Juselius (1990) and Banerjee et al, 1993) emphasizes the importance of extracting long-range information. The impact of credit market liberalization on consumption is easier to capture using long-run information. Third, the solved-out approach is directly relevant for policy analysis. For instance, the effects of a tax reform (which would alter the profile of future household income) could be analysed by incorporating an income-forecasting model into the solved-out consumption function.

The final difference concerns robustness. Even without the extreme informational and rationality assumptions made by the Euler approach, any consumer

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<sup>12</sup> These include no credit restrictions or ‘worst case scenarios’ (Carroll, 1997,2001), quadratic utility, a given market real interest rate equal to the subjective discount rate, additive preferences (excluding habits and interactions with leisure), infinitely lived or Barro-style dynastic households, and rational expectations.

with some interest in sustaining consumption through time, will be aware of the life-cycle budget constraint. Such consumers will know that consumption out of assets needs to be smoothed over time, while future as well as current income is relevant for setting the current consumption level. Approximations to equation (4.2) with these rudimentary ingredients are likely to capture key features of consumption behavior.

## 4.2 Developing an Empirical Model.

A useful log-linearization of equation (4.2) is shown in Muellbauer and Lattimore (1995) to be

$$\log c_t = \alpha_0 + \log y_t + \gamma A_{t-1} / y_t + \log(y_t^P / y_t) \quad (4.3)$$

One important advantage of equation (4.3) is to avoid the log-assets formulation employed in many studies of consumption.<sup>13</sup> This tends to be a poor approximation when asset levels are low, as is true for many households. It is also a poor approximation when assets are disaggregated to test hypotheses on, for example, the marginal propensity to consume out of equity wealth versus housing wealth.

The difference between log permanent and log current income in (4.3) can be expressed as

$$\begin{aligned} \log(y_t^P / y_t) &= E_t(\sum_1^k \delta^{s-1} \log y_{t+s} / \sum_1^k \delta^{s-1}) - \log y_t \\ &= E_t \Delta \log y_{t+k} \end{aligned} \quad (4.4)$$

where  $\Delta \log y_{t+k}$  can also be defined as a weighted moving average of forward-looking income growth rates, see Campbell (1997). To dynamise the static form of equation (4.2), for instance to introduce habits or adjustment costs, implies a partial adjustment form, see Muellbauer (1988) for a rigorous derivation.

The log approximation to this, substituting in (4.4) is

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<sup>13</sup> Aron et al. (2008) also show how the approximation can be improved further by including a second-order term.

$$\Delta \log c_t = \beta(\alpha_0 + \log y_t + \gamma A_{t-1} / y_t + E_t \Delta \log y m_{t+k} - \log c_{t-1}) \quad (4.5)$$

This is a rational expectations permanent income hypothesis (REPIH) model with habits, where  $\beta$  measures the speed of adjustment. The parameter  $\gamma$  is directly interpretable as the long-run marginal propensity to consume out of assets. Extending the model to probabilistic income expectations, suggests the introduction of both a measure of income uncertainty,  $\theta_t$ , as well as allowing the discount factors in expected income growth, measured by  $E_t \Delta \log y m_{t+k}$  to incorporate a risk premium, thereby discounting the future more heavily than by the real rate of interest, see Hayashi (1985a), Skinner (1988) and Zeldes (1989). If real interest rates are variable, standard theory suggests the real interest rate  $r_t$  enters the model, with the usual interpretation of inter-temporal substitution and income effects.

However, particularly where floating rate debt is important, rises in interest rates can have stronger effects on the spending of borrowers than of savers.<sup>14</sup> This suggests including a term measuring the impact on the debt service ratio of the rise in nominal rates:  $\Delta nr_t (db_{t-1} / y_t)$ , where  $nr$  is the nominal interest rate on debt and  $db$  is debt<sup>15</sup>. Incorporating this debt service effect, along with income uncertainty, the real interest rate, and a stochastic error term, implies:

$$\begin{aligned} \Delta \log c_t \approx & \beta(\alpha_0 - \alpha_1 r_t - \alpha_2 \theta_t + \log y_t + \alpha_3 E_t \Delta \log y m_{t+k} + \gamma A_{t-1} / y_t - \log c_{t-1}) \\ & - \beta_2 \Delta nr_t (db_{t-1} / y_t) + \varepsilon_t \end{aligned} \quad (4.6)$$

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<sup>14</sup> This is an outcome of Jackman and Sutton's (1982) analysis of households able to borrow subject to a collateral constraint, see p. 117-120 of their paper. Stiglitz (1999) also emphasizes such effects and Bernanke (2007) suggests that differences between countries in the interest sensitivity of consumption might be linked to the size and proportion of floating rate debt.

<sup>15</sup> In Aron et al. (2008) we compare this formulation with an alternative in which the change in the nominal loan interest rate is replaced by the log change.

In principle, the coefficients  $\alpha_3$  and  $\gamma$  should depend upon the real interest rate and on income uncertainty. For simplicity we will suppress this complication and the associated potential non-linearities.<sup>16</sup>

In practice, there are a number of reasons why income growth expectations embodied in  $E_t \Delta \log y_{t+k}$  are likely to reflect a limited horizon. With aggregate data it is difficult to forecast income beyond about three years. Indeed, widely used time series models have usually lost most of their forecasting power by then. This suggests that the log of income in the more distant future is best forecast in practice by near-term log-income plus a constant. Further, with anticipated credit constraints, under buffer-stock saving theory (see Deaton 1991, 1992), a shortening of horizons is suggested. Precautionary behaviour with uncertain ‘worst case scenarios’ also generates buffer-stock saving, see Carroll (2001) who argues that plausible calibrations of micro-behaviour can give a practical income forecasting horizon of about three years - as Friedman (1957, 1963) himself suggested<sup>17</sup>.

Finally, there is the question of the relevant level of disaggregation of the term  $A_{t-1} / y_t$ . In Carroll’s 2001 model, there is a single liquid asset, and cash on hand, consisting of current income plus the liquid asset, can have a marginal propensity to consume as high as one third in calibrations for aggregate data (though this will vary both in cross-sections and time). Otsuka (2006) has developed a theoretical model of buffer stock saving in which there is a liquid asset and an illiquid asset with a higher return but subject to a fixed transactions cost. She shows that consumption responds more to liquid assets than to illiquid assets. In our empirical model we therefore generalize equation (4.6) by splitting the asset to income ratio into three types: the ratio of liquid assets minus debt to non-property income (NLA/y), the ratio of illiquid financial assets to non-property income (IFA/y), and the ratio of housing wealth to non-property income (HA/y)<sup>18</sup>.

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<sup>16</sup> In principle, the aggregate consumption function should also include trend-like effects arising from aggregation over subgroups when evolutions take place in distributions of age, wealth and incomes, in life-expectancy and in social security provision.

<sup>17</sup> The FRB-US model, see Brayton et al (1997) shares this approach. The better fitting version of the model assumes that consumers discount future income at 25 percent per annum and also that 10 percent of consumers just spend current income. However, alternative versions of the model are available which assume that households are more forward-looking.

<sup>18</sup> Charles Bean suggested to me that the collateral interpretation of housing wealth should imply asymmetric reactions to house price rises and declines. While this is plausible, buffer stock behavior by consumers, adjusting liquid assets and debt as their view of future

$$\begin{aligned} \Delta \log c_t \approx & \beta(\alpha_{0t} - \alpha_{1t}r_t - \alpha_{2t}\theta_t + \alpha_{3t}E_t\Delta \log y_{t+k} + \gamma_1NLA_{t-1} / y_t + \gamma_2IFA_{t-1} / y_t \\ & + \gamma_3HA_{t-1} / y_t + \log y_t - \log c_{t-1}) - \beta_{2t}\Delta nr_t(DB_{t-1} / y_t) + \varepsilon_t \end{aligned} \quad (4.7)$$

The time subscripts on the various parameters indicate that many parameters are likely to shift with credit market liberalization. In order,  $\alpha_0$  rises reflecting mainly reduced saving for a housing down-payment – the direct effect of liberalization for first-time buyers;  $\alpha_1$  and  $\alpha_3$  should rise reflecting increased inter-temporal substitution;  $\alpha_2$  could fall because of reduced concern with income uncertainty - however, the higher levels of debt held in a liberal credit regime may offset this;  $\gamma_3$  should rise with increased access to housing collateral; and  $\beta_2$  should fall because increased access to finance allows households to overcome temporary cash flow constraints from higher nominal rates.

## 5. Estimates for the UK, US and Other Countries.

As we shall see, equation (4.7) captures key features of consumption behaviour in the UK, the US, South Africa and Japan, with interesting parallels and differences. The differences with Japan are particularly striking.

### 5.1 Estimates for the UK.

The UK makes a particularly useful case study for the theme of this paper. Not only was there a very clear credit market liberalization from 1980, but given a small open economy, UK interest rates and financial asset prices are strongly influenced by outside shocks, and are therefore more exogenous than corresponding variables in the US. Furthermore, the size of variation in asset prices has typically been substantially above that in the US. Finally, the UK has had a large survey of mortgage lenders since 1968, from which invaluable microeconomic information on mortgage market

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constraints evolves, will soften such asymmetries and we find little evidence in Aron et al. (2008) for significant asymmetries.

conditions has been available on a quarterly basis. This has permitted a more sophisticated extraction of information on credit conditions than is possible for most countries.

For the UK, we use the consumer credit conditions index, CCI, derived by Fernandez-Corugedo and Muellbauer (2006). It is widely perceived that credit supply conditions faced by U.K. consumers, particularly in the mortgage market, have been liberalised since the late 1970s, see discussion in Section 2.2 above. This paper examines quarterly micro-data from the Survey of Mortgage Lenders (SML) to learn about changes in credit conditions from loan-to-value ratios (LTVs) and loan-to-income ratios (LTIs) of first-time buyers (classified by region and age). It combines data on the proportions of high LTV and high LTI loans with aggregate information on U.K. consumer credit and mortgage debt to give ten quarterly series for 1975-2001. These are modeled in a ten-equation system. A comprehensive set of economic and demographic influences on the demand and supply of credit, applying relevant sign restrictions, are controlled for, including an uncertainty factor common to all ten equations. A single time-varying index of credit conditions captures the common variation in the ten credit indicators purged of the economic and demographic controls. In the extension of the data to 2005, we assume no change in the index after 2001 and splice it to the index estimated in Muellbauer (1997) before 1976. The index increases in the 1980s, peaking towards the end of the decade, retreating somewhat in the early 1990s and reaching a new peak in 2001.

### **5.1.1 Credit Conditions and Housing Equity Withdrawal.**

In Figure 1 we plot the credit conditions index against the ratio of housing equity withdrawal (as defined by the Bank of England) to non-property income. This ratio peaked at 0.10 (i.e. 10 percent of annual non-property income) in 2003. We also show the ratio of housing wealth to non-property income. Figure 1 shows clearly that, in the early 1980s, the dominant driver of mortgage equity withdrawal was the easing of credit conditions, while housing wealth actually fell relative to income. Later, with CCI at a high, if not entirely stable level, variations in housing wealth became the dominant force. In the appendix, empirical evidence is presented suggesting that housing wealth was irrelevant to housing equity withdrawal in the UK before 1980 – it is only with the easing of credit conditions that it started to matter. The econometric

model also includes controls for the ratios to income of mortgage debt and unsecured debt: the former with a negative effect, the latter with a positive effect. In other words, when mortgage debt is high, *ceteris paribus*, there is less scope for equity withdrawal; but when unsecured debt is high, there is an incentive to use cheaper mortgage debt to replace it. Other controls include the change in the unemployment rate and in interest rates, weighted by the debt to income ratio, both with negative coefficients, as one should expect: greater job insecurity and a higher debt service burden discourage further equity withdrawal. There is also evidence that equity withdrawal is influenced by demography, in that a rising proportion of older people seems to be associated with equity withdrawal<sup>19</sup>. However, the rest of the conclusions are robust to the omission of this effect.

### 5.1.2 The UK Consumption Function.

We draw on Aron et al. (2008) to summarize key evidence for UK consumption. We begin by estimating our version of the text-book rational expectations permanent income model given by equation (4.5), with quarterly data. Consumption refers to real per capita consumer spending, including durables. Income is real per capita non-property income. The asset to income ratio is defined as liquid assets minus debt plus illiquid financial assets plus housing wealth, taken as the end of previous quarter levels, relative to current income.

The dependent variable in the income forecasting equation,  $\Delta \log y_{perm}$ , is defined as the difference between log permanent and log current income given by equation (4.4), where the quarterly discount factor,  $\delta$ , is 0.85 and the horizon,  $k$ , is 3 years (as originally suggested by Friedman (1963), see Carroll (2001) for discussion). With a discount factor of 0.85, truncating the geometric formula for permanent income after 12 quarters introduces only a slight approximation error.<sup>20</sup>

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<sup>19</sup> See the second column in the appendix table.

<sup>20</sup> To forecast  $\Delta \log y_{perm}$ , we examined a range of alternative informational assumptions. At one extreme, we regressed it simply on  $\Delta \log y$  and its lags, which would be the reduced form of an AR process in  $\Delta \log y$ . However, we allowed for the possibility of longer lags by considering also  $\Delta_4 \log y$  at lags of 4 and 8 quarters. The only significant lag is a negative effect at lag 8, suggesting some kind of reversion in growth rates, but this is not a very stable relationship. The next simplest is to introduce a trend and the level of  $\log y$ . This suggests strong trend reversion, with some persistence in the annual growth rate, and fits better. We use it to generate a 'naïve' forecast. At the other extreme, we posited a long-run relationship

In Table 1, column 1 shows the text-book REPIH model with habits, with highly significant estimates of total wealth and income growth expectations effects and a speed of adjustment of 0.16 per quarter.<sup>21</sup> The long-run marginal propensity to consume out of net worth is obtained by dividing its coefficient 0.0036 by the speed of adjustment 0.16, to give 0.022. Column 2 shows one relaxation of the text book model, in which the ratio to income of net liquid assets, defined as liquid assets minus debt, is permitted to have a different coefficient from illiquid assets. This radically affects the size of the wealth effects, with the marginal propensity to consume for net liquid assets 0.11 and out of illiquid assets 0.033, rather than the 0.022 implied by column 1. The speed of adjustment rises to 0.23 and the improvement in fit clearly rejects the text-book model in column 1. In column 3, we report on estimates of equation (4.7) again without including CCI or its interaction with any other variables. The additional variables are the change in the unemployment rate, a proxy for income insecurity, the real interest rate, the weighted change in nominal interest rates on debt, and a separate housing ‘wealth’ effect. Though the real interest rate is insignificant, the other effects are all significant and the marginal propensity to consume out of housing wealth effect is apparently larger at 0.036 than out of illiquid financial assets at 0.023. Clearly, the superior fit of this model rejects the restrictions embodied in columns 1 and 2.

Finally, we show a specification in column 4 in which we allow the relevant parameters of equation (4.7) to shift with the UK index of credit conditions, CCI. The expected shifts in parameters all occur, though some are insignificant. Overall, the improvement in fit is significant relative to column 3. We show a parsimonious version of the model. The housing wealth to income ratio is insignificant, while its interaction effect<sup>22</sup> with CCI is strongly significant, and so we omit the former. The

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for log  $y$  as a function of a linear trend (+), real interest rates (-), the logs of real oil prices (-), share prices (+) and real house prices (+), the rate of taxes on income (-), the rate of unionization (+), since greater union power should raise the share of labour income, and some national accounts ratios (see Aron et al. for details). Perhaps surprisingly, the results are not very sensitive to which of these alternative permanent income measures is chosen, and we used the simple average of the naïve and sophisticated forecasts.

<sup>21</sup> All specifications reported in Table 1 also include an intercept, dummies for temporary shifts in consumption due to sales tax anticipations, a measure of the change in consumer credit controls for durables purchases, and a measure of working days lost in labor disputes.

<sup>22</sup> This interaction effect takes the form (housing wealth/income minus the mean value of this ratio from 1980 to 2005) multiplied by CCI. The post-1980 mean value of the housing wealth to income ratio is 3.08, compared to a 2005Q4 value of 4.71.

marginal propensity to spend out of housing assets at the maximum value of CCI (normalized at 1) is 0.032, while that of illiquid financial assets is around 0.019, which, in turn, is far below that of net liquid assets, at around 0.11. These results for the housing assets effect are lower than many found in the literature. We find that a four quarter moving average of observations on illiquid financial assets fits better than the end of previous quarter value, consistent with findings by Lettau and Ludvigson (2004).<sup>23</sup> Since much of illiquid financial assets lies in pension funds, this plausibly reflects the slow adaptation of contribution and pay-out rates to changes in asset values.

The real interest rate effect is negative, but significant only at the 10 percent level. According to point estimates, not shown, the evidence is that it strengthens as CCI rises. The debt-weighted nominal interest rate change, also negative, weakens as CCI rises. With easier access to credit, inter-temporal substitution should play a bigger role, explaining, as noted above, the enhanced role for income growth expectations, for which there is also evidence here. Income uncertainty is represented by the four quarter change in the unemployment rate, which has a negative effect on consumption. The interaction effect with CCI is positive, but quite insignificant, suggesting that higher debt levels may have offset the reduction in income uncertainty effects one might have expected from easier access to credit. The speed of adjustment is 0.33 meaning that 80 percent of the adjustment of consumption to income and the other explanatory variables is complete after four quarters. Interestingly, adding the ratio (and its lags) of housing equity withdrawal to non-property income to the specification in column 4, shows these effects to be insignificant.

The parameters of this equation are remarkably stable as the charts of recursive estimates shown in Aron et al. (2008) reveal. The model can be interpreted in terms of co-integrated variables. Effectively, the log ratio of consumption to non-property income and the three asset to income ratios form a co-integrated relationship between four I(1) variables, subject to a shift in the intercept via CCI. Since the real interest rate is arguably I(0) and in any case plays only a marginal role, we can neglect it here. We carried out a co-integration analysis, in which we treat CCI as an exogenous shift dummy, and include in the equation system I(0) variables such as income growth and forecast growth and the change in the unemployment rate and the impulse dummies,

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<sup>23</sup> However, over a one or two year horizon, the estimated stock market effect on consumption of Lettau and Ludvigson is implausibly small.

but outside the co-integration space. With a lag of two, there is only one co-integrating relationship and this is close to the long-run solution implied by the column 2 estimates. Effectively, this analysis treats current income growth and the forecast of future growth and the unemployment rate as weakly exogenous variables. Evidence for weak exogeneity is found from models for these  $I(0)$  variables in which the lagged equilibrium correction term implied by the co-integration vector is insignificant<sup>24</sup>. For the UK, therefore, the pessimism expressed by Lettau and Ludvigson (2004) and Carroll et al. (2006) for the existence of a cointegrating relationship between consumption, income and assets appears to be misplaced, at least once the CCI effect is included and assets are split into the three components indicated.

A further specification check on the model is to estimate it introducing a smooth stochastic trend, to capture omitted demographic and other trending effects, see discussion below for the US. Using the STAMP software (Koopman, Harvey, Doornik and Shephard, 2000), we find no indication of such a trend, in contrast to the US. This suggests that the net influence of such omitted effects on consumption is small for the UK in this period, relative to the large variations in asset prices, credit conditions, unemployment changes and other shocks. The indications are that higher income inequality may have lowered the consumption to income ratio while a higher proportion of adults aged over 65 may have raised it. But these trending effects are hard to identify.

Figures 2 and 3 show the long-run contribution to the log consumption to income ratio of the three asset to income ratios and of the credit conditions index, weighting each by its estimated long-run coefficient. As discussed further below, it should be noted that these are not general equilibrium effects. Figure 2 suggests that a substantial part of the upturn in consumption relative to income can be attributed to the rise in the credit conditions index and that some of the upturn in consumption relative to income from 1984 to 1989 and much of the upturn from 1995 to 2005 can be attributed to the rises in the collateral values of homes relative to income.

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<sup>24</sup> This answers Allen Sinai's question at the Symposium about endogeneity bias. For example, income is likely to be endogenous for consumption. However, on the UK data, current quarter growth of real income appears to be weakly exogenous for the log consumption to income *ratio*.

Figure 3 further suggests that the upward trend in the value of illiquid wealth holdings relative to income also played an important part in the upward trend in consumption relative to income. However, the rise in debt, reflected in the fall of net liquid assets relative to income seen in Figure 3, has major offsetting effects in the long run<sup>25</sup>. The fact that the estimated marginal propensity to consume out of net liquid assets is substantially higher than that out of other assets is quite important here. Much conventional discussion of wealth effects focuses on net worth and so misses the special role of liquidity and of debt. Figure 3 suggests that UK consumption levels are now quite vulnerable to downturns in asset prices, given that debt is hard to reduce in the short-run<sup>26</sup>.

With these results, the key questions I was asked to address can now be answered, at least for the UK. The first question was whether changes in the ability of households to borrow/extract home equity have influenced consumer spending? The answer is clearly 'yes'. Our evidence is that there was no housing wealth effect before 1980, but thereafter the size of the effect increased as credit supply conditions eased. But it is important to realize that the relaxation of credit conditions in the UK both for first-time buyers and for existing owners has influenced consumer spending in multiple ways: it has directly increased the consumption to income ratio, and, as well as introducing a housing collateral effect, it has shifted the influence of income growth expectations and the cash flow impact of nominal interest rate changes. There is also mild evidence that it has increased the negative effect on consumption of real interest rates<sup>27</sup>.

A second question asked whether these changes help explain the decline in the household saving rate that some countries have experienced in recent years? The partial equilibrium answer to this question is very clearly 'yes' for the UK. The estimated direct long-run effect of the change in CCI from 1980 to 2001 on the log consumption to income ratio and hence on the personal sector saving ratio is

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<sup>25</sup> As Ed Lazear and William White noted at the Symposium, if the house price effect on consumption is mainly a collateral effect, payback time has to come. This is reflected in Figure 3.

<sup>26</sup> Note that at mid-2007 illiquid financial assets relative to income were substantially above the 2005 ratio shown in Figure 3.

<sup>27</sup> In our work on UK house prices, we find a highly significant increase in the (negative) real interest rate effect with the easing of credit conditions, and a reduction in the effect of the nominal rate, Cameron et al. (2006).

approximately 6.5 percentage points, given real interest rates, and ratios to income of net liquid assets, illiquid financial assets and housing wealth.

To find the long-run general equilibrium effect, we need to take into account the effect of credit market liberalization on these four variables. It is clear that credit market liberalization was associated with a rise in real interest rates, though this has a relatively small direct effect on the consumption to income ratio. Let us suppose that the illiquid financial asset to income ratio is likely to have been little affected by consumer credit market liberalization. The effect via housing wealth has two parts: one is the interaction effect between CCI and the housing wealth to income ratio and the other is the effect on house prices. We analysed the latter in Cameron et al. (2006). Again we find a direct positive effect from CCI on house prices, raising the house price to income ratio by around 25 percent since 1980, but since interest rates are higher, in part because of the credit revolution, the net effect is perhaps only half as much, depending on how much of the rise in rates is attributed to CCI.

Much the more important effect results from the new spendability of housing wealth. The composite variable defined by the interaction of the housing wealth to income ratio with CCI rose by 1.65 between 1980 and 2005. With a long-run coefficient of 0.032, this accounts for a rise in the consumption to income ratio of just over 5 percentage points. However, there was a large offset in the opposite direction from the rise in debt, reducing the ratio of net liquid assets to income. Fernandez-Corugedo and Muellbauer (2006) attribute of the order of 80 percent of the rise in the debt to income ratio to the direct effect of CCI, but given important interest rate effects, the net effect is likely to have been substantially lower. If half of the fall in the ratio of net liquid assets to income from around 0.9 in 1980 to around -0.1 in 2005 were attributed to the general equilibrium effect of CCI, this would have had an impact on the consumption to income ratio of around -6.5 percent.

The main effects on the consumption to income ratio of the change in CCI from 1980 to 2005 are therefore the positive direct effect of around 6.5 percent and a 5.3 percent increase from interacting CCI with housing wealth, which are partially offset by perhaps a negative 6.5 percent effect from the rise in debt. The approximate total general equilibrium effect on the UK consumption to income ratio or the saving ratio is therefore of the order of 5 percent. However, this should be regarded as a provisional estimate depending as it does on assumptions about the effect of CCI on

interest rates, and the assumption that effects on ratios to income of gross liquid and illiquid financial assets are small.

Given that housing equity withdrawal has no empirical role in our UK consumption equation - current and lagged value of its ratio to income are jointly and individually insignificant, which is confirmed in our US evidence, one can consider the marginal informational value of housing equity withdrawal data. Figure 1 suggests the ratio shown is highly correlated with CCI. Therefore, in the absence of information on a credit conditions index, housing equity withdrawal has strong information content about credit conditions but also about the joint effect of credit conditions and housing wealth, as well as other variables likely to be relevant for explaining consumption.

## **5.2 Preliminary Estimates for the US.**

In joint work, John Duca, Anthony Murphy and I looked for information analogous to the micro data on loan to value (or its equivalent, downpayment to value) and on loan to income (LTI) used by Fernandez-Corugedo and Muellbauer in the UK context. The American Housing Survey has such data for 1978 to 2005, though it is a far smaller sample than the UK survey of mortgage lenders. Mean LTVs and LTIs for first time buyers under 30 buying with a private mortgage are shown in Figure 5. Though some of the increase in LTI from the late 1990s is likely to be due to higher house prices relative to income, the UK parallel suggests this was not true for LTV, so its rise since the late 1990s is likely to have been largely due to a shift in the mortgage credit supply to first time buyers. It coincides with the great expansion of the sub-prime mortgage market in this period. However, neither LTV nor LTI rose much from 1978 to 1998 or even showed much reaction to the high interest rates of the early 1980s. This is very different from the UK and suggests that, for first time buyers in the US before the 2000s, the easing of credit conditions may have been less dramatic than for the UK.

One data advantage the US has over the UK is the quarterly Senior Loan Officer Survey. Since 1966, this has reported the net percentage of domestic bank respondents indicating more willingness to make consumer instalment loans, and since 1990, the net percentage of domestic respondents tightening standards for mortgages to individuals. On the face of it, these surveys report changes in credit conditions. Thus,

if we cumulate the two series and take the negative of the latter, we should have indicators of credit supply conditions. With small trend corrections<sup>28</sup>, the results can be seen in Figure 5. The data suggest some cyclical sensitivity, especially for the mortgage market indicator, probably connected with perceptions of risk in the housing market, so that short term movements probably exaggerate shifts in fundamental supply conditions. Nevertheless, the longer series does suggest long term shifts in consumer loan conditions that match perceptions of the easing of credit conditions.

The series rises quite strongly from around 1984, matching the expansion of home equity lending from the mid-1980s. It seems that credit constraints on the use of housing collateral by existing owners started to ease then at the same time as lenders were more willing to make instalment loans. In Figure 6, the ratio of housing equity withdrawal to non-property income<sup>29</sup> is plotted against the ratio of the end of previous quarter's housing wealth to non-property income. The correlation between the two appears to be quite high since before 1980, unlike in the UK. This again suggests that the shift in credit supply conditions for existing owners may have been less dramatic in the US than in the UK. This is consistent with the fact that real mortgage interest rates in the US in the 1970s were never as persistently negative as in the UK. At any rate, this index seems an excellent candidate for a US CCI.

We have estimated a model for the US of a similar form to the UK consumption function reported in Table 1. Since fixed rate mortgages were the norm up to 1983 and dominate the mortgage stock even now, we would not expect such a strong cash flow effect on the spending of borrowers from rises in short interest rates and, indeed, do not find one. However, the real interest rate on new auto finance, as used in the Federal Reserve's FRB-US model, and its lag, do have a strong effect on total consumer spending. In the US, the quarterly change in the unemployment rate is more significant than the four quarter change which was used as the UK proxy for income insecurity.

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<sup>28</sup> The cumulative value, SCRC, of the willingness to make instalment loans is defined by  $SCRC = (SCRC + CRC) - 6$ ; where CRC is the net percentage of lenders more willing than before; the cumulative value, SMRC of the net percentage of lenders tightening loan conditions, is defined by  $SMRC = (SMRC + MRC) - 2$ , where MRC is the net percentage tightening. The adjustments by -6 and -2 are equivalent to trend adjustments of the cumulative series. Minus SMRC is then an indicator of easier mortgage credit. Each series is scaled, so that its maximum value is 1.

<sup>29</sup> This is the simple definition given by home mortgage borrowing less the value of residential construction put in place. Greenspan and Kennedy (2007) have constructed more sophisticated measures.

A standard criticism of time series estimates of solved out consumption functions is that there are many slowly moving, correlated factors that could be affecting consumption. These include demographic trends, evolutionary changes in the inequality of income and wealth and changes in social security and pensions systems, cohort-specific evolutionary shifts in attitudes in time preferences and risk, as well as long-term shifts in credit conditions. We therefore protect ourselves against this criticism by including a freely estimated smooth stochastic trend in the model<sup>30</sup>. We report preliminary results in Table 2.

When we include both housing wealth/income and its interaction with our candidate credit conditions index<sup>31</sup>, the t-ratio on the former is 0.5 and on the latter 1.5, see column 1. The implied long-run mpc for housing wealth in 2006 is estimated at 0.080, while the long-run mpc for illiquid financial assets is 0.018 and for net liquid assets 0.095, both very close to UK estimates. The latter variable trends down almost monotonically, making its coefficient hard to identify accurately. Given the UK estimate of 0.11 and the micro estimates by Gross and Souleles (2002)<sup>32</sup> in the range 0.1 to 0.15, we fix its long-run mpc at 0.1, by constraining its coefficient to be 0.1 times the coefficient on  $(\log y_t - \log c_{t-1})$ . Omitting the insignificant housing wealth/income term, we then find a coefficient of 0.035 on the interaction effect of housing wealth/income with our credit conditions proxy. With a t-ratio of 2.3, this is not very accurately estimated, so the true coefficient could be only half as large. A coefficient of 0.035 implies a long-run marginal propensity to spend at the credit conditions peak of 1, of 0.080, given the estimated speed of adjustment of 0.438.

For illiquid financial assets the estimated long-run mpc is 0.019, almost exactly the same as in UK, and highly significant, and this enters as a four-quarter moving average, which fits somewhat better than last quarter's value, in the US as well as the UK. In all specifications the interaction of the income growth expectations term with the US CCI is insignificant, but the growth expectations proxy is always significant. A range of alternative specifications, with and without the stochastic trend, are all consistent with the view that the marginal propensity to consume out of housing wealth in recent years has substantially exceeded that out of illiquid financial wealth.

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<sup>30</sup> Using the STAMP software of Harvey, Koopman, Doornik and Shephard (2000).

<sup>31</sup> The interaction effect takes the form (housing wealth/income minus its mean value from 1962 to 2006) multiplied by the US CCI measure.

<sup>32</sup> I am grateful to José García-Montalvo for pointing this out.

This supports the claim by Case et al. (2005) that the housing wealth effect in the US exceeds the stock market wealth effect, despite queries on their data raised above. These results are also consistent with Benjamin et al (2004) and with Carroll et al. (2006). As noted above, the latter separate assets into two kinds, broadly illiquid financial wealth and the rest, largely net liquid assets plus housing wealth. Our evidence is consistent with the marginal propensity to consume for housing collateral being almost as large as that for net liquid assets, at least with full credit market liberalization, though on a priori grounds it should be less.

I exercise a similar degree of caution to that expressed in Carroll et al. (2006) and emphasize that these are preliminary findings. We have not as yet, for example, fully checked robustness to different specifications of the income growth expectations proxy<sup>33</sup>. However, the inclusion of the smooth stochastic trend in the estimated consumption equation protects against trend like mis-specifications of all kinds. But, this comes at a cost: because housing wealth/income is itself a relatively smooth series, one cannot obtain sharp estimates of its effect when the stochastic trend is included. The stochastic trend shown in Figure 8 is clearly correlated with the credit conditions proxy but undoubtedly reflects some of the other long run forces mentioned above. Clearly, the US aggregate data are simply less informative than the UK's.

Interestingly enough, if we include our credit conditions proxy in the model, it is highly significant, as we see in column 3, even when we include the stochastic trend. Then the estimate of the housing wealth effect sharpens up considerably and the point estimate of its long-run marginal propensity to consume is now 0.088, while the long-run mpc for illiquid financial wealth drops to 0.014. We suspect that this may be because there is a cyclical element in the credit conditions proxy, for example, reflecting movements in the stock market. In this version, the freely estimated mpc for net liquid assets would have been less than that out of housing wealth, which is

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<sup>33</sup> The proxy used here rests on a forecasting equation for expected income growth including split time trends, the future income component of the Michigan Survey of consumer sentiment, and changes in short term interest rates over the preceding two years. The conclusions in the text are robust to the inclusion in the forecasting equation of real oil prices and housing starts per capita.

quite implausible since cash must be more spendable than housing collateral – a good reason to restrict the estimate for net liquid assets<sup>34</sup>.

In the UK, the marginal propensity to consume for net liquid assets is relatively accurately estimated at 0.11, and the US estimate in Table 2, column 1, as well as the microeconomic evidence from Gross and Souleles (2002), suggests a similar value holds true in the US. However, the marginal propensity to consume for housing collateral in the UK in recent years is close to 0.032 while most values estimated for the US, as well as ours, are substantially higher. It seems obvious that, given transactions costs and capital uncertainty, housing equity must be less spendable than cash, so values of the marginal propensity to consume for housing collateral should be substantially below those for net liquid assets.

One can ask whether it is plausible that the US figure could be twice or more that for housing in the UK. Transactions costs are broadly similar: the higher fees of US real estate agents being offset in the UK by higher transactions tax rates (Stamp Duty). However, the US is different for the UK in three major ways. The first is that mortgage interest, even on second homes, is fully tax deductible in the US, while the UK, after heavily capping tax deductibility for many years, gradually eliminated it. This creates a relative incentive in the US for loading as much debt as possible on home equity. The second major difference is that the fixed rate mortgage system is highly effective in protecting US households from interest rate risk: it protects households from rising rates and gives them a low cost option to refinance when rates drop. The view that there was an implicit government guarantee underwriting Fannie Mae and Freddie Mac, and the existence of a deep financial system permitting prepayment risk to be hedged effectively through the government bond market and elsewhere, explain the low cost of this option, see Green and Wachter (2007). In contrast, as Miles (2004) makes clear, the high penalty charges for refinancing in the UK have discouraged demand for fixed rate mortgages. Thirdly, in most US states there is a ‘walk away’ option for households with negative housing equity: they can simply hand in the keys to their home to the mortgage lender and be free of further

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<sup>34</sup> It is important to note that the stochastic trend in columns 1 and 2 incorporates the combined effect of credit market liberalization and of other trending factors. The fact that the column 3 specification in which the US CCI variable enters both as a level and as an interaction effect, fits only a little better does NOT mean that the effect of credit market liberalization on the consumption to income ratio in the US is small – as suggested by Sydney Ludvigson’s discussion.

debt service obligations. In the UK, in contrast, borrowers can be pursued for seven years for any debt not covered by the sale of their repossessed home. Together, the tax and risk advantages of US mortgages, make it plausible that the marginal propensity to consume for home equity should be significantly larger in the US than in the UK. In my view, a US value of 0.06 or 0.07 is perfectly plausible.

Though the US results are provisional, we suspect that the main conclusions will prove robust to further investigation. As for the UK, our evidence favours the hypothesis that the easing of consumer credit conditions has increased the spendability of housing wealth, particularly through much easier access to home equity loans. The evidence also points towards a major long-run effect from the easing of credit conditions on the ratio of consumption to income and hence on the household saving rate.<sup>35</sup> As I have argued, lower deposit requirements for first time buyers are likely to have been an ingredient in this, in addition to home equity access. If one took the Table 2, column 3 estimate literally, the long-run effect of the rise of 0.7 in the credit conditions proxy from say 1980Q1 to 2005, on the log ratio of consumption to non-property income is 0.054. However, this depends on the correct separation in the estimates of the credit conditions effect from the stochastic trend, which then has a negative slope<sup>36</sup>. On top of the intercept effect, comes the effect via the interaction of credit conditions with housing wealth, but this is partially offset by the fall in net liquid assets relative to income owing to the rise in debt. This takes us only some of the way towards the general equilibrium estimate, but it seems unlikely that the offsetting effects via higher real interest rates will be as large as in the UK. The circumstantial evidence is that the general equilibrium effect of credit market liberalization on the ratio of consumption to income in the US is likely to be large and positive.

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<sup>35</sup> However, on our current evidence, the post 2000 surge in credit availability to first time buyers appears to have had a stronger effect on consumption through the house price channel than directly. This may be because many sub-prime borrowers have relatively modest levels of consumption.

<sup>36</sup> It also depends on the precise definition of the interaction effect between housing wealth/income and the US CCI. As noted above, we interact the US CCI with the deviation of the housing wealth/income ratio from its 1962-2006 mean. Had we subtracted the mean over some other period, the direct US CCI effect on the ratio of consumption to income would have been different.

### 5.3 Estimates for other Countries.

Further support for these findings and the basic form of the consumption model comes from work on South Africa, with large wealth and collateral effects<sup>37</sup>. South Africa has long had a sophisticated financial system and UK style mortgage markets, with credit market liberalization in the 1980s and 90s. The marginal propensity to consume out of housing collateral for South Africa appears to be larger than for the UK, more similar to US estimates. However, the marginal propensity to consume out of financial wealth is larger than in either the UK or the US. We suspect there may be some upward bias in our estimates interpreted purely as estimated marginal propensities to consume. South Africa has, of course, been through great political turmoil and periods of great uncertainty since 1970. Despite our efforts to control for uncertainty and expected income growth, it is probable that our proxies are inadequate. It is likely therefore that asset prices in South Africa represent a mix of genuine wealth effects and uncertainty and growth expectations<sup>38</sup>. However, it is clear that credit market developments have had substantial effects on the personal sector saving rate in South Africa.

In contrast, work in progress with Keiko Murata on consumption in Japan points to very different conclusions. We find no evidence that between 1980 and 2000 there was any important easing of credit conditions for consumers. Models for household debt in Japan comparable to those developed in Fernandez-Corugedo and Muellbauer (2006) for the UK, show no symptoms of structural breaks, once standard income, interest rate and asset effects with plausible magnitudes are accounted for. This is in sharp contrast to the UK. It seems likely that the non-performing loan burden of the banking system in the 1990s, combined with barriers to entry, impeded the efficiency of the Japanese mortgage market. The high spreads between interest rates on household saving deposits and mortgages were a symptom of the relative failure of the intermediation function of the Japanese banking system, though spreads have recently narrowed a little.

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<sup>37</sup> See Aron and Muellbauer (2008). These results use data on household wealth in South Africa constructed in Aron and Muellbauer (2006) and now taken over by the South African Reserve Bank.

<sup>38</sup> Poterba (2000), among others, has argued that this is a generic problem even in the US. In our view, our proxy for US income growth expectations and the change in the unemployment rate do much to counter this problem. South African unemployment data are unfortunately not reliable enough to be useful.

Using residential land prices as a proxy for house prices, we find a negative effect from higher prices on consumption consistent with the view that the young save harder when prices rise, offsetting any wealth or collateral effects for existing owners. Since Japanese inheritance tax favours residential housing, there are good reasons why older households are less likely to downsize or withdraw equity.

Our Japanese consumption function uses income growth expectations generated from a forecasting model which places significant weight on the ratio to GDP of government deficits in recent years.. This helps to explain why expansionary fiscal policy was less effective than many hoped in this period. The missing household credit channel together with our finding that real interest rates on saving deposits have a positive effect on aggregate consumption in Japan, help explain the relative ineffectiveness of easy monetary policy in Japan in this period.

## **6. Household Vulnerability and Debt.**

Ratios to non-property income of household debt have risen strongly: more than doubling in the US from 1980 to 2005 and almost trebling in the UK. Figures 8 and 9 plot the ratios to non-property income of unsecured debt (consumer credit) and mortgage debt, revealing the dominant nature of the latter. However, the debt ratios are dwarfed by the housing wealth to income ratios, which have risen particularly strongly in the UK. Clearly, aggregate net equity is hugely positive. Therefore, questions of household vulnerability have mainly to do with the distributions of ratios of debt service costs in relation to income and of debt in relation to the asset backing, and of how these distributions evolve in the context of higher interest rates or reduced access to credit, lower income or lower asset prices.

Micro studies generally agree that most of the increase in debt has been for those who can afford it, see the review of evidence in Girouard et al. (2006). However, as Dynan et al. (2003) and Bucks et al. (2006) point out, since the early 1990s, most of the rise in the US homeownership rate was among those with limited ability to make a down-payment, as LTVs rose and maturities were extended, even to the recent introduction of ‘interest only’ mortgages. The flood of recent documentation on lending practices in the US sub-prime market, suggests that these trends became even

more pronounced from 2000<sup>39</sup>. While mortgage default rates have been low in recent years, see Girouard et al. (2006), p.16, they are rising strongly in the US and also in the UK. The number of UK households experiencing mortgage repossessions rose 30 percent in the first half of 2007 compared to the first half of 2006, though the numbers are still only one quarter of the peak reached in 1991-2.

Waldron and Young (2006) report on a September 2006 survey of 2000 British households for evidence on the incidence of financial difficulties among British households and updated information on the distribution of indebtedness. They report a small upturn in the proportion of households having difficulties servicing their mortgages but little change in the proportion in difficulty with unsecured debt. The UK has not had an explosion of sub-prime lending of the type seen in the US. Nevertheless, in July 2007 the Financial Services Authority took enforcement action against five sub-prime lenders with lax standards, and found that in almost half of intermediaries it investigated, there was inadequate assessment of customers' suitability.

Potential household vulnerability has to be seen in the context of widespread financial illiteracy (see surveys by the US National Council on Economic Education and the Health and Retirement Study). Lusardi and Mitchell (2007a, 2007b) report that US households have difficulties making very simple economic calculations, for example, of compound interest. Miles (2004), reporting on the UK mortgage market for the government, found that even independent professional financial advisers were often poorly informed on basics. For example, many did not appreciate the risks of increases in interest rates or that the yield curve provided information on the market view of interest rate prospects. He recommended a concerted effort to improve the transparency of debt contracts and make households better aware of risks.

Lunde (2007) reports on a remarkable data set from Denmark from which it is possible to trace the distributions of debt, income and housing wealth for the entire household population. Denmark is very interesting because it has the oldest mortgage market in the world and close to world record levels of mortgage debt to GDP. Furthermore, between 2001 and 2006, national house prices rose more than 70

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<sup>39</sup> The Wall St. Journal reported on August 16<sup>th</sup> that in 2000 Standard and Poor's decided that "a type of mortgage that involves a 'piggy-back', where borrowers simultaneously take out a second loan for the down-payment, was no more likely to default than a standard mortgage....six years later...it said that they were actually far more likely to default".

percent.<sup>40</sup> In the early 1990s, Denmark experienced severe rates of mortgage defaults. Lunde shows that distributions of net equity relative to income are now about as exposed as they were on the eve of that housing crisis, and debt to income ratios are higher, though interest rates are lower. He also notes that most new mortgage lending in recent years has been in the form of adjustable rate mortgages, though fixed rate debt still dominates the mortgage stock. Recent increases in European interest rates have thus put many households under financial pressure, and StatBank Denmark reports prices for single homes and residential flats beginning to fall in 2006Q4.

One can argue that globalisation has been a very mixed blessing for lower income households in highly developed economies. Though high global growth rates have helped maintain employment, wages of less skilled workers have been under pressure from low-wage Asian competition. Greater inequality of income and wealth and financial globalization, have contributed to the rise in house prices. The financial system has responded by offering increasingly risky loans (and often without making clear to borrowers the true medium term costs of such loans). The relative prices of goods particularly important in the budgets of lower income families, namely food and fuel, are undergoing what could be the largest sustained rise in a generation. The cost of debt service has increased almost everywhere and concerns about inflation in which food is playing an important part, may limit central bank flexibility in responding to the 'credit crunch' of 2007. In this context, one may have some concerns about household vulnerability.

There is also the question of vulnerability of the economy as a whole to asset price and credit shocks. As noted in Section 5, net worth or even net housing wealth are not the most behaviourally relevant concepts for aggregate consumer spending. For example, in the UK our estimate of the marginal propensity to consume out of liquid assets minus debt is 0.11, while it is 0.032 for housing wealth. The fact that the latter is far smaller, limits the sensitivity of spending to downturns in asset prices. However, the scale of the former implies a sustained constraint on spending, as illustrated in Figure 3, and the US picture, not shown, is similar.

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<sup>40</sup> The rise occurred in part because in 2001 the government abandoned a key stabilising element of the Danish property tax, the automatic annual indexation to property values, see Muellbauer (2005).

## 7. Conclusions

This paper has emphasized the importance of understanding credit market developments in explaining consumer spending and the shifting effects, with credit liberalization, of housing wealth on such spending. This liberalization concerns not just the availability of home equity loans but also the down-payment terms offered to first-time home buyers. I have argued that where credit markets are poorly developed (possibly because of limited access by lenders to collateral in the event of default, or lack of competition) higher house prices are likely to reduce aggregate consumption relative to income. This is because the young save more for the down-payment needed to enter the market and renters save more in anticipation of higher rents, more than offsetting any wealth or collateral effect for home owners. As credit conditions ease, lowering down-payment ratios for first-time buyers and increasing access of home owners to home equity loans, the aggregate effect of increased house prices on consumption is likely to become more positive.

The omission of controls for such shifts in credit conditions, as well as of other variables with a direct impact on consumption, but correlated with house prices, is liable to bias up estimates of the marginal propensity to consume out of housing collateral. Our econometric work suggests that with the current state of credit availability in the UK, the marginal propensity to consume out of housing wealth is a little over 3 percent, while our provisional estimates for the US suggest a higher value of perhaps 6 to 7 percent. Tax advantaged loan costs, lower interest rate risk and less severe consequences of mortgage default are plausible reasons for the larger US marginal propensity to consume. Our work also suggests a separate direct effect on the consumption to income ratio of greater credit availability. Developing an indicator for credit conditions is therefore important, with interesting current policy implications.

Chairman Bernanke's opening remarks at the Symposium emphasized the importance of institutional factors in "determining the influence of monetary policy on housing and the role of housing in the business cycle". The implication that institutional differences between countries can generate major differences in the influence of monetary policy and in the transmission of asset price and credit shocks

has been explored in some detail in this paper. There is a connection here with the criticisms of the Fed by Ed Leamer and John Taylor for keeping interest rates too low and too long in 2002 and 2003. Many macroeconomists and financial market participants at the time, drawing parallels with post-bubble Japan, were worried about deflation and the risk that monetary policy might become ineffective in a low inflation environment. This view influenced an interest rate policy widely seen as protection against such a risk. The tendency in modern macro to use a “one theory fits all” approach led to a quite erroneous evaluation of the Japanese example. As discussed in Section 5.3 above, monetary transmission via households in Japan works rather differently than in the US or the UK. One of the most important lessons from Japan was and is that a continued ineffectiveness by the banking system to carry out its intermediation and investment allocation functions has very serious consequences, see Hoshi and Kashyap (2004). But there was no risk of that in the US post-2001, so that the wrong lesson was learned. Indeed, the empirical evidence of this paper suggests that, at this time, US monetary policy via the credit and housing channel was becoming even more powerful than before.

The current situation in the US and much of the discussion at the Symposium was lucidly anticipated by Duca (2006), including an excellent discussion of the role of residential construction in softening economic activity emphasised by Ed Leamer (2007), and of parallels and differences between the UK and the US. Fernandez-Corugedo and Muellbauer’s credit conditions index for the UK experienced a retreat from its 1990 peak in the early 1990s, mainly due to the repricing of mortgage insurance premia to the mortgage lenders. In turn, this caused the lenders to tighten their terms to households. With hindsight, it seems clear that mortgage risk was substantially under-priced in the US in recent years, especially in the sub-prime market. The US equivalent of a credit conditions index will retreat somewhat from its 2005-6 peak in 2007-8. This will reduce the marginal propensity to consume out of housing wealth at the same time as the credit tightening has a direct negative effect on consumer spending. If the retreat of house prices in the US runs on, the combination of these two effects and the recession in construction will lower the growth rate of US domestic demand.

Martin Feldstein’s overview and concluding remarks summarized these effects and the wider context very well. Nevertheless, I would emphasize that mortgage equity withdrawals are important not so much as a direct causal influence on

consumption, but rather as a manifestation of the increased ability of households to borrow against housing wealth and how it alters the impact of credit conditions on consumption. The Federal Reserve response will support economic activity through the usual channels discussed by Governor Mishkin, including lowering the bond yields from which US mortgages are priced.

Fortunately, as Chairman Bernanke's speech at the Symposium indicated, he has a deep appreciation of the problems of asymmetric information, of the credit channel by which interest rate and credit shocks are transmitted, of the importance of institutional change and the lessons of history, as well as the technical command of econometric modelling to use the full resources of the Fed modellers. It is also fortunate that the Fed, almost alone among the leading central banks, did not adopt for its main model, the current generation of Dynamic Stochastic General Equilibrium models. These add some price stickiness and adjustment costs to the Real Business Cycle model founded on the assumptions of efficient financial markets and rational expectations, in which all agents share the same information set and the same view of the future. The efficiency conditions, the Euler equations, for inter-temporal optimization for households, usually summarized by a single 'representative' household, when heterogeneity is far more plausible, are central to these models. Not only do the underlying rationality and informational symmetry assumptions look somewhat hollow in the 2007 credit and financial market crisis, but these models are not readily adaptable to take on board the lessons of this Symposium and of the events of 2007. In contrast, the FRB-US model is easily adaptable, for example, by shifting some parameters of the consumption function, to produce simulations of a variety of scenarios that take credit market shifts into account<sup>41</sup>. These considerations and the huge expertise embodied in the Federal Reserve system certainly increase my confidence in the outlook for the US economy.

As far as Europe is concerned, tensions in the Eurozone of the type discussed by Maclennan et al (1998, 2000) will increase. Spain and Ireland have large construction sectors and in 2006 started respectively 5.5 and 7.5 times as many housing units per head of population as the UK; the US, by contrast, started twice the UK proportion. The Spanish construction downturn, on top of the decline in house prices with

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<sup>41</sup> For example, taking into account some of the findings of this paper.

consumption repercussions<sup>42</sup>, an overvalued real exchange rate resulting from years of higher inflation, and a corporate sector in worse shape than that of the US, and no flexibility of interest rates and the exchange rate, will almost certainly lead to recession in Spain<sup>43</sup>. The Netherlands and Denmark will also be in some difficulty, as will some of the accession countries where Euro and Swiss Franc denominated mortgages have proved so popular, even though exchange rates are not yet fixed. Germany, France and Italy where credit liberalization has been far slower, will mainly be affected by the rise in the Euro relative to the US Dollar, as will the countries already mentioned. Though the UK, particularly London and the South East, as shown by Cameron et al (2006), is more sensitive to problems in the financial sector than other European countries, the construction effect will be slight, while pent-up demand by those priced out of the housing market in recent years will limit the down-side. The UK's interest rate and exchange rate flexibility provide further protection against falling demand.

For the rest of the global outlook, much depends on the extent of the decoupling of Asian demand growth from the US. The analysis of this paper has some relevance for this too, but no easy answers. A credit revolution is in process in emerging markets, including China, and India. Credit sharing information and credit scoring systems have been or are being installed, and consumer debt markets are growing at enormous rates. In many countries, house prices are increasing rapidly. The conventional wisdom is that these developments are bound to raise consumption relative to income. However, it is important to be aware that, at the current stage of development of many of these credit markets, it is likely that higher house prices are still *reducing* consumption relative to income. Thus, while the direct effect of credit market developments on consumption is positive, there is a partially offsetting indirect effect.

Central banks in emerging markets face a difficult task in untangling the separate influences of interest rates, income growth, credit development and higher house prices on consumption. One implication of the more nuanced view on the effects of house prices on consumption put forward here is that higher interest rates in many of

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<sup>42</sup> Olympia Bover's very plausible estimate of the Spanish mpc for housing wealth of 1.5 to 2 percent is about half the UK's, but Spanish house prices have further to fall.

<sup>43</sup> While there has been occasional discussion by financial market participants of Italy departing from the Eurozone, it seems likely that Spain will be mentioned more often in this context in the coming two years.

these countries may currently have less of a growth reducing effect, at least via the house price channel, than is widely believed. Another implication is that house building in these economies could currently make an even larger contribution to growth by restraining the rise in house prices than would be the case in financially mature economies.

Governments possess a number of policy levers to influence the housing market with implications for the cyclical behaviour and interest rate response of their economies. It is unfortunate that governments do not accept more of their shared responsibility in dealing with massive and sustained house price fluctuations<sup>44</sup>. The levers they possess include property taxation or subsidies, tax relief on interest payments, the regulation of the financial system, zoning controls for residential land use and incentive structures for local authorities to release land. For example, property taxes in proportion to value, with frequent revaluations, help stabilize house prices, as cash flows for households automatically improve if house prices fall, and automatically slow when house prices increase, while households factor these expectations into their behaviour (detailed discussion in Muellbauer (2005)). Subsidies or tax breaks to help first-time buyers overcome the widespread housing affordability problem are likely to be counterproductive, since they will be capitalized in prices.

Unfortunately, public opinion tends not to understand such issues, opening the field to populist policies, often posing central banks with more difficult policy dilemmas. The tightness of zoning controls influences the response of house building to higher prices. In the UK, this appears to have been close to zero for the last decade (Barker, 2004), and partly explains the high level of housing wealth relative to income. Along with the floating rate nature of much UK household debt, this makes the UK particularly responsive to short term interest rates.

As emphasized in this paper, heterogeneity in household borrowing markets and their evolution imply that home price appreciation can have different effects on consumer spending across countries. One consequence is that the almost worldwide rise of home prices of the early decade has had asymmetric effects across countries and on international capital flows. These considerations have important implications

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<sup>44</sup> For example, a succession of Dutch governments and the financial regulator seem not to have appreciated fully the lessons for financial stability of the UK and Scandinavian credit and housing booms of the 1980s, and their subsequent collapse.

for the central banking community to the extent that central banks either coordinate or take into account each other's actions.

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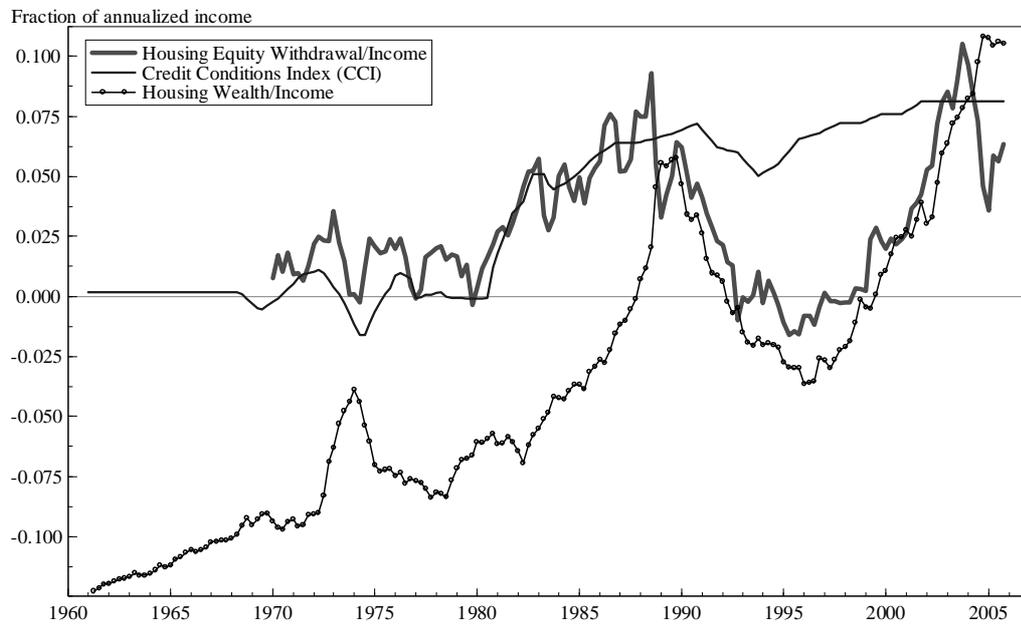
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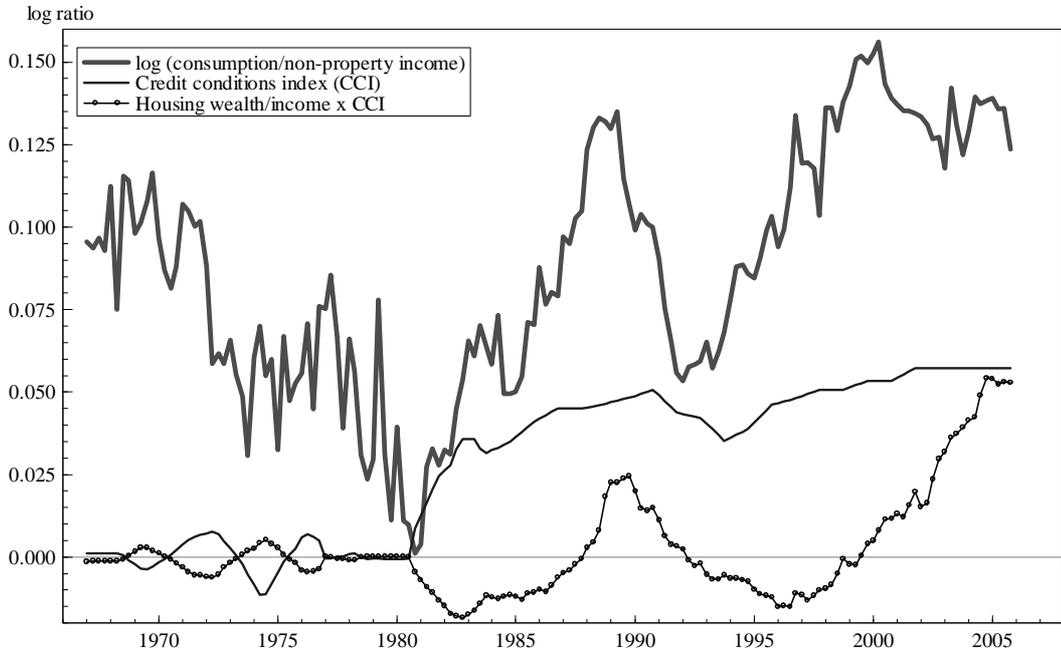
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**Figure 1: UK Housing Equity Withdrawal/Non-Property Income, UK Credit Conditions Index and Housing Wealth/Income.**



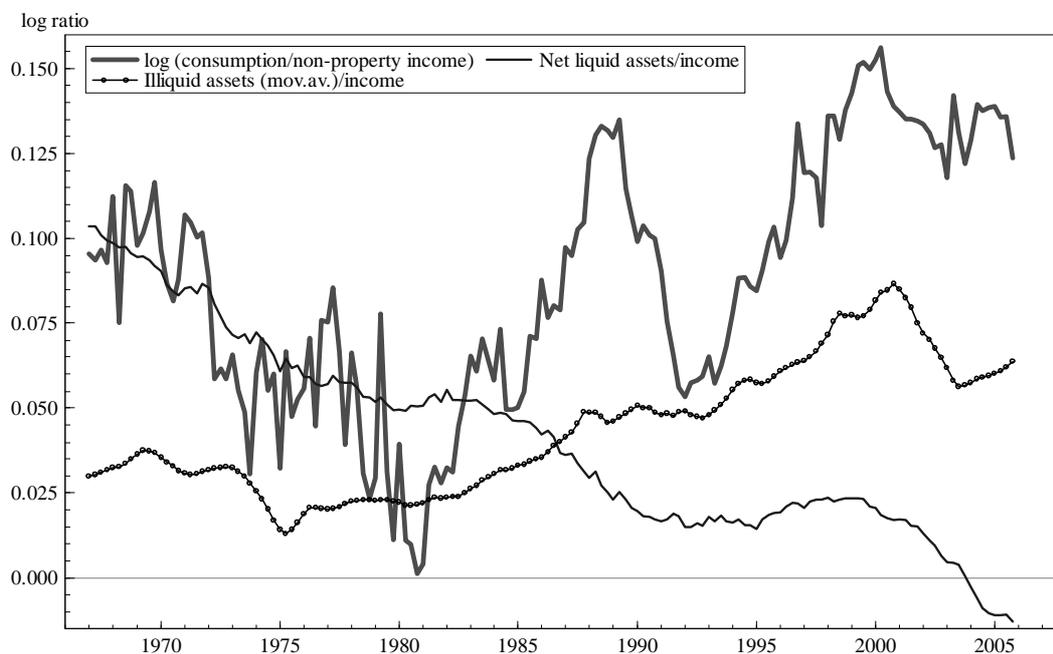
Note: the scaling of the credit conditions index and of housing wealth/income is tuned to the units of housing equity withdrawal/income.

**Figure 2: Long-run contributions to log consumption/income of the credit conditions index and its interaction with housing wealth/income.**



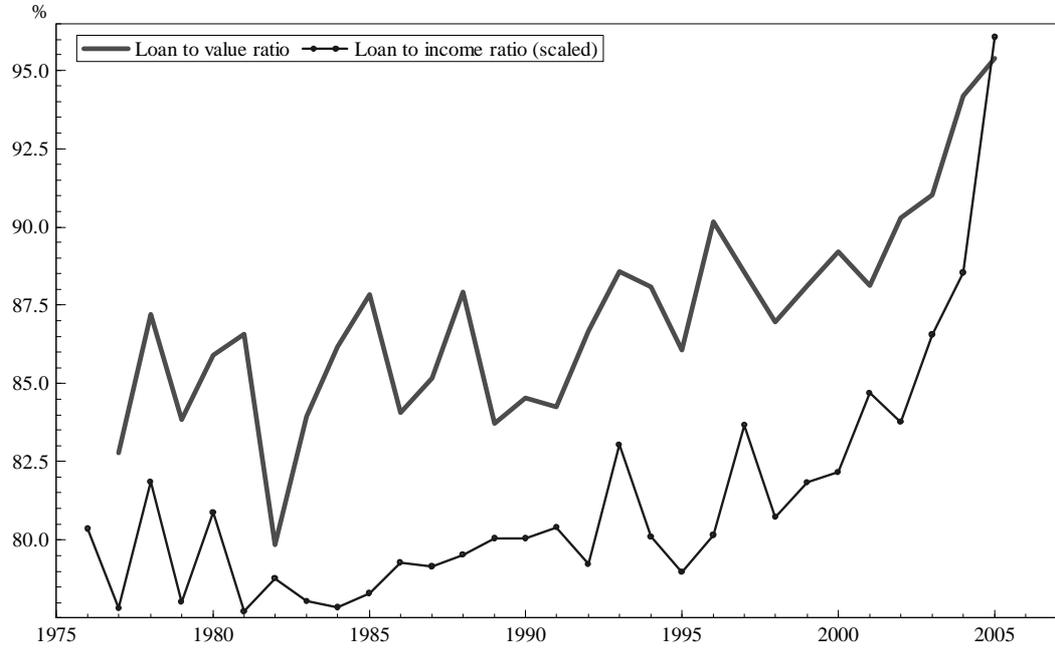
Note: asset to income ratios are defined as end of last quarter assets/4 (current quarterly non-property income). Explanatory variables are scaled by the estimated coefficients in the long-run solution. See footnote to Table 1 for the definition of the interaction between CCI and housing wealth/income.

**Figure 3: Long-run contributions to log consumption/income of net liquid assets/income and illiquid financial assets/income.**



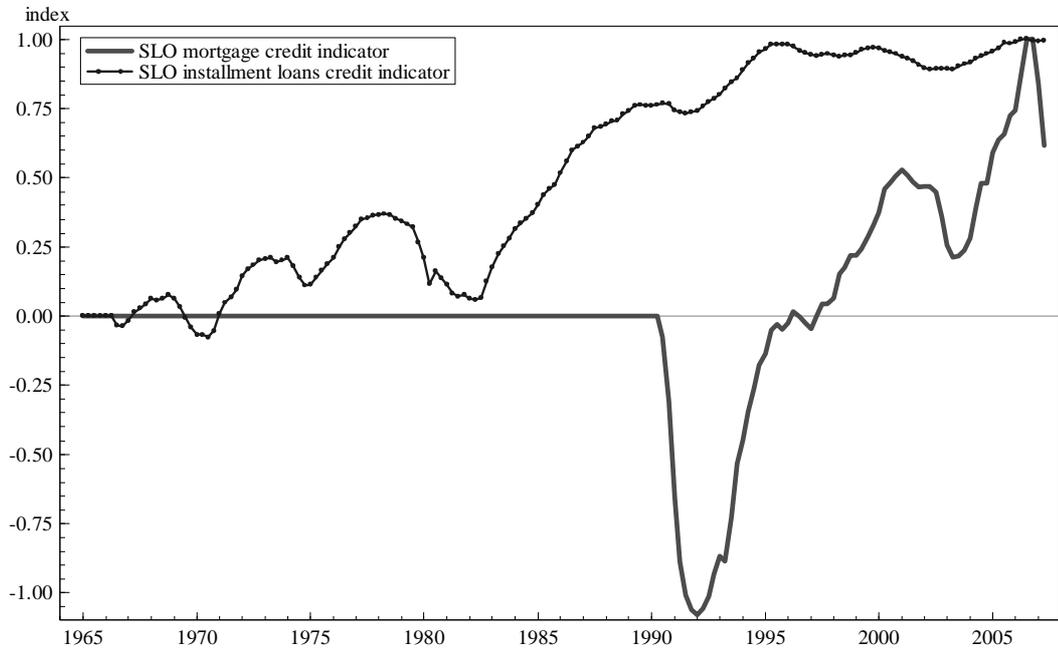
Note: asset to income ratios are defined as end of last quarter assets/4 (current quarterly non-property income). Explanatory variables are scaled by the estimated coefficients in the long-run solution.

**Figure 4: Loan to value ratio and loan to income ratio for private US mortgages for first-time buyers under 30.**



Note: the source is the American Housing Survey, excluding government backed mortgages. The loan to income ratio add-factor is 60%, for purposes of scaling. From 1984, the data include second mortgages.

**Figure 5: Senior Loan Officer Survey data on consumer instalment loan and mortgage market credit conditions.**



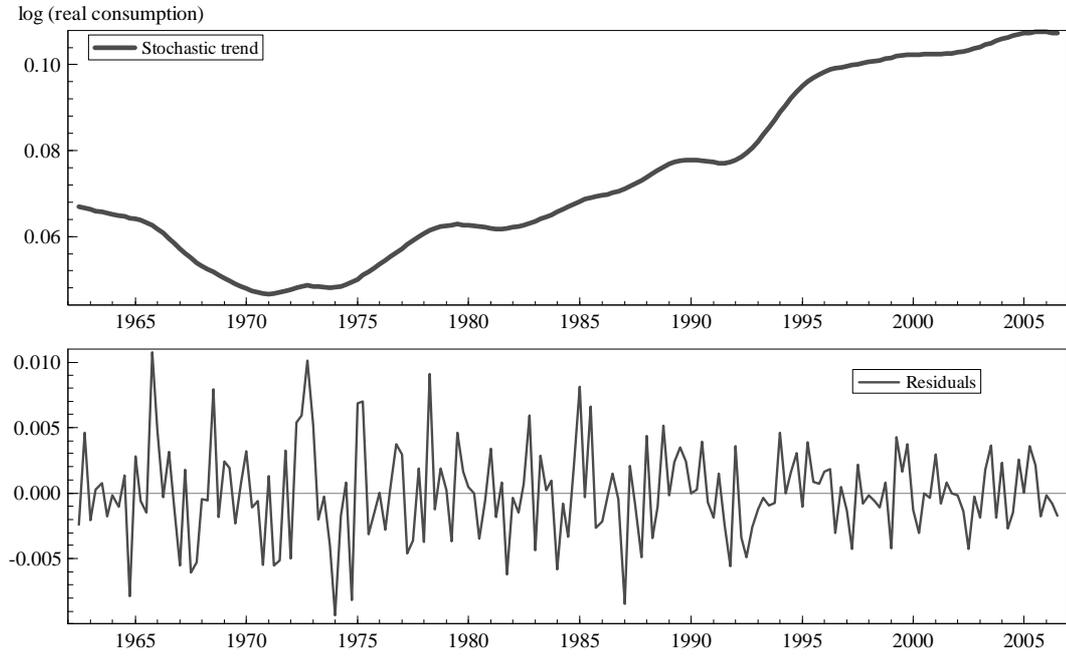
Note: the data are normalized to equal 1 at the maximum, for both indexes.

**Figure 6: US Housing equity withdrawal/non-property income and housing wealth/non-property income.**

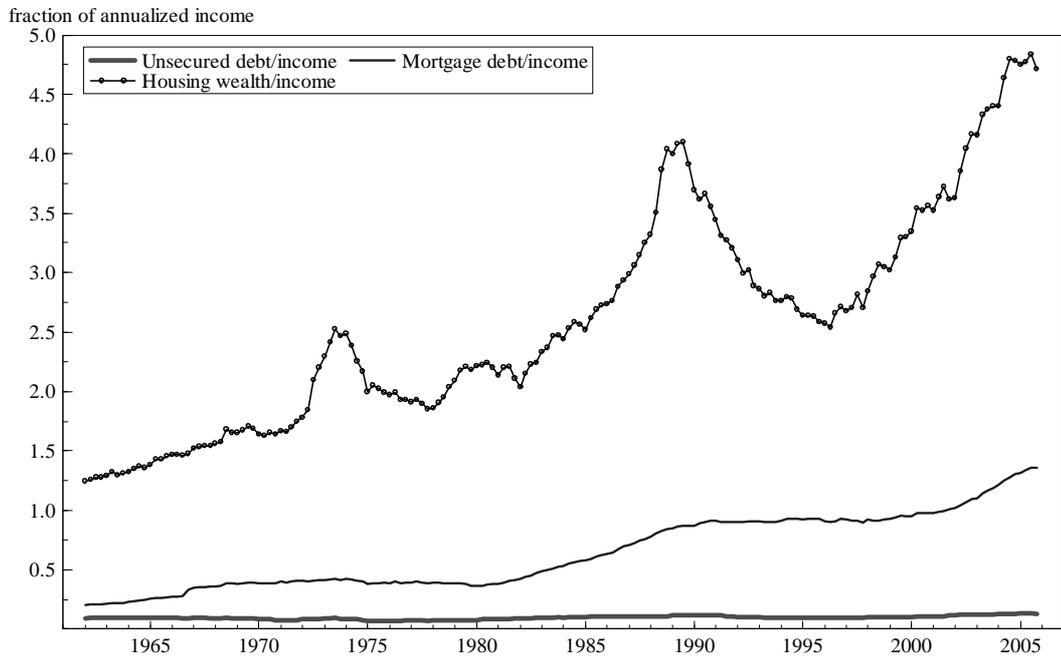


Note: mortgage equity withdrawal is home mortgage borrowing less the value of residential construction put-in-place, as a percentage of non-property income, multiplied by 10. Housing wealth/income is the end of last quarter's housing wealth/current annualized non-property income.

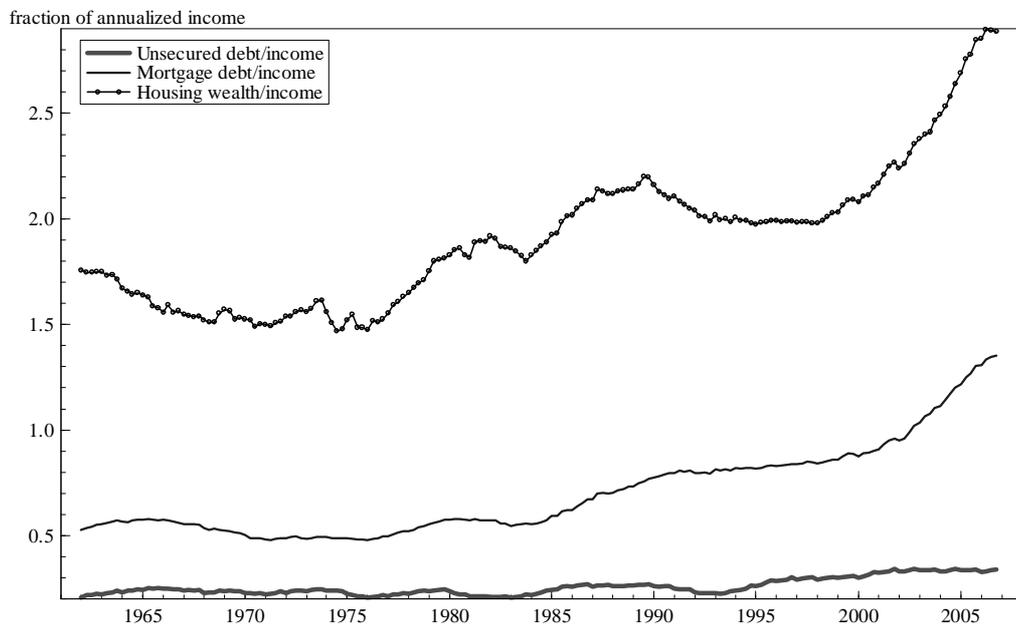
**Figure 7: The stochastic trend for US consumption corresponding to Table 2, column 2.**



**Figure 8: UK household debt ratios to annualised income**



**Figure 9: US household debt ratios to annualised income.**



**Table 1: UK estimates of consumption function (4.7) for 1967Q1 to 2005Q4.**

<b>Dependent variable:</b> $\Delta \log(c)$	<b>Column 1</b>		<b>Column 2</b>		<b>Column 3</b>		<b>Column 4</b>	
<i>Variables</i>	<i>Coeff.</i>	<i>t-ratio</i>	<i>Coeff.</i>	<i>t-ratio</i>	<i>Coeff.</i>	<i>t-ratio</i>	<i>Coeff.</i>	<i>t-ratio</i>
$\log y - \log c_{t-1}$	0.16	4.9	0.23	6.3	0.31	8.5	0.33	8.9
Credit conditions index, CCI	-	-			-	-	0.020	3.5
Net liquid assets/income	0.0036	4.8	0.026	4.3	0.033	5.6	0.038	5.6
Illiquid financial assets/income	ditto	ditto	0.0076	5.9	0.0071	5.1	0.0061	4.7
Housing assets/income	ditto	ditto	ditto	ditto	0.0111	5.7	-	-
Housing assets/income x CCI	ditto	ditto	-	-	-	-	0.0106	6.3
Expected income growth	0.21	4.9	0.18	4.4	0.22	5.5	0.10	2.4
Expected income growth x CCI	-	-	-	-	-	-	0.15	1.6
Real mortgage interest rate	-	-	-	-	-0.03	1.4	-0.04	1.5
$\Delta_4$ unemployment rate	-	-	-	-	-0.56	7.8	-0.64	8.6
Debt/income x $\Delta_4$ nominal interest rate	-	-	-	-	-0.0029	3.8	-0.0072	3.1
Debt/income x $\Delta_4$ nom. interest rate x CCI	-	-	-	-	-	-	0.0057	1.9
<b>Diagnostics</b>								
Standard error of Equation	0.00759		0.00728		0.00614		0.00586	
$R^2$	0.579		0.616		0.734		0.763	
D.W.	1.41		1.34		1.85		1.98	
p-value for no structural break	0.112		0.064		0.093		0.754	

Note that the interaction effect with housing assets/income, takes the form (housing assets/income-3.08)\*CCI, where 3.08 is the mean value of housing wealth/income for 1980-2005.

**Table 2: US consumption function estimates for 1962Q2 to 2006Q3.**

Dependent variable: $\Delta \log(c)$	Column 1		Column 2		Column 3	
<i>Variables</i>	<i>Coefficient</i>	<i>t-ratio</i>	<i>Coefficient</i>	<i>t-ratio</i>	<i>Coefficient</i>	<i>t-ratio</i>
$\log y_t - \log c_{t-1}$	0.45	9.6	0.44	9.9	0.52	11.0
Credit conditions proxy	-	-	-	-	0.040	4.0
Real auto-finance rate	-0.25	3.7	-0.25	3.7	-0.21	3.2
Real auto-finance rate <sub>t-1</sub>	0.12	1.7	0.12	1.8	0.13	1.9
Change in unemployment rate, $\Delta u_r$	-0.63	4.6	-0.63	4.6	-0.55	4.2
$E_t \Delta \log y_{t+k}$	0.14	3.3	0.14	3.4	0.20	4.8
Net liquid assets/income	0.042	2.1	0.044	Restrict	0.052	Restrict
Illiquid financial assets/income	0.0081	3.4	0.0081	3.4	0.0073	3.2
Housing assets/income	0.007	0.5	-	-		
Housing assets/income x US CCI	0.029	1.5	0.035	2.3	0.046	3.0
<b><i>Diagnostics</i></b>						
Standard error of equation	0.00471		0.00472		0.00451	
$R^2$	0.686		0.685		0.712	
D.W.	1.90		1.92		1.89	

Note: All columns include a stochastic trend and dummies for outliers in 1980Q2 and 2001Q4. Non-property income constructed using Blinder-Deaton methodology. Wealth data from Federal Reserve Z1 release household balance sheets. Auto finance real interest rate for new auto purchase as constructed in FRB-US model. See text for credit conditions proxy. Note that the interaction effect with housing assets/income, takes the form (housing assets/income-1.87)\*CCI, where 1.87 is the mean value of housing assets/income for 1962-2006. In columns 2 and 3 the coefficient on net liquid assets/income is restricted to be 0.1 times the coefficient on  $\log y_t - \log c_{t-1}$  so that the mpc is 0.1 in the long-run.

## Appendix 1

**Table: UK equations for housing equity withdrawal/non-property income for 1970Q2 to 2005Q4.**

Dependent variable: Housing equity withdrawal/income	Column 1		Column 2	
	Coeff.	t-ratio	Coeff.	t-ratio
$(\text{Housing equity withdrawal/income})_{t-1}$	0.61	10.3	0.62	10.8
Credit conditions index, CCI	0.032	4.2	0.031	3.7
$\Delta_4 \log \text{nominal interest rate} \times (\text{debt/income})_{t-1}$	-0.031	4.5	-0.036	5.4
Real mortgage interest rate $ma_t$	-0.11	2.1	-	-
$\Delta_4(\text{proportion of adult pop. aged } 60+/65+)_t$	-	-	3.55	3.1
$(\text{proportion of adult pop. aged } 60+/65+)_{t-4}$	-	-	0.80	3.0
Change in unemployment rate $\Delta_4 ur_t$	-0.23	2.5	-0.28	3.0
Change in log real house prices $_t$	0.050	2.1	0.053	2.2
Unsecured debt $_{t-1}/\text{income}$	0.66	3.1	0.51	2.7
Mortgage debt $_{t-1}/\text{income}$	-0.073	6.1	-0.072	6.0
$(\text{Housing wealth}_{t-1}/\text{income}) \times \text{CCI}$	0.014	3.8	0.016	5.0
<b>Diagnostics</b>				
Standard error of equation	0.00836		0.00822	
Adj. $R^2$	0.907		0.910	
D.W.	1.74		1.83	
p-value for no structural break	0.071		0.171	
p-value for no autocorrelation up to 4 <sup>th</sup> order	0.184		0.199	

Note: Housing equity withdrawal data from Bank of England website. Other data are as in Aron, Muellbauer and Murphy (2008).