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The housing market, household portfolios and the German consumer

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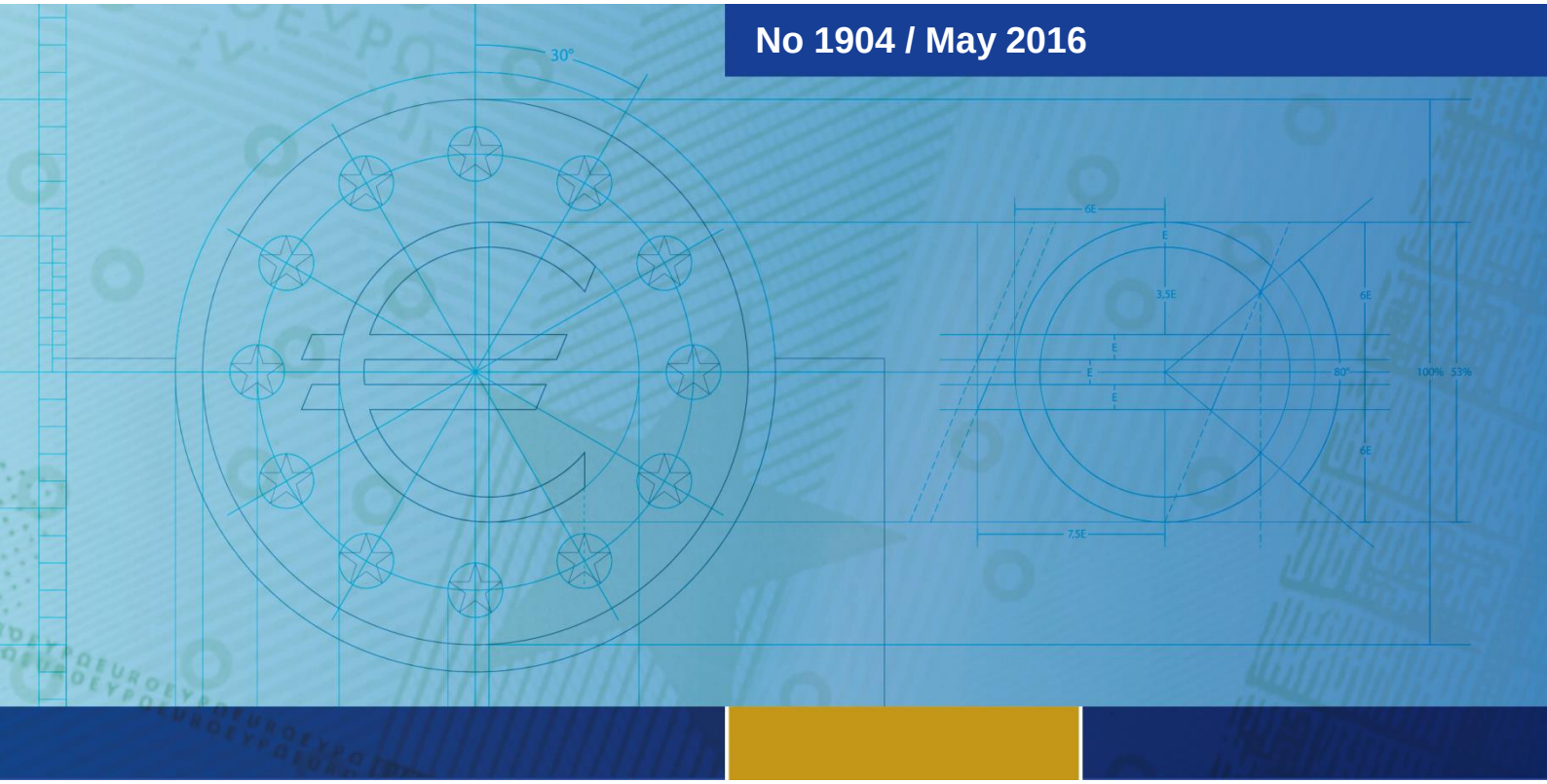

Abstract: *House price booms in Anglo-Saxon economies and their collapse were an important part of the financial accelerator via consumption, construction and the banking system. This paper examines links for Germany between household portfolios, income and consumption in a six-equation system, for 1980-2012 data, for consumption, house prices, consumer credit, housing loans, liquid assets and permanent income with latent variables representing the shifts in the availability of the two types of credit.*

We find evidence of well specified consumption and house price functions and that Germany differs greatly from the Anglo-Saxon economies: rising house prices do not translate into higher consumer spending. This suggests that the transmission of monetary policy via asset prices, in particular house prices, on consumption is likely to be less effective, and any financial accelerator weaker, in Germany than in the US or the UK. There is little evidence of overvaluation of German house prices by 2012.

JEL Classification: E21, E27, E44, E51, E58

Keywords: consumption, credit conditions, credit market liberalization, household debt, housing collateral, monetary transmission.

Non-technical Summary

Germany is undergoing its first house price boom in many years. House price booms in Anglo-Saxon economies such as the US and Ireland and their collapse were an important part of the financial accelerator. The transmission of house price shocks into economic activity occurred via construction and consumption and there were amplifying effects via credit creation. These were most dramatic on the downside as property loan defaults built up, damaging bank balance sheets and triggering reductions in credit availability, with feedback effects on house prices and on economic activity both directly and via house prices. This raises two questions about recent German house price movements: is there a similar transmission via consumption into economic activity? And are German house prices becoming overvalued? There are also perennial questions about the impact of income, income growth expectations, credit availability, risk appetite, pension reform, demography and financial wealth on consumption and household saving rates in Germany. These are the questions the paper attempts to address.

More generally, the German case examined in this paper throws further light on key aspects of the interaction between the financial sector and the real economy as well as on monetary policy transmission given portfolio balance data. Since international patterns of institutions, household portfolios and of house price movements are diverse, it is important to understand their role. Moreover, structural changes due to shifts in credit market architecture potentially can radically change the linkages between household portfolios and consumer spending. An economy in which such structural changes have been small is an enlightening reference point for comparisons with economies with large structural changes.

This paper analyses the links between German household consumption and household portfolios of assets, including housing, financial assets and debt. A six-equation equilibrium correction system for consumption, house prices, consumer credit, housing loans, liquid assets, and permanent household income uses latent variables to represent potentially important shifts in the availability of the two types of credit to households, controlling also for changes in risk appetite, and examines the impact of pension reform and demography. A key feature of the approach is that it captures the credit and monetary policy channels operating via house prices and household balance sheets ultimately affecting spending. The analysis covers the time span 1981– 2012.

The main findings are as follows. Firstly, Germany differs greatly from the Anglo-Saxon economies in the effective absence of home equity withdrawal, in the conservative lending standards historically applied for housing loans and in the low level of owner-occupation. The implication is that higher house prices at given incomes and given income growth expectations are likely to reduce rather than to increase aggregate consumption in Germany: households with ambitions to become owner-occupiers need to save harder for a housing down-payment. Renters can anticipate higher rents in future and are likely to be more cautious in their spending decisions. With the appropriate controls in our model for aggregate consumption, we find evidence consistent with this interpretation.

Secondly, mortgage market liberalization in Germany since the late 1980s has been very modest and by 2012 there was no sign of a worrying recent credit explosion as occurred

in the US, Ireland or Spain in the run-up to the 2008 crisis. This major source of house price vulnerability is absent in Germany. Given housing supply, income growth and low interest rates, house prices in Germany in 2012 do not look overvalued on aggregate.

On the perennial questions, we find evidence of a well-specified aggregate consumption function in which current income, income growth expectations and financial wealth have plausible positive effects, controlling for pension reform and labour market reform and demography. The direct effect of lower interest rates on German household spending is marginally negative (for given current and expected income and other variables), as German households hold far more in liquid assets than they do of debt. Our findings on the household demand for liquid assets, i.e. broad money demand, and for unsecured debt emphasise their buffer stock roles.

The adjustment of consumption to its long-run determinants is rapid, contradicting some other models in the literature. House prices are fairly well explained by an inverse demand model in which mortgage interest rates play an important role. There is evidence for a momentum effect of German house price appreciation relative to other countries: the house price boom in the Euro area periphery associated with monetary union seems to have induced investors to invest in Euro area periphery property rather than in German housing property. Thus, the boom there helps explain the relative weakness of German house prices in the 2000s. Conversely, the collapse of the boom in the periphery, together with low interest rates, contributed to the very recent German house price boom.

An implication of this research is that current monetary policy is likely to be less effective on Germany than similar policies previously pursued in the US and the UK. Since higher house prices relative to income reduce aggregate consumption, our results suggest that monetary transmission via the household sector operates differently in Germany. Increasing house prices are likely not to increase consumer spending unless there are major changes in German mortgage markets including the introduction/usage of home equity loans and more generous loan-to-value rules. Indeed, it is likely that the consumption to income ratio in Germany will fall in the medium term as a result of rising home prices, other things equal. In the same vein, wealth effects are smaller compared to the Anglo-Saxon economy *inter alia* given lower levels of stock market ownership. Therefore, (recent) monetary policy measures by the ECB are more likely to transmit via reduced borrowing costs and improved credit availability for businesses, and via investment, net exports and a corresponding increase in income which will contribute to a rebalancing in the Euro area.

The paper concludes with reflections on the integration of such a model of joint household expenditure and portfolio decisions into a general equilibrium macro-econometric model.

I. Introduction

Germany is undergoing its first house price boom in many years. House price booms in Anglo-Saxon economies such as the US and Ireland and their subsequent collapse were an important part of a financial accelerator, Duca et al. (2010). The transmission of house price shocks into economic activity occurred via construction and consumption and there were amplifying effects via credit creation. These were most dramatic on the downside as property loan defaults built up, damaging bank balance sheets and helping to trigger a major reduction in credit availability with feedback effects on house prices and on economic activity both directly and via house prices. This raises two questions about recent German house price movements: is there a similar transmission via consumption into economic activity? And how could one judge whether German house prices are becoming overvalued? There are also perennial questions about the impact of income, income growth expectations, credit availability, pension reform, demography and financial wealth on consumption and household saving rates in Germany. These are the questions the paper attempts to address.

More generally, the German case examined in this paper throws further light on key aspects of the interaction between the financial sector and the real economy given balance sheet data. Since international patterns of institutions, household portfolios and of house price movements are diverse, it is important to understand their role. Moreover, structural change due to shifts in credit market architecture potentially can radically change the linkages between household portfolios and consumer spending. An economy in which such structural changes have been small is an enlightening reference point for comparison with economies with large structural changes.

This paper analyses the links between German household consumption and household portfolios of assets, including housing, financial assets and debt. A six-equation equilibrium correction system for consumption, house prices, consumer credit, housing loans, liquid assets and permanent income uses latent variables to represent potentially important shifts in the availability of the two types of credit to households and other hard to measure effects on consumption and debt such as pension reforms. We also introduce a measure for risk appetite as another driver of household portfolio choices. A key feature of this approach is that it captures the credit and monetary policy channels operating via house prices and household balance sheets ultimately affecting consumer spending. The key dependent variables are shown in Figure 1. The rises until around 2000 in the ratios to income of consumption,

consumer credit and mortgage debt contrast with the striking long-term decline in real house prices (and, a fortiori, the house price to income ratio), so different from the experience of many other countries.

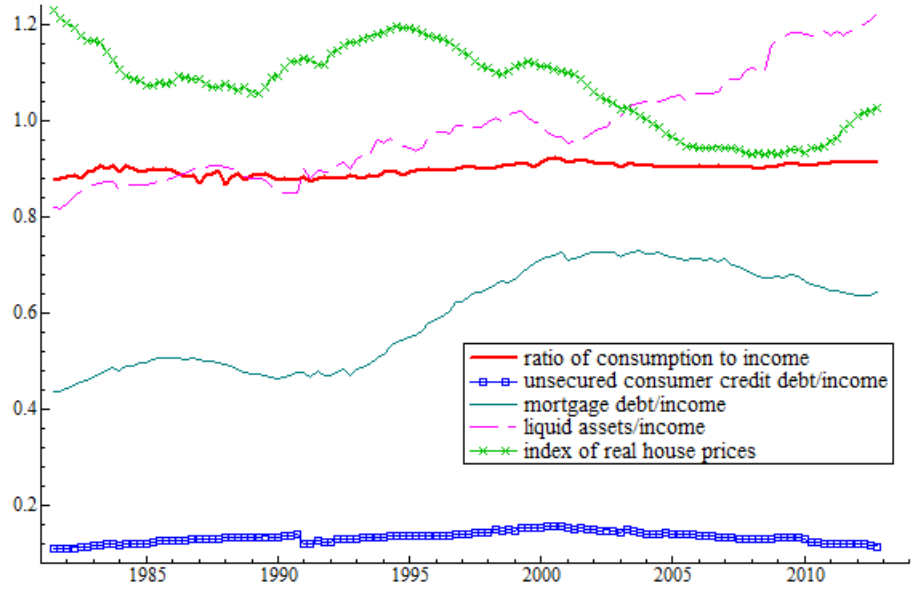

Figure 1: The ratios to income of consumption, consumer credit, mortgage debt and liquid assets, and the real house price index.

The main findings of the paper are as follows. Firstly, with the effective absence of home equity withdrawal, the low level of owner-occupation and higher down payments, higher house prices at given current and expected income are likely to lower rather than to increase household consumption. There are only very modest indications of changing credit conditions due to mortgage market liberalization in Germany. Secondly, given a well specified aggregate consumption function, we find that the direct effect of lower interest rates on consumer spending is slightly negative or neutral as German households hold far more (deposit rate bearing) liquid assets than they do of debt. In the same vein, due to a low share of market-based financial instruments, financial wealth effects are far less pronounced. Thirdly, house prices are well explained by an inverse demand model in which mortgage rates play an important role. Moreover, a momentum effect mirroring house price dynamics in the Euro area periphery seems to partly explain German house prices, particularly in the 2000s. The results suggest that monetary policy transmission and the role of asset price and interest rate dynamics in Germany crucially differs from the Anglo-Saxon economies due to

households' portfolio structure, the credit market architecture as well as socio-demographic factors.

The paper is structured as follows: Section 2 provides a brief theoretical background for the econometric specifications. Section 3 presents the estimation and the methodology to derive the credit condition indices. Section 4 discusses previous literature for models of consumption, debt and house prices for Germany. Section 5 gives an overview of the German institutional and socio-demographic background. Section 6 discusses the estimation results, including for forecasting permanent income. Section 7 concludes. There is a brief data appendix.

2. Theory background to the consumption, debt, house price and liquid asset models

Households make joint consumption and portfolio decisions every period. While understanding consumption conditional on beginning of period asset holdings is important, longer-term dynamics depend on the portfolio decisions which influence next period's consumption. One of the most important decisions is on the demand for housing, which, given housing stocks, drives house prices. Since a number of common factors are likely to drive these joint consumption and portfolio decisions, a system approach is advantageous to model consumption, portfolio choices and house prices simultaneously[1].

2.1 Consumption

The basic solved-out Friedman-Ando-Modigliani aggregate life-cycle/permanent income consumption function suggests a linear relationship between consumption, real wealth at the end of the previous period and permanent non-property income. The log approximation to this is

$$\ln c_t = \alpha_0 + \ln y_t + \gamma A_{t-1}/y_t + \ln\left(y_t^P/y_t\right) \qquad (1)$$

[1] Chrystal and Mizen (2001) recognise the basic principle in their three-equation model of consumption, unsecured borrowing and liquid assets, see Cloyne et al (2015) for a similar model. We add mortgage debt, housing demand and a model for income growth expectations to the system.

where c is real consumption, A is real net worth, y is current real non-property income and y^p is permanent real non-property income[2]. The log ratio of permanent to current income $\ln\left(y_t^p / y_t\right)$ reflects expectations of income growth. To reflect habits, lags in perception or adjustment costs, a partial adjustment form of (1) would make the change in log consumption depend on the deviation between lagged log consumption and the RHS of equation (1). An alternative justification of the partial adjustment form is the sticky information hypothesis of Reis (2006). He suggests that if only some households update their information set every period, aggregate consumption should depend on a declining weighted moving average of the drivers, which is similar to partial adjustment.

The difference between log permanent income and log current income in equation (1) can be closely approximated by an expression in logs of expected future non-property incomes:

$$\ln\left(y_t^p / y_t\right) = \left(\sum_{s=1}^{k} \delta^{s-1} E_t \ln y_{t+s}\right) \Big/ \left(\sum_{s=1}^{k} \delta^{s-1}\right) - \ln y_t \qquad (2)$$

Here δ is a discount factor so that future expected incomes are discounted more and more heavily as the horizon extends. This expression is also equivalent to a weighted moving average of forward-looking income growth rates.

The micro foundations of the classic life-cycle/permanent income model represented by equation (1) have been heavily criticised in research by Deaton (1991, 1992) and Carroll (1992, 2001) who emphasise buffer stock saving in response to liquidity constraints in an environment of uncertain incomes. Key findings are that different households will have different relevant income horizons and that, on average, rather higher discount rates are likely to be applied to expected future incomes than the real risk-free rate of the classic theory.[3] The discount factor we adopt reflects these findings and is close to the 25% per annum used in the FRB-US model of the US economy, Brayton et al (2014).

The originators of the permanent income/life-cycle consumption hypothesis, Friedman and Modigliani, did not distinguish between liquid and illiquid assets and did not recognise that housing wealth is different in another respect: a rise in house prices has an

[2] One important advantage of equation (1) is that it avoids the log assets formulation employed in many studies of consumption. The log formulation is a poor approximation when asset levels are low, as is true for many households. It is also a poor approximation when testing hypotheses on disaggregated assets.

[3] Kaplan et al. (2014, 2015) argue that this short-horizon or 'hand-to-mouth' element of behaviour applies even for asset-rich households where assets such as pensions and housing are illiquid.

income and substitution effect as well as a wealth effect. As shown, e.g. in Aron et al (2012), reformulated life-cycle theory in the absence of credit constraints then suggests a small, probably negative effect of a rise in real house prices on the conventional national accounts consumption aggregate.

Mortgage credit constraints have potentially two aspects. The first is a down-payment constraint resulting from information asymmetries between lenders and borrowers, typically in the form of restrictions on loan-to-value (LTV) and loan-to-income or on the debt-service ratio. The closer the LTV is to 100 percent, the weaker is this constraint. The second is a home equity constraint. In some jurisdictions, home equity loans are effectively not available. In an environment of cautious lending standards and low LTVs, higher house prices at given incomes and given income growth expectations are likely to reduce aggregate consumption: households with ambitions to become owner-occupiers need to save harder for a housing down-payment. Renters can anticipate higher rents in future and are likely to be more cautious in their spending decisions. A positive aggregate 'wealth' effect of house prices on consumption depends crucially on the availability of home equity loans.

The formulation in equation (1) therefore needs to split up assets into different types with different marginal propensities to consume. Variations in household access to credit induce potential time variation in key parameters of the consumption function. This suggests the following 'credit-augmented' version of the Friedman-Ando-Modigliani consumption function in partial adjustment form:

$$\begin{aligned}\Delta \ln c_t \approx \lambda\,(&\alpha_{0t} + \alpha_{1t} r_t + \alpha_{2t}\theta_t + \alpha_{3t} E_t \ln\left(y_t^p / y_t\right) + \gamma_1\, NLA_{t-1}/y_t + \gamma_2\, IFA_{t-1}/y_t \\ &+\gamma_{3t}\, HA_{t-1}/y_t + \gamma_{4t} \log(hp_{t-1}/y_{t-1}) + \alpha_4 demog_t + \ln y_t - \ln c_{t-1}) \\ &+\beta_{1t}\Delta \ln y_t + \beta_{2t}\Delta nr_t \left(DB_{t-1}/y_t\right) + \beta_{3t}\Delta\theta_t + \varepsilon_t\end{aligned} \qquad (3)$$

The time variation in some of the parameters, seen in their time subscripts, and induced by shifts in credit availability, is discussed below.

The net worth to income ratio has been disaggregated into three elements: *NLA/y* is the ratio of liquid assets (such as cash and bank deposits) minus debt to non-property income, *IFA/y* is the ratio of illiquid financial assets (such as pension wealth and directly held equities) to non-property income, and *HA/y* is the ratio of housing wealth to non-property income. However, where the down-payment constraint is stringent, it is better to replace the ratio of housing wealth to income by the log house price to income ratio, expecting a negative

coefficient γ_{4t} as discussed above. The term $\Delta nr_t \left(DB_{t-1}/y_t \right)$, relevant where households face floating rate debt, measures the cash flow impact on indebted households from changes in nominal rates (Δnr_t). Given refinancing possibilities, the impact is greater with high debt relative to current non-property income, DB_{t-1}/y_t. The speed of adjustment is given by λ and the γ_i parameters, for i=1, 2 and 3, measure the marginal propensity to consume (mpc) for each of the three types of assets.

The evidence from several countries is that the change in the unemployment rate is a good proxy for income uncertainty, θ_t, or for the change in income uncertainty (Aron et al., 2012).[4] The term in the log change of income allows for the possibility that some households' spending growth follows current income growth more closely than implied by equation (1), for example because they are credit constrained. This could also be because some, perhaps less sophisticated, decision-makers in households take current income growth as an indicator for future income growth. Equation (3) has the most basic life-cycle model (i.e. equation (1)) as a special case. The more general formulation is consistent with bounded rationality, inefficient financial markets and information asymmetries, which underlie the credit channel.

The credit channel is reflected in the consumption function through the different *mpc*s for net liquid assets and for housing, through the cash flow effect for borrowers, and by allowing for possible parameter shifts stemming from credit market liberalization. Of these, the three most important are as follows: credit market liberalization potentially should (i) raise the intercept α_0, implying a higher level of $\ln(c/y)$, because of reduced saving for a housing down-payment or of the smaller proportion of constrained consumers, especially among the young – the direct effect of liberalization; (ii) increase the *mpc* for housing collateral, γ_3 with greater access to home equity loans, or reduce the corresponding negative coefficient γ_4 if the down-payment constraint is relaxed; (iii) raise α_3 by increasing the impact of expected income growth if reduced credit constraints make inter-temporal consumption smoothing easier. With numerical indicators of the degree of credit market liberality, credit conditions indices for the mortgage market (*MCCI*) and for unsecured consumer credit loans (*UCCI)*, it would be possible to make each potentially time-varying parameter a linear function of the *CCIs* and test hypotheses about time variation. In principle, with a measure of risk appetite, we can also check whether an increase in risk appetite (lower

[4] The multi-country empirical evidence favours the change, rather than the level of the unemployment rate, given the other controls in this formulation of the consumption function.

risk aversion) has a parallel effect on α_0 and on α_3, as greater risk appetite might be expected to reduce precautionary saving and increase the role of expected income growth.

This consumption equation satisfies long-run homogeneity in income and assets: doubling both, doubles consumption. The long run coefficient on *ln y* is set to 1. This means that the income endogeneity issues which Hall (1978) highlights are not of concern for the measurement of the long-run income and asset effects: variations in asset to income ratios are dominated by movements in lagged asset prices, so that the endogeneity of income is practically irrelevant, except possibly for the estimation of the coefficient on $\Delta \ln y_t$.[5]

One important question for monetary policy transmission concerns the effect of real interest rates on consumption. In principle, this could operate directly, given income, income expectations, household portfolios and asset prices, and indirectly via these controls. The conventional wisdom, particularly among Anglo-Saxon economists, is that the direct effect of real interest rates on consumption is negative. However, economic theory does not guarantee this except for households with zero or negative net assets. In the standard two-period model of household consumption choices, the inter-temporal budget constraint is given by

$$c_1 + c_2 / (1 + r_1) = A_0(1 + r_0) + y_1 + y_2^e / (1 + r_1) \equiv W_1 \tag{4}$$

where all variables are in real terms, c refers to consumption, y to disposable non-property income, A to end-of-period assets, r to the interest rate, W defines life-cycle wealth, and the e superscript means expected.

Assume the utility function is additive and has the CES form. Then

$$U^{-\rho} = c_1^{-\rho} + [1 / (1 + \delta)]c_2^{-\rho} \tag{5}$$

Maximising (5) subject to (4) results in the solved out consumption function

$$c_1 = W_1 / k_1 \tag{6}$$

where

$$k_1 = 1 + \{1 / (1 + \delta)\}^{\sigma} \{1 / (1 + r_1)\}^{1-\sigma} \tag{7}$$

and $\sigma = 1 / (1 + \rho)$.

For small values of δ and r_1.

[5] Instrumenting the income denominator makes virtually no difference to the estimated coefficients on asset to income ratios. In a wider system, income, asset prices and the portfolios households held at the end of the previous quarter are, of course, endogenous. Nevertheless, important insights for policy and for short-term forecasting are obtained from estimates of the partial system proposed below.

$$k_1 \approx 1 + [1 / \{1 + \sigma\delta + (1 - \sigma) r_1\}]. \quad (8)$$

Here the inverse marginal propensity to consume out of assets k_1 depends on the weighted average of the subjective discount rate δ and the market rate r_1. The responsiveness of consumption to the real interest rate - given A_0, y_1, and y^e_2 - can be examined by differentiating equation (6) in logs with respect to r_1:

$$\frac{\partial \log c_1}{\partial r_1} = \frac{\partial \log W_1}{\partial r_1} - \frac{\partial \log k_1}{\partial r_1}$$

$$= \frac{\frac{-y^e_2}{(1+r_1)^2}}{W} + \frac{1-\sigma}{k_1(1+\sigma\delta+(1-\sigma)r_1)^2} \quad (9)$$

A low value of expected discounted income relative to life-cycle wealth (which corresponds to a high share of assets in life-cycle wealth) and a low value of the elasticity of inter-temporal substitution σ – in other words, intolerance to consumption volatility make a *positive* response more likely. Muellbauer and Murata (2011) argue that Japan, where household deposits greatly outweigh household debt, and household caution is legendary, is a classic example of such a positive direct consumption response to higher real interest rates. It remains to be seen whether, on the empirical evidence, Germany resembles Japan.

The last ten pages of Deaton (1992) summarise the massive evidence from micro as well as macro data against the simple permanent income theory. He also notes that consumers' balance sheets include illiquid assets such as pensions, stocks and bonds, and houses: "The presence of these illiquid and sometimes high-yielding assets needs to be integrated into the model of credit-constrained consumers". This is a task for formal theory that is still incomplete in 2016[6]. However, basic economic reasoning suggests a number of insights that can be applied and tested in empirical work on household portfolios. One of the most important is to take account of the influence of shifts in credit conditions on household portfolios, most clearly on house prices and mortgage debt.

Household heterogeneity is one of the implications of the research of Deaton and Carroll cited above, and of Ayagari (1994). Carroll (2002, 2014) and Kaplan et al (2016) criticise the representative agent model of consumption and the general equilibrium models

[6] Steps on the way include Otsuka (2006) who introduced an illiquid financial asset with transactions costs and Kaplan et al (2015) who analyse theory and empirical evidence on further implications of illiquidity on buffer-stock saving decisions and on the marginal propensity to consume out of income.

founded on it. Differences in behaviour according to housing tenure and the different degrees to which households are subject to credit constraints in the mortgage market are further reasons to question 'representative agent' consumption functions and macro-economics. This does not rule out finding fairly stable empirical relationships on aggregate data, for example if joint distributions of income and assets are fairly stable. However, there is the possibility that the latent variables estimated in this paper and interpreted as shifts in credit conditions might be picking up the joint effect of such shifts and evolving distributions of incomes and assets.

2.2 House prices

There are two basic theories of housing price determination. The first is based on supply and demand functions, and a price adjustment process which brings supply and demand into balance. The second is based on asset pricing theory from finance and assumes that arbitrage brings housing prices and rents into an equilibrium relationship, again after a price adjustment process. In both approaches, interest rates as well as shifts in access to credit for households provide an important link between the macro economy and housing prices. The supply and demand approach will be followed in this paper.

In this approach, the supply – the stock of housing – is given in the short run. Then housing prices are determined by the inverted demand curve, that is, by the stock of housing and the factors driving demand. Let the log of housing demand, h, be given by

$$lnh = -aln\,rhp + b\,lny + z \qquad (10)$$

where *rhp* is the real housing price, *y* is real income and *z* represents other demand shifters. The own-price elasticity of demand is –*a*, and the income elasticity is *b*. Solving for housing prices, *rhp*, yields:

$$lnrhp = (blny - lnh + z)/a \qquad (11)$$

Note that forecast simulations of housing prices for this model would need a residential investment equation as well as assumptions on income, interest rates and credit availability. An advantage of the inverted demand function approach (i.e. expressing price as a function of quantity and the other factors shifting demand) is that it is well grounded theoretically, unlike

many 'ad hoc' approaches. In addition, we have strong priors regarding the values of the key long-run elasticities, corresponding to the 'central estimates' set out in Meen (2001). For example, many time-series estimates of the income elasticity of demand suggest that *b* is in the region of 1, in which case the income and housing-stock terms in the above equation simplify to log income per property, i.e. *ln y – ln h*. But the elasticity of housing prices with respect to income, given the stock, is *b/ a*, which is typically substantially above 1 since the own-price elasticity, *a*, is below 1.

The demand shifters included in z cover a range of other drivers. Since housing is a durable good, inter-temporal considerations imply that expected or 'permanent' income and 'user cost' should be important drivers. The user cost takes into account that durable goods deteriorate, but may appreciate in price and incur an interest cost of financing as well as tax. The usual approximation is that the real user cost, *uc*, is:

$$uc = rhp(r + \delta + t - \Delta rhp^{e} / rhp) = rhp(uch), \qquad (12)$$

where r is the real after-tax interest rate of borrowing, δ is the deterioration rate plus transactions costs and a risk premium, t is the property tax rate, and $\Delta rhp^{e} / rhp$ is the expected real rate of capital appreciation. There is much evidence in favour of a tendency of home buyers to extrapolate recent house price appreciation into future expectations, and some evidence favouring a four-year memory of relevant appreciation, see Muellbauer (2012).

The long-run solution for real house prices is given by:

$$\ln rhp_t = h_{0t} + h_{1t} \ln nmr_t + h_{2t} \ln user_t + h_{3t}\, \theta_t + h_4 ln(y_t/hs_{t-1}) + h_{5t}\, E_t \ln(y_t^p / y_t) + h_6 NLA_{t-1}/y_t + h_7 IFA_{t-1}/y_t + h_8 demog_t + h_9\, trans_t + h_{10}\, subs_t \qquad (13)$$

Here the intercept is time varying and increasing with *MCCI*, the credit conditions index for the mortgage market. The theoretical rationale for this comes from the fact that a credit constraint introduces a shadow price or 'wedge' into the basic inter-temporal efficiency condition, Meen (1990). The credit conditions index reflects the time-varying size of this wedge. The intercept should also increase with risk appetite, as a greater willingness to bear risk should increase demand for a long-lived investment such as housing. The next term, the

log of the tax adjusted nominal[7] mortgage rate should have a negative coefficient and could be time varying, potentially with credit conditions. The log user cost term, defined as log *uch* from equation (6), should also have a negative coefficient, potentially becoming more important relative to the nominal mortgage rate with credit market liberalisation. Income uncertainty should have a negative effect. The next term, the log of income per house should have a positive coefficient, interpreted as minus the inverse of the price elasticity of the demand for housing. The next four terms, income growth expectations, the ratios to income of net liquid assets and of illiquid financial assets and housing subsidies should have positive effects on the price of housing while higher transaction costs should have negative effects. Finally, demographic composition should have an effect on house prices related to demographic effects on consumption and mortgage demand.

2.3 Mortgage Debt

In contrast to the vast literature on consumption, little systematic econometric work exists on household debt, see the reviews in Fernandez-Corugedo and Muellbauer (2006) and in Meen (1990). The canonical rational expectations permanent income model of the representative consumer has little to contribute to understanding the determination of aggregate household debt. In that model there is only a single asset, so that it can explain only the evolution of aggregate net wealth. Typically, consumers have multiple motives for holding debt in general. These include first, borrowing to finance the acquisition of consumer durables and housing, human capital investment through education or training, or portfolio investment in financial assets when return prospects look favourable; second, acquiring debt in anticipation of higher future income or for consumption-smoothing through temporary income downturns; and thirdly, using debt to offset what could otherwise be excessive amounts of saving implied by occupational pension rules. In practice, in Germany as well as most developed economies, mortgage debt accounts for the major proportion, often 70 to 85 percent of total household debt. Miles (1992) and Brueckner (1994) discuss the borrowing and saving decisions for housing and portfolio investment motives and discuss the consequences of the relaxation of mortgage rationing, also see Meen (1990). Given asymmetric information between lenders

[7] Standard mortgage amortization contracts, which fix annual payments in nominal terms, suggest that the nominal rate matters, see Kearl (1979).

and borrowers, assets have an important collateral role. Mortgage debt is backed by housing collateral.

In a closed financial system, much of household saving in liquid asset form is recycled by the financial system into lending for other households, suggesting that at the aggregate level, current end-of-period mortgage debt should increase with liquid assets at the end of the previous period. With the internationalisation of finance, however, domestic liquid assets are likely to become less of a constraint at the domestic level. At the micro level, a household with high levels of liquid assets will be less in need of a mortgage. This leaves some ambiguity about what can be expected for the aggregate relationship between liquid assets and the mortgage stock.

In principle, higher house prices or housing wealth should increase the demand for mortgages, partly because of the collateral role of housing and because, for a given level of housing demand, higher house prices need greater levels of debt. However, this relationship is likely to be time varying: when large down-payment ratios are required, higher house prices could even *reduce* the overall demand for mortgages by excluding larger fractions of potential buyers from the mortgage market. Credit market liberalisation should reduce this fraction and its potentially negative influence, respectively. Variables such as income, interest rates and proxies for income uncertainty, reflecting economic conditions during the period, will also influence current debt. We use a log formulation, linking the log mortgage debt to income ratio with log ratios to income of the various assets, and to the log of real income to obtain the following long-run equation for mortgage debt:

$$\ln(mdebt_t/y_t) = m_{0t} + m_{1t}\ln nmr_t + m_{2t}\ln user_t + m_{3t}\theta_t + m_4 lny_t + m_{5t}E_t\ln(y_t^p/y_t) + m_{6t}ln(LA_t/y_t) + m_7\ln(IFA_{t-1}/y_t) + m_{8t}\ln(HA_{t-1}/y_t) + m_{9t}\ln(rhp_{t-1}/y_t) + m_{10}demog_t \quad (14)$$

The time-varying intercept m_{0t} should be increasing in *MCCI*, the mortgage credit availability indicator and in risk appetite, reflected in the willingness to take on a mortgage payment commitment. This equation incorporates the log[8] of the nominal tax-adjusted mortgage rate, nmr. The latter reflects the cash-flow constraint on the ability to finance debt

[8] Note that the debt service ratio, defined by the product of the nominal mortgage rate and debt, scaled by current income, is a cash-flow measure of affordability. The log formulation makes sense since the dependent variable is in logs and plausibly depends on the log of the nominal interest rate and on log income.

and both would be expected to have a negative coefficient. A second interest rate influence potentially enters via the user cost term discussed in the previous subsection. Alternatively, households may perceive as relevant the real interest rate burden corrected for the rate of inflation of total consumption. These are issues for empirical testing. The equation also incorporates income uncertainty, the log ratio of permanent to current income, log income, two log financial asset to income ratios[9], the log house price to income ratio, the log of the housing wealth to income ratio, and demographic composition since a younger age structure should be associated with higher levels of debt. The house price to income ratio could enter with a negative coefficient as, with high down-payment ratios, higher house prices reduce the proportion of potential buyers able to enter the housing market. However, other things being equal, a larger housing stock owned by the household sector will typically require a larger stock of mortgages.

Credit market liberalization should impact in several ways on this long-run relationship, broadly corresponding to effects described on consumption. A direct, positive effect on debt should result from lower housing down-payments as a fraction of house values. This is why m_{0t} should increase with *MCCI*, as noted above. For similar reasons, a negative coefficient on the log house price/income ratio should shrink if the down-payment ratio declines (i.e. the LTV rises) while that on log housing wealth/income should rise if home equity loans are introduced, to reflect the increased use of housing collateral.

On the practical implementation, see below, we adopt an equilibrium correction formulation, a slight generalisation of partial adjustment, which adds some short term dynamics.

2.4 Consumer credit

There is very little published research on what drives the ratio of consumer credit to income. However, unsecured consumer credit probably has three main purposes. One is for short-term finance of consumption, particularly of durable goods.[10] The second is to help bridge the gap between the price of a home and the available mortgage. The third is consumption smoothing,

[9] In contrast to the linearization in terms of asset to income ratios not in logs chosen for the consumption function, the log linearization here adopted would be more consistent with proportional effects in the long run. However, it is simple to test the two alternatives.

[10] Revolving credit in the form of credit card debt fully paid off every month or two is a component of unsecured debt which should be closely related to total consumption spending, and not just spending on durables.

particularly through temporary income down-turns. The stock of consumer credit in the form of credit card debt, personal loans or overdrafts and loans for the purchase of durable goods other than housing would be expected to have similar drivers to those for consumption, and interest rate effects would be expected, given controls for increased credit supply.

We propose the following long-run formulation for the log of consumer debt

$$\ln cdebt_t = u_{0t} + u_{1t} \ln ncr_t + u_{2t} rcr_t + u_{3t}\theta_t + u_4 lny_t + u_{5t} E_t \ln(y_t^p/y_t) + u_6(\alpha_{1t} r_t + \gamma_1 NLA_{t-1}/y_t + \gamma_2 IFA_{t-1}/y_t + \gamma_{3t} HA_{t-1}/y_{t-1} + \gamma_{4t} \ln(rhp_{t-1}/y_{t-1})) + u_{7t} \ln(HA_{t-1}/y_t) + u_{8t} \ln(rhp_{t-1}/y_t) + u_9 demog_t \quad (15)$$

Here, the intercept is time-varying and increases with *UCCI*, the credit conditions indicator applying to consumer credit. It should also be increasing with risk appetite, reflected in a greater willingness to take on debt servicing commitments. The nominal interest rate on consumer credit, *ncr* and the real rate *rcr* would be expected to have a negative sign with coefficients potentially time-varying with *UCCI*. The first and third purposes of consumer credit, short-term finance of consumption and consumption smoothing, are represented in equation (15) by the composite term consisting of the long-run solution from the consumption function. The second purpose of consumer credit, to help bridge the housing down-payment gap, is represented by including in equation (15) the linear combination of the log house price to income ratio and the log housing wealth to income ratio which appears in the mortgage stock equation.

2.5 Liquid assets

There is an extensive literature on the demand for money, including household demand for broad money, i.e. liquid assets. The literature typically encompasses three aspects of the demand for money, including empirical time series and micro studies.[11] The first is the transactions demand and hence the need for a scale variable such as income. The second focuses on portfolio influences introducing other wealth components and opportunity costs. The third is a buffer stock view of money, introducing uncertainty and a precautionary motive. Since unsecured debt can also serve a buffer stock role in maintaining consumption under temporary declines in income, one would expect increased access to unsecured credit

[11] See Seitz and von Landesberger (2001), section 2 for a review.

to reduce the demand for liquid assets. Further, as one motive for saving in the form of liquid assets is to build up a deposit for an envisaged housing down-payment, increased access to mortgage credit should also reduce the demand for liquid assets, other things equal. Increased risk appetite, in turn, might reduce the demand for buffer stock liquid assets. Together, these are three reasons for a time-varying intercept effect.

In equation (16), s_{0t} is the time-varying intercept. There are two opportunity costs terms: $yld - depr$ is the 10-year bund yield minus the average deposit rate on liquid assets; and $rdepr$ is the real deposit rate. θ is an indicator for income uncertainty. The following five terms are log current income, the log ratio of permanent to current income, the log debt to income ratio and two log asset to income ratios. Finally, demography is likely to be a factor, while the last term is a random disturbance.

$$\ln LA_t = s_{0t} + s_1 (yld - depr)_{t-1} + s_2 rdepr_{t-1} + s_{3t} \theta_t + s_4 lny_t + s_{5t} E_t \ln(y_t^p / y_t) + s_6 \ln(TDEBT_{t-1}/y_t) + s_7 \ln(IFA_{t-1}/y_t) + s_{8t} \ln(HA_{t-1}/y_t) + s_{9t} \ln(rhp_{t-1}/y_t) + s_{10} demog_t \quad (16)$$

2.6 Permanent income

Equation (2) defines the log ratio of permanent to current income. Making assumptions about income growth beyond the end of the sample, we construct this log ratio taking a 40 quarter horizon. Since the log of permanent income is likely to be a relatively smoothly evolving trend, we model lny_t^p / y_t in terms of trends and the deviation of log current income from these trends. Since we are trying to model actual household expectations, a key driver should be survey data on household expectations of future economic conditions. Other relevant variables that could influence household expectations include real asset prices and real oil prices. The deviation of log current income from underlying trends could be related to monetary policy as measured by interest rates and spreads.

As far as underlying trends are concerned, there will be long-term productivity trends but since income is defined on a per capita basis, the log ratio of working age to total population should be another important long-run trend element. The decline in this ratio should reduce expected growth of income relative to total population.

$$ln\, y_t^p / y_t = f_0 + f_1 lny_t + f_2 t + f_3 \ln(wapop_t / pop_t) + f_4 conf_t + f_5 \ln(rhp_{t-1}/y_{t-1}) + f_6 lnrdax_{t-1} + f_7 lnrpoil_t + f(spreads, real\ interest\ rate, inflation\ rate)$$

3 Previous findings on German consumption, household wealth effects, debt and the role of house prices.

Our work is related to the extensive literature on the relationship between consumption, income, household wealth, debt and asset prices. Based on variants of the permanent income/ life cycle model, most studies find a long-term link between consumption, wealth and income. However, the strength of the link varies across sample periods and model setups. In this context, allowing for structural breaks in order to take into account the German reunification typically improves the identified co-integration relation, Al-Eyd et al. (2006). Based on quarterly data from 1980-2003, Hamburg et al. (2008) attribute variations to consumption mainly to permanent income shocks within an error correction model. This is also confirmed by most other studies. Overall, empirical evidence for Germany suggests that the speed of adjustment of consumption to its long-term trend is rather high in international comparison. Moreover, and in stark contrast to the empirical claims for the US, Lettau and Ludvigson, (2001, 2004) and the UK, Fernandez-Corugedo et al. (2003), deviations of the variables from their common trend primarily predict variations of consumption, income and other business cycles indicators rather than asset price movements and associated excess returns. Hamburg et al. (2008) attribute these findings in the consumption, wealth and income nexus to different institutional features in the respective financial systems. This is *inter alia* reflected in the proportion of direct share holdings, which is much lower in German household portfolios than in the US and UK. In the latter countries, pension and retirement funds are much more used than in Germany in which the pension system still mainly relies on the "pay-as-you go" scheme.

The high speed of adjustment for the German consumption function in comparison with similar specifications studied in other countries in Muellbauer and Williams (2011), Aron et al (2012), Aron and Muellbauer (2013) and Muellbauer et al (2015), could be consistent with the sticky information hypothesis of Reis (2006). Financial decision making is less complex for most German households, given limited asset market participation, lower home ownership, the PAYGO pension system, and low volatility and hence relevance of house prices and credit conditions. Lower complexity would be consistent with lower information costs of frequent updates of the information set.

The existing literature also refers to these institutional differences between the German (and continental Europe) and Anglo-Saxon financial systems when explaining the effects of wealth changes (e.g. due to asset price shocks) on consumption. These effects are typically found to be rather small or even statistically insignificant for Germany and other European countries (Dreger and Reimers, 2006). For instance, Hamburg et al. (2008) find that (permanent) total wealth shocks have only a minor impact on German consumption. In contrast, in the US or UK, wealth effects play a much more pronounced role in explaining consumption dynamics, Aron et al. (2012) and Duca and Muellbauer (2013). By separating wealth into financial and non-financial components, other studies try to account for the different marginal propensities to consume out of the disaggregated assets of which household wealth is composed. In this respect, one major finding across selected studies is that financial wealth effects seem to be stronger than non-financial wealth effects in Germany and other European countries. In contrast, changes in house prices seem to be more relevant in the US or UK, see IMF (2008), Slacalek (2009), Sousa (2009), and De Bonis and Silvestrini (2011). As the possibility of home equity withdrawal is not a widespread feature of most euro area credit market architecture and as down-payment ratios for home buyers are substantially higher in European countries, the effects of rising house prices on household consumption are therefore supposed to be rather small or can become even negative, see Balta and Ruscher (2011) for the euro area and for recent evidence on negative house price effects in France, Chauvin and Muellbauer (2013) and Canada, Muellbauer et al. (2015).

Several other factors help to fit household consumption models. Real mortgage rates, if significant, are found to exhibit a negative impact on consumption as expected by standard consumption theory, Al-Eyd et al. (2006). Based on the life cycle approach of specifying a consumption model, a number of studies also identify the role of population and age cohorts as a further determinant of aggregate consumption patterns. Al-Eyd et al. (2006) find for a number of countries that the old age cohort (the over 65 age group) contributes negatively to consumption, particularly in Germany. This result is hardly compatible with the life cycle approach according to which older people consume more relative to their income. At the same time, the younger age cohort (20-40 age group) is found to be a positive contributor to consumption except in Germany. The authors attribute these results for Germany to a high proportion of younger, liquidity constraint households that do not borrow to smooth consumption plans over time. Moreover, since the late 1990s, the old age cohort has grown faster than other age cohorts, which adds weight to the relevance of such findings.

Studies on the role of credit market conditions and changing credit market architecture on German consumption are rare. This is mainly due to the lack of data availability. Since 2003, the bank lending survey conducted by all central banks of the Eurosystem provides information on overall credit conditions across all euro area countries; for previous years no such information is available. Most research focuses on the impact of changing credit supply (both in terms of volumes and in terms of credit conditions) on investment and real GDP. The existing evidence points to significant effects of changing credit conditions on real activity in Germany as well as in other euro area countries, see Capiello et al. (2010), Blaes (2011), and Van der Veer and Hoeberichts (2013).

Research on house price models has so far focused on the determinants of house price dynamics. Empirical studies based on time-series data for German residential property prices, however, often have problems in pinning down price dynamics with macroeconomic variables because the econometric models either yield imprecise estimates or price effects can hardly be captured by the available set of macroeconomic variables, Hiebert and Sydow (2011), Igan and Loungani (2012). One major drawback is the measurement of house prices in terms of low frequency and short times series that make the estimation challenging. Some studies assess house price dynamics based on a cross-section in order to improve the statistical inference of the underlying house price model, see Koetter and Poghosyan (2008) as well as Kajuth et al. (2013) for German data. Most studies find a positive impact of income on house prices, yet the magnitude varies according to the sample period and modeling specification. For instance, based on a time series of regional data and a stock-flow approach of modeling house prices, the results of Kajuth et al. (2013) suggest that for the period 2004-2010 income had a moderate impact on house prices, while no statistical significance can be observed for the longer horizon 1996-2010. In contrast, demographic factors such as the population share of the middle-aged and population density are important to explain house price dynamics in Germany throughout the whole sample period. They find that the housing stock contributes negatively to house price developments in Germany. Interestingly, the authors do not find that (real) interest rates have a significant and economically meaningful influence on German house prices. This stands in contrast to economic intuition and other available research that studies the relationship between mortgage rates, interest rates, user costs and house prices, Igan and Loungani (2012) and Dreger and Kholodilin (2011). Kajuth et al. (2013) attribute their findings to the fact that their model specification also includes growth expectations. In the short sample under consideration, this makes it difficult to separate the effects of interest rates on house prices. Finally, to the best of our knowledge and

similar to the evidence as regards modeling consumption, the impact of changes in credit conditions on German house prices is hardly discussed in studies on German house prices.[12]

Existing work on modeling credit in Germany typically focuses on total credit to the non-financial private or on selected credit sub-aggregates such as loans to households and to non-financial firms. Household consumer credit and mortgage credit are not modeled explicitly. Most studies try to reveal insights into monetary policy transmission, i.e. they aim at quantifying the effects of monetary shocks on real GDP, inflation and loans to the private sector, see for example Huelsewig et el., (2004, 2006) and Eickmeier et al. (2009). In particular, they test whether in Germany a credit channel exists according to which changes in credit supply conditions amplify monetary shocks to the real economy. These financial accelerator effects can at least be partly found alongside the traditional interest rate channel, although the evidence remains mixed.

There is a more substantial empirical literature on the household demand for broad money or liquid assets, though rather little for Germany. Gerdesmeier (1996) and Read (1996) suggest that in the long run, household demand for liquid assets in Germany depends on income, gross financial wealth and some opportunity cost measures. In a log-formulation they both find homogeneity of degree 1 in income and wealth. However, while Gerdesmeier finds the coefficient on log income to be around three times as large as that on wealth, Read finds the opposite. The most recent study not of Germany but of the euro area is by Seitz and von Landesberger (2010). In a specification including housing wealth, following Greiber and Setzer (2007), de Bondt (2009) and Beyer (2009), they find a total eleasticity w.r.t. income and housing wealth of around 1.3. The elasticity rises to 1.8 if income is the only scale variable. They also test for a broad range of interest rates and spreads and uncertainty indicators.

4 Institutional and socio-demographic background

Germany has one of the lowest rates of owner-occupation in Europe, at around 40 to 45 percent (ECB 2013). Mortgage interest tax relief on all mortgages was removed in 1986 and replaced by far less valuable tax-breaks confined to first time buyers. Furthermore, during the first half of the 2000s, they were first halved and then fully abolished.

[12] One notable exception is Duemmler and Kienle (2010) who extend the standard user cost approach by allowing credit frictions to affect user costs of housing. However, their analysis focuses on household investment in housing rather than on house prices *per se*.

Property taxes in Germany are of three kinds. First, there are local property taxes with locally distinct rates (*Grundsteuer*). The tax is based on valuations of the respective property. However, since these valuations are from 1964 (or even 1935 in the former East Germany)[13], there is essentially no correlation over time between total tax revenue and average German house prices. These tax payments are subtracted from pre-tax income in the definition of household disposable income in Germany. The second tax is a transfer tax (*Grunderwerbssteuer*). Before 1983, it was applied only to larger properties. From 1983 to 1996 the national tax rate was 2% and was raised to 3.5% from 1997 to 2006. In 2007 the tax became a state-level tax, though most states initially kept the rate at 3.5%, with the average rate drifting up beginning in 2011. Thirdly, there is a capital gains tax but it applies only to properties held for less than 10 years and where the proceeds are not re-invested in housing. This means that it has negligible implications for property prices and consumption.

In Germany, there is no law which explicitly prohibits banks from offering home equity loans. However, according to the general regulation,[14] banks are always required to evaluate their assets in a very conservative manner. Furthermore, the regulation says that the amount of credit a borrower can take out is essentially determined by his/her income and, hence, the ability to pay back the debt. This would be one constraint on the ability to increase borrowing when the market price of the collateral increases. Another constraint arises from pre-payment penalties. Most housing loans have an initial maturity between 25 and 30 years and are at fixed interest rates with initial durations of around 10 years which are reset thereafter. It is far more expensive to refinance than in the US, where the fees are typically of the order of 1 percent. There is anecdotal evidence that flexible mortgages are beginning to appear where borrowers are able to pay back or borrow more, without penalty, up to the pre-agreed LTV ceiling. Keeping track of the spread of such mortgages should be a priority for the data gatherers since potential relaxation of constraints on home equity loans could alter the future relationship between housing wealth and consumer spending.

On the issue of loan-to-value ratios, there is no *general* regulatory maximum. Mortgage lending practices by German banks suggest that LTVs are on average around 70 percent and that LTVs typically do not exceed 80 percent (if higher there are significant

[13] See §§ 125 to 128 Bewertungsgesetz (BewG).

[14] This applies to all banks which are subject to German regulation. Hence, branches of foreign banks should not be affected. Recent data suggest that foreign branches have not been very active in the German mortgage market.

mortgage rate mark ups, particularly above an LTV of 90 percent). However, for banks that want to refinance mortage loans via covered bonds ('Pfandbriefe') the amount of mortgage loans may not exceed 60 percent of the collateral value and the collateral is valued in a very conservative manner. Households may be able to add (unsecured) borrowing to top up a mortgage, but at comparatively higher borrowing costs.

Any study of German data from 1981 to 2012 needs to take account of the unification of Germany on October 3 1990. Data on the West German economy are spliced with data on the unified Germany from 1991Q1. As previous studies indicate, it is important to take into account at least a shift in the mean behaviour of economic relationships and impulse dummies around the time of unification to capture potential short term dislocations of previous behavior. Whether this is enough might be questioned. For example, the quality of housing in the former East Germany was a good deal lower than in the West, as were average incomes and probably income inequality. In the initial years, a good deal of migration took place from east to west, creating a potential mismatch between demand and supply not expressed in aggregate data on the housing stock and on aggregate demand factors.

One of the early policy decisions after unification was the 'Foerdergebietgesetz' (Development Areas Act) announced in June 1991. This offered large tax write-offs – *inter alia* the entire cost of the investment over 10 years – to investors willing to invest, including in housing, in the former East Germany. In September 1993, it was announced that the tax breaks would be limited to projects that started before 1997 so signaling an end to the tax breaks. However, in October 1995, the directive was finally prolonged until 31.12.1998 but with lower tax advantages for projects initiated between 01.01.97 and 31.12.98. Some authors[15] have argued that the introduction and later withdrawal of this tax break had an important impact on house prices, potentially positive in the first stage of the Development Areas Act and later negative. Our empirical evidence confirms this argument.

A second set of policy interventions, this time important for the consumption to income ratio, or one minus the saving rate, took place in the pension arena. The German state pension system is still mainly based on a pay-as-you-go system (PAYGO). Due to continuing increases in life-expectancy and declines in the birth rate, the ratio of population of working age relative to that of retirement age has been declining and is expected to decline further in decades ahead. A series of pension reforms since 2001, described in Deutsche Bundesbank (2008), have addressed the underlying sustainability problem. These were, however, preceded

[15] See for instance Belke (2010).

by a temporary increase in the generosity of the system and increased use of general taxation to fund it in 1999 under Schroeder's chancellorship. In March and June of 2001, major changes were announced. They included policies to promote private, including occupational, pension plans and the announcement that, for 8 years, state pension benefits would grow more slowly. The 'Riester' pensions introduced in June 2001 gave tax-deductions for personal private pension contributions with the ceiling on maximum contributions raised year by year to 2,100 euro in 2008. There were 4 million 'Riester' contracts by the end of 2003 and more than 16 million at the end of 2015[16].

In 2002, further tax breaks to encourage company pensions were announced and employees were allowed to make direct payments into company schemes. At the end of 2001, 38 percent of employees were enrolled in private sector company pension schemes and this had risen to 46 percent by mid-2004. In 2004 it was announced that company pensions would in future make their full contribution to health and long-term care insurance. Also in 2004 the 'retirement income act' was announced, which phased in increases in taxation of income from pensions at the same time as increasing tax relief on pension contributions. To make the PAYGO system more sustainable it was also announced that, in future, pension levels would depend on the ratio of contributors to beneficiaries and some pension benefits were reduced, e.g. eliminating 'points' previously awarded for years spent in higher education. Finally in 2007, a gradual rise in the retirement age from 65 to 67 years was announced. Virtually all the changes since 2001 promoted private saving by increasing incentives and making it clear that future state benefits or the period over which they could be received would be lower[17]. It would be astounding if these reforms have not had a significant impact on the household saving rate.

In 2003-5, the Hartz labour market reforms were instituted. Key elements were drastic cuts in benefits for the long-term unemployed and tighter job search and acceptance obligations. A number of authors have suggested that the increase in income uncertainty increased saving rates, see Whang (2015) for evidence. It seems plausible that this would have contributed to a rise in household saving rates.

[16] For details refer to http://www.bmas.de/DE/Themen/Rente/Zusaetzliche-Altersvorsorge/statistik-zusaetzliche-altersvorsorge.html. Among the various alternatives (e.g. savings plan with banks, investments in mutual funds, insurance contracts), insurance contracts are by far the most popular form of a Riester contract.

[17] In 2014, parts of these reforms were turned back by the introduction of the possibility to retire already at the age of 63 under certain conditions. However, since these recent changes are beyond the period under review, they are left out here.

Mention has already been made of changes in German demography and the rise in the ratio of retirement aged population to working age population. The other really striking feature of German demography is the fact that from 1974 to 2012 the ratio of children to the adult population went from around 40 percent to about 21 percent, having reached 33.5 percent in 1981 at the beginning of our sample.

5 Empirical results for the six-equation system

The system consists of equations, in equilibrium correction form, for logs of consumption, house prices, mortgage debt, unsecured debt, liquid assets and an equation for the ratio of permanent to current income. Cross-equation restrictions apply mainly through common latent variables. The system is by estimated by maximum likelihood[18] on quarterly data from 1981Q3 to 2012Q4. General-to-specific model selection methods were used to reduce general models to more parsimonious ones, imposing zero restrictions on parameters when supported by tests of significance.

5.1 The latent variables

The five behavioural equations are potentially influenced by three latent variables: credit availability for unsecured and for mortgage borrowing and risk appetite. Increased credit availability and risk appetite should raise consumption relative to income, lower holdings of liquid assets, increase unsecured and mortgage borrowing, and raise demand for housing and hence house prices.

The unsecured credit conditions index *UCCI* is primarily specified as a linear combination of smooth transition or 'ogive' dummies for the period before 2002Q4 when the ECB's Bank Lending Survey (BLS) begins. The dummies make a smooth transition from zero to one over eight quarters with values 0.05, 0.15, 0.3, 0.5, 0.7, 0.85, 0.95, 1. We also include the change in the spread between the interest rate charged on loans and the money market rate, a proxy for the short term cost of funds. From 2002Q4, a measure of credit conditions is constructed from the data on the proportions of banks reporting tightening of credit conditions for consumer loans. The BLS reports the change in conditions relative to the previous quarter, so the cumulated value since the survey began can be interpreted as a level

[18] Using Hall et al (1991) Time Series Processor.

measure of the tightness of credit conditions. With an estimated *negative* coefficient, this levels measure of tightness turns into a measure of ease of credit availability. The estimated *UCCI* suggests an upward drift of credit availability in the 1980s, with a little burst around unification; another burst in the 1996-2000 pre-monetary union period; then a small relapse and a slight upward drift peaking in early 2008, followed by another small relapse.

For mortgage credit availability *MCCI*, a richer set of interest rate spreads, all with positive coefficients, proved relevant. These include the spreads between the mortgage rate and the deposit rate and the 10-year bund yield, measures of funding and opportunity costs. The spread between the 10-year and 1-year bund yields is also significant. Since banks tend to borrow at the short end of the yield curve and, in the mortgage market, lend at the long end, this is a more general measure of bank profitability which appears to be relevant for the willingness to extend mortgages loans. A measure of recent falls in the housing market[19] is also strongly significant. This could indicate incidence of or fear of bad loans on the part of banks, so making them less able or willing to increase mortgage supply. Given these variables, the BLS survey measure for tightness in the mortgage market is insignificant. But 10 ogive dummies are included to capture the time variation in mortgage credit conditions.

Risk appetite, whose coefficient is normalised at one in the house price equation, is modelled as a function of three economic variables and two dummies. The first economic variable is the spread between the 10-year and 1-year bund yields: in a financial crisis, a typical policy response is to bring down the short term policy rate, thus increasing the long-short yield spread. Whilst this improves the profitability of banks it also indicates the stress conditions which led to the policy decision.[20] The second economic variable captures aspects of the sovereign debt crisis in Europe: it is the deviation from its lagged 4-quarter moving average of the 10-year sovereign bond spread of Italy and Spain relative to Germany. At its peak, fears of a Eurozone break-up and of the associated turmoil would, for example, have been reflected in this measure. The third economic variable is a measure of recent falls in the Dax share price index.[21] The first dummy is 1 in 2008Q4 and -1 in 2009Q1, picking up the initial stress of the Lehman Bros bankruptcy. The second dummy is 1 in 2010Q2 and Q3

[19] Define the negative of the change in log house prices, and zero when house prices rise. The cumulated value of these negatives with a quarterly decay of 10% defines the measure of recent falls.
[20] Note the dual role of the spread: in the mortgage credit conditions index, the spread has a positive effect on credit supply, but as far as house prices are concerned, this is partially offset by the negative effect via risk appetite.
[21] The definition is exactly parallel to that of the corresponding measure for the housing market in footnote 18.

reflecting the initial impact of bad news on Greek debt, which the yield spread of Spain and Italy vs Germany does not fully capture.

The estimated functions are shown in Figure 5.1. Since long-run CCI and risk

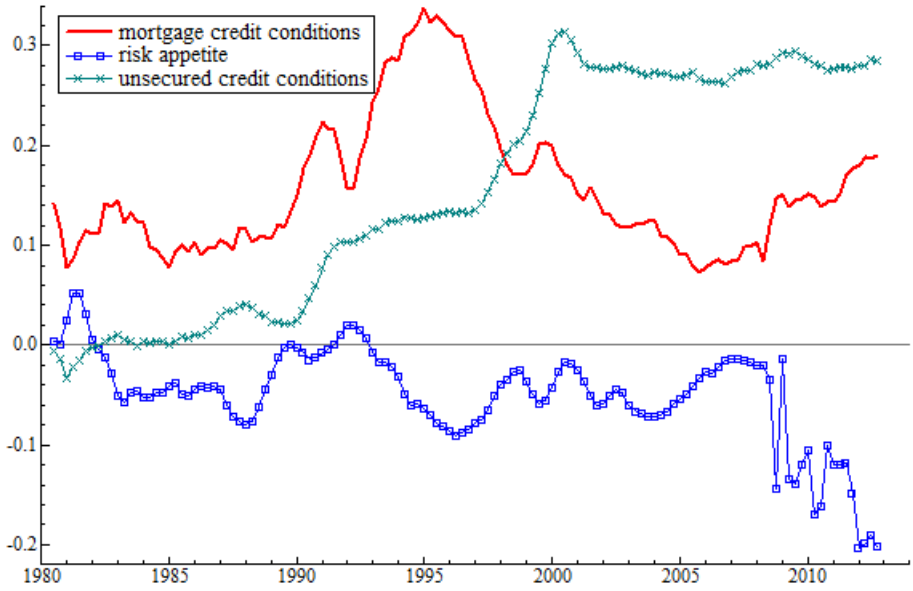

Figure 5.1: Estimated mortgage credit conditions index, risk appetite, consumer credit conditions index

appetite coefficients are normalised at 1 in the house price equation, the figure shows that the apparent easing of credit conditions since 2008 has been largely offset by reduced risk appetite, as far as the housing market is concerned. In the mid-1990s, the easing of mortgage credit conditions was only somewhat offset by lower risk appetite.

The rise in German consumer credit conditions in the mid-1980s parallels a similar but larger rise in France. Credit conditions contracted in many countries in the early to mid-1990s though little change seems to have occurred in consumer credit availability in Germany at this time. However, it was more than compensated by the expansion of mortgage credit availability, perhaps due to the expansion of the covered bond market[22]. In the late 1990s, a time of general financial innovation and also of some consolidation of German banks[23], the latent variable for consumer credit availability *UCCI* rose strongly again, and

[22] In the 1990s, covered mortgage bonds played an increasing role in mortgage finance and in 1995 German jumbo covered bonds began to be available to international investors. The legal framework for securitisation of mortgages was established only in 1997 though covered bonds have existed for over 200 years.
[23] Schlueter et al (2012) suggest that productivity growth in German banking in the late 1990s resulted in benefits to customers, for example in lower mark-ups on market interest rates, given credit risks. The market

broadly levelled out in the 2000s, while credit availability for mortgages contracted in the early 2000s. As discussed above, the failure of mortgage credit conditions to rise with those for consumer credit in the second half of the 1990s and the decline in the early 2000s were probably connected with the high incidence of non-performing loans on property in the former East Germany (Deutsche Bundesbank, 2001). Perhaps the general weakness of house prices at this time also discouraged mortgage lending. It would be interesting to relate these developments to changing bank leverage, systematic data on the ratio of non-performing loans to total loans and other features of bank balance sheets.

5.2 The consumption function

It is clear that an empirical model of German consumption needs to take into account pension reform and demography, as well as the factors set out in the credit-augmented life-cycle model of equation (3). However, the temporary tax breaks for investment in East German property are more directly relevant for house prices than for consumption.

The discussion of pension reforms suggests that the cumulative take-up rate of Riester contracts as a proportion of the working age population should be a useful proxy to measure the impact on the consumption to income ratio. We expect a significant negative effect. In 2003-4, coinciding with the Hartz reforms of the labour market, there was a fall in the consumption to income ratio that cannot be explained by the Riester measure and the other variables in the consumption function. We therefore introduce a smooth transition dummy rising from zero to one from 2003Q1 to 2004Q4, interpretable as proxy for the effects of the labour market reforms. We also allow a small effect in the opposite direction for the temporary relaxation of pension policy in 1999 by the Schroeder government by introducing a smooth dummy making the transition from zero to one from 1999Q1 to 2000Q4.

The connections between demography and the aggregate household saving rate are complex and differ according to whether or not one controls for past portfolio choices. Simple life-cycle models in which households save during the working lives and dis-save in retirement to keep consumption roughly constant are contradicted by the facts (see above). Data suggests that consumption actually tends to follow income more closely than predicted during working lives, that consumption expenditure tends to be lower in retirement so that

rates for consumer loans used in our study do not reflect this reduction in mark-ups so that the latent variable for consumer credit conditions compensates.

dissaving then is far less than simple models predict. Among reasons for the latter are uncertainty about life expectancy and medical bills in retirement[24], the inheritance motive, lower work-related expenses in retirement and the extra leisure which allows home production and time to search for shopping bargains to maintain living standards with lower money cost. Among reasons for the former are credit constraints and income uncertainty which prevent younger working households from spending as much as they would otherwise in anticipation of higher expected future income. Another reason is spending on children, which tends to coincide with higher earnings in the middle of most working lives.

International evidence is for higher saving rates among adults in pre-retirement age groups. The estimated effect here, though not very precisely estimated with t=-1.7, implies a maximum contribution to the variation in the aggregate consumption to income ratio between 1981 and 2012 of 1.1 percent[25].

In the first of two alternative formulations of the main demographic variable we include one minus the dependency ratio, the ratio of working age population to total population: the lower the latter, the higher should be the consumption to income ratio. In the second formulation, the working age population ratio is replaced by a measure of the deviation of the child/adult ratio from its generational moving average. The rationale for this measure is that in comparing steady states, an economy with a lower child/adult ratio will have a broadly similar aggregate household consumption-to-income ratio. But, in the transition to a lower child/adult ratio, falls in child-related expenditure will temporarily lower the consumption to income ratio. We represent the effect by defining the deviation between the current child/adult ratio and its moving average dated from 15 to 40 years ago. Because of income growth between cohorts, the moving average gives somewhat higher weights to more recent years. In Germany, the two demographic variables have a quite similar (sign-corrected) profile, see Figure 5.2a.

[24] Though this is likely to be a less important factor in Germany, given the public health insurance system.
[25] The variable is defined as the share in the adult population of the 45 to 59 age group plus the share of the 40 to 59 age group, implying a lower coefficient for the 40-44 age group than for those aged 45-59.

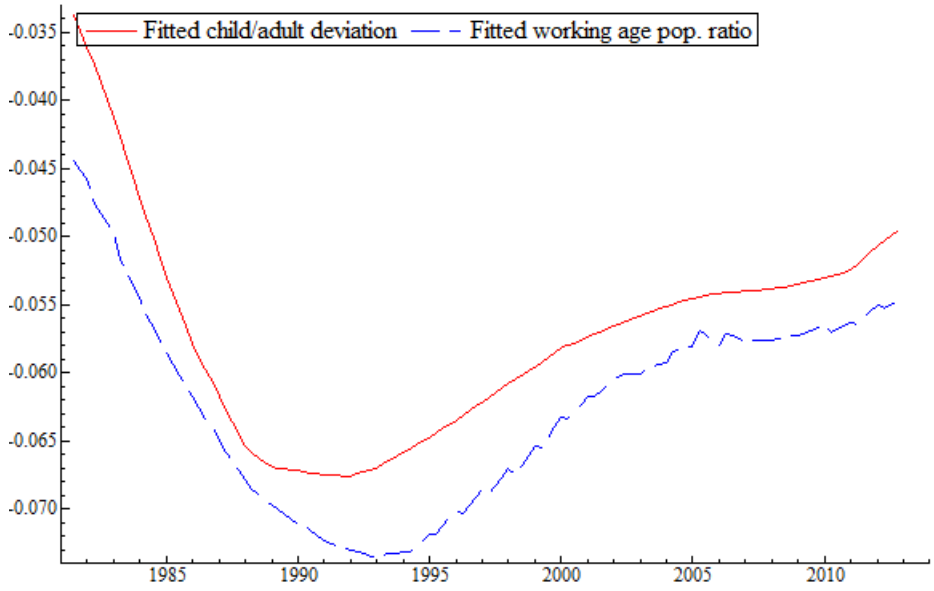

Figure 5.2a: alternative demographic formulations for the consumption function.

We report estimates below for the working age population ratio version of the model but with the addition of two more ogive dummies, extremely similar results are found for the alternative formulation using the deviation of the child/adult ratio.

Empirical results for the long-run coefficients of the consumption function as part of the six-equation system are shown in four columns of Table 5.2. Column 1 shows the full sample results while column 2 demonstrates parameter stability for a sample ending in 2005Q4. Column 3 reports results for a formulation using the moving average of the ratio to income of illiquid financial assets in the consumption function. Finally, column 4 examines full sample parameter estimates when the two credit conditions indices and risk appetite are omitted. In all specifications, the speed of adjustment of consumption to the long-run solution is high, over 65% per quarter, confirming previous findings by Hamburg et al. (2008) and other studies discussed above. This suggests a well determined long-run solution, even when credit conditions and risk appetite are omitted. Estimates of the housing market effects on German consumption are more significant when credit conditions and risk appetite controls are included. Initially, income was measured as a weighted average of text-book non-property income and household disposable income. However, it became apparent that plain household disposable income gave a better fit.[26] The very general formulation in equation (3) includes

[26] With low inflation, the classic distortions of conventional disposable income definitions are small and a PAYGO pension system makes disposable income more relevant than in text-book models where non-labour

both the housing wealth to income ratio and the log house price to income ratio. The former is completely insignificant (and with a negative coefficient) while the latter has a significant negative coefficient. This suggests the down-payment constraint dominates any wealth effect for German aggregate data.

Three real interest rate effects were introduced: the deposit rate on savings accounts as well as borrowing rates on consumer credit and on mortgages. The former has a significantly positive effect on consumption while the latter are significantly negative. The sum of the three effects is positive in all specifications, considerably more so without credit and risk controls. This suggests that a common increase in all three rates has a positive overall effect on consumption. The positive effect of real deposit rates looks unusual in the context of previous empirical work on Germany, but matches the finding of a significant positive real short term interest rate effect in the Japanese consumption function (see above).

The theoretical formulation in equation (3) used ratios of end of previous quarter portfolios to current income. In practice, using ratios to last quarter's income gives almost identical results and is slightly more convenient. The formulation of the ratio to income of illiquid financial assets was compared to one using the 4-quarter moving average of the ratio. This could be rationalized as consistent with sticky information. For the full sample, the log likelihood of the 6-equation system is slightly higher by 1.3 for the moving average formulation, shown in column 3 of the tables, which implies a higher marginal propensity to consume of 0.023 out of illiquid financial assets compared with 0.012 for the standard formulation. However, parameter stability tests show that for samples beginning in 1984 or later, the log likelihood is slightly lower for the moving average formulation. On post 1984 samples, the mpc out of illiquid financial assets is estimated at 0.016 (t=2.7), which is more in line with evidence from other countries and we impose this for the full sample.[27]

In the short run dynamics, the annual change in the unemployment rate[28] is significant for all samples for models with latent variables, and quarterly income growth is marginally significant. For the post-unification period, there is a significant negative effect

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income is just the return on assets owned by the household. The pre-1990 income measure in the current version of the paper is an improvement on the version presented at the Bundesbank conference in 2014, see data appendix.

[27] The full sample estimate of 0.0012 has a standard error of 0.006 so that a value of 0.016 is easily acceptable. See Muellbauer et al (2015) for Canada, Chauvin and Muellbauer (2013) for France, and Aron et al (2012) for the UK and US.

[28] In countries such as Germany and France with high replacement rates, changes in the unemployment rate tend to matter a little less for consumption than in countries such as the US, UK and Australia, see Aron et al (2012) and Muellbauer and Williams (2011) for evidence on these countries.

of the previous year's consumption growth, perhaps reflecting the negative effect on durable expenditures of durable stock accumulation. Impulse dummies capture outliers during the unification period, anticipation effects of VAT rises and two other outliers.[29]

The estimated size of the controversial house price to income effect depends on whether the specification is from the equation system incorporating or excluding the latent variables for credit conditions. For the latter, see column 4 of Table 5.2, the effect is negative but insignificant; for the inclusive system, which also produces betters fits for the consumption function as well as all the other equations, the effect is estimated to be in the range -0.057 to -0.070, in the results reported below. The estimated parameters are stable running from 1987 to 2012, or from 1981 to 2005, see column 2. However, given the relatively low range of variation in the German data compared to other countries, one needs quite a long sample to obtain sensible empirical identification of the model.

The consumption effect of the latent variable representing (non-mortgage) consumer credit conditions is estimated at 0.025 and 0.021 for the two alternative formulations of the ratio to income of illiquid financial assets. The estimates of the mortgage credit conditions effect are rather more significant, respectively 0.092 (t=7.7) and 0.089 (t=6.8). Section 2.1 suggested that, given the economic interpretation of the mortgage credit conditions index as a measure of the down-payment constraint, a less severe constraint (higher *MCCI*) should result in a less negative coefficient on house prices relative to income. It was also suggested that income growth expectations should matter more under a less severe constraint. Both the implied interaction effects are estimated to be positive, with t-ratios of 1.0 respectively. This is circumstantial evidence in favour of the interpretation of the latent variable as a credit conditions index. However, as neither interaction effect is significant, they are omitted in the interests of parsimony. Risk appetite is not significant (t=0.9), perhaps because German households own substantial liquid asset buffers.

The column 1 estimates suggest that pension reforms from 2001, had by 2012 lowered the consumption to income ratio compared to 1998 by 2.7%, and the labour market reforms of 2003-5, lowered the ratio by 1.5%. The alternative formulation of the ratio to income of illiquid assets suggests slightly lower figures of 2.5% and 1.3%, respectively. In

[29] These are in 1987Q1 and 1988Q1. The VAT dummies capture forward shifting of expenditure just before announced rises in VAT. They operate in 1983Q2, 1992Q4 and 2006Q4. The dummy takes the value of 1 in the quarter before the rise and then -0.25 in the four quarters following. In 1992Q4 there may also have been forward shifting of expenditure in advance of rising import prices after the ERM re-alignment of Sept 1992.

column 4, omitting the latent variables for consumer credit and risk appetite, the estimate of the pension reform effect is lower at 1.4% and the labour market reform effect is 1.5%.

To obtain an idea of the empirical magnitudes of the estimated effects, Figures 5.2b to 5.2d, show the fitted components of the long run solution for the consumption to income ratio using column 1 estimates. Figure 5.2b plots the contribution of the two latent variables proxying credit conditions, of the ratio to income of net liquid assets and of the composite of real interest rates on deposits and on borrowing. The build-up of debt in the late 1990s,

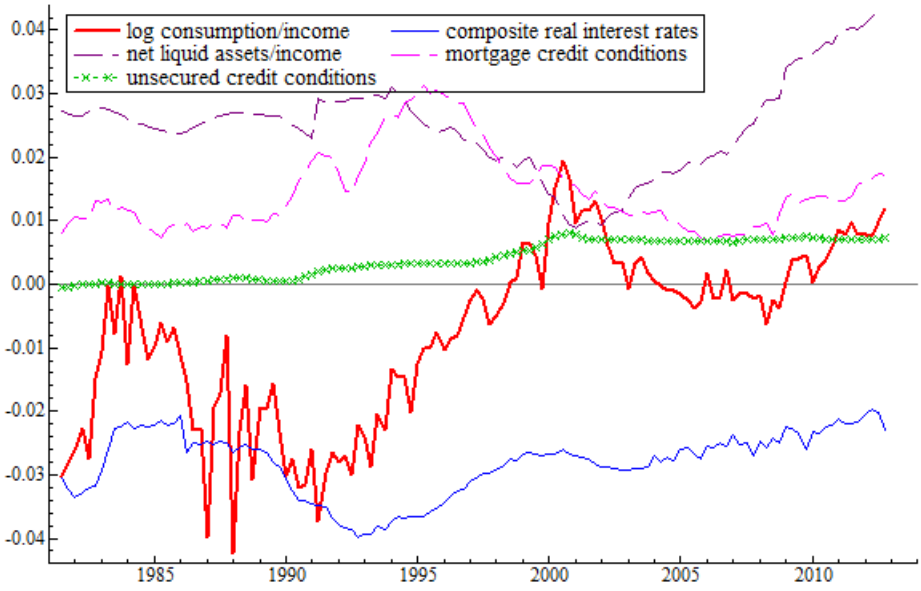

Figure 5.2b: Effects of mortgage and non-mortgage credit conditions, net liquid assets/income and real interest rates on log consumption/income in Germany.

associated with a decline in the saving rate, reduced the ratio of net liquid assets to income, which had a dampening effect on spending, but offset by the, albeit moderate, credit liberalization of the time. The accumulation of net liquid assets since around 2000 has had a pronounced effect on the consumption/income ratio. This is part of a stock feedback effect in which saving rates tend to stabilize. The implied marginal propensity to spend out of net liquid assets, at around 0.095 (from Table 5.2, column1) is not far from propensities for the UK and the US, and a little above those for Japan, reported in Aron et al. (2012). This may be because of the high proportion of not quite so liquid term deposits in Japanese household liquid assets.

It is clear that overall, the credit conditions proxies only account for relatively small parts of the variation in log consumption/income, though they do help explain buoyancy in 1997-1999 and offset negative tendencies from demographic change and the decline in

expected income growth in the mid to late 1980s, see below. Over the sample as a whole, the moderate expansion of the two types of credit availability results in variations in the consumption to income ratio of only around 2.5 percent in total. Since both latent variables are modestly trending over time, it is not surprising that when they are omitted, one can still obtain a well-fitting consumption function for Germany, see further discussion below.

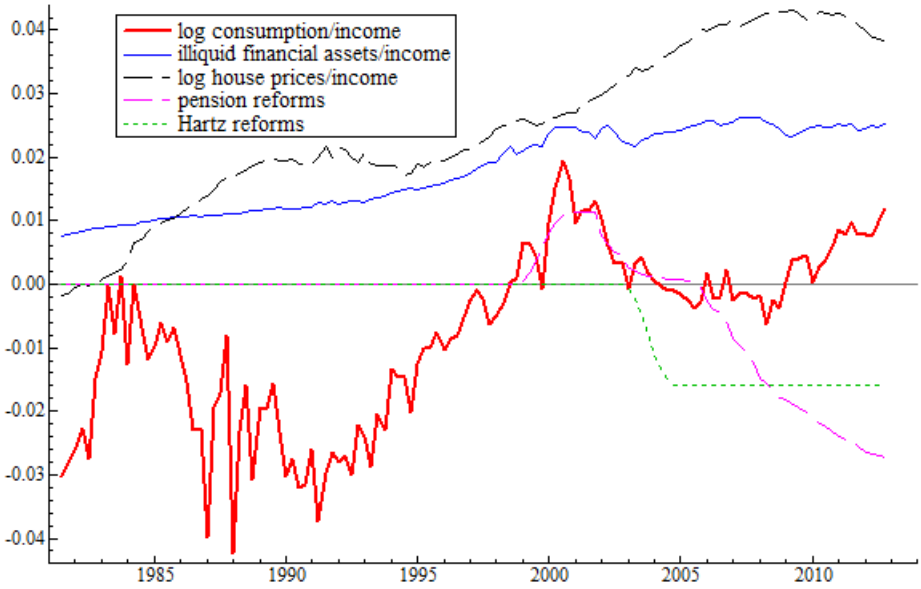

Figure 5.2c Effects of illiquid assets/income, house prices/income, pension reforms and Hartz reforms on log consumption/income in Germany.

Figure 5.2c displays the long-run effects of the log ratio of house prices to income and of illiquid financial assets/income, both showing upwards trends: as German housing has become more affordable relative to income, potential first-time buyers needed to save less and renters could be less apprehensive about future rent rises. The figure also shows the estimated effects of the Riester pension and Hartz labour market reforms, discussed above. They look quite large relative to the variation in Germany in log consumption/income and are substantially offset by other tendencies – the positive effects of financial wealth accumulation and of more affordable housing. The rise in financial wealth relative to income over time is, of course, related to relatively high saving ratios for Germany as well as, to a minor extent, equity price movements.

Figure 5.2d shows the contributions of ratios to income of the fitted ratio of log permanent to current income, demography and of unification.

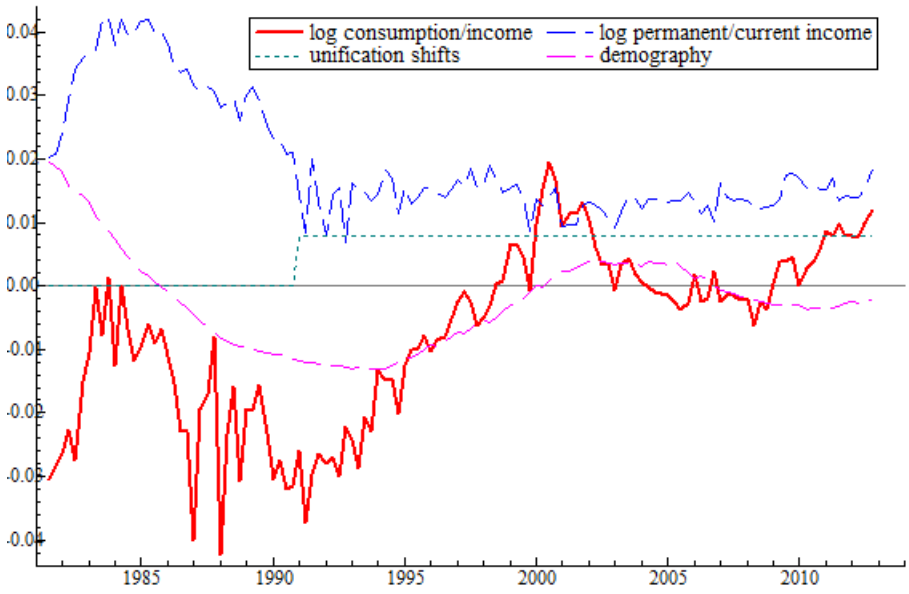

Figure 5.2d: Effects of log permanent to current income, demography and unification on log consumption/ income in Germany.

The coefficient on the log ratio to current income of fitted permanent income is around 0.35 or 0.36 instead of the 1 implied by the simple text-book model. This looks consistent with German households' fairly restrictive access to credit and, for aggregate data, with the PAYGO pension system which tends to link pension levels with current income. Declining income growth expectations in the 1980s help explain the fall in consumption/income at the time. Since permanent income remained fairly steady in the recent recession, the rise in the ratio of permanent to current income helps marginally to explain the rise in the consumption to income ratio since 2008.

In the 1980s, the increase in the fraction of the population of working age (decline in the dependency ratio) had made a notable negative contribution to consumption/income: this effect bottoms around 1990 and then reverses slowly. The effect of changes in the proportion of adults in the higher saving groups aged 40 to 59 is to dampen what would otherwise have been a positive demographic effect from the rise in the dependency ratio from the early 2000s. The unification dummy effect is small and positive and is probably a mix of correcting for measurement bias and structural shift.

5.3 The house price equation

The German data on house prices, which come via the OECD, are based on interpolation of annual averages.[30] This means that the house price model set out in equation (13) needs to be converted into a model for annual averages. In the dynamic version, the dependent variable is then the annual change in logs and the lagged level will be at a 4-quarter lag and all independent variables appear as 4-quarter moving averages, corresponding to the construction of the house price data. The equation residuals will necessarily be positively auto-correlated.[31] The coefficient on (minus) the log level of real house prices lagged 4 quarters, the annual speed of adjustment, should be far higher than for a quarterly specification.

Empirical results are reported in Table 5.3. The point estimate of 0.59 in col. 1 implies a quarterly speed of around 0.20. This is the result of the fact that if this is the quarterly speed of adjustment, then the annual speed is 1- (1-s).[4] The coefficient on income per house is 1.21 in col. 1, 1.18 for the short sample in col. 2 and 1.20 in column 3, somewhat below international evidence broadly in the 1.4 to 2.4 range. This implies estimates of minus the price elasticity of the demand for housing of 0.81. We can accept the hypothesis that the income elasticity is one.

The coefficient on the mortgage credit conditions index is normalized at one in the house price equation and freely estimated in the other equations. It is important to control for the effect on house prices of the above mentioned tax breaks announced in 1991 and finally withdrawn in 1998 for investors in the former East Germany. Failure to do so would lead to mis-interpretations of the latent variable. The tax effect is represented by 3 smooth transition 'ogive' dummies (going from 0 to 1 over eight quarters) with a positive coefficient in 1992, and negative in 1995 and 1997, so that their sum is zero. Identification in the system comes from the assumption of a zero effect on consumption. Without such a restriction, separate identification from the latent variable would be near impossible. Then it turns out that the effect on the mortgage stock is small and insignificant and can also be set to zero. The

[30] Official quarterlydata on aggregate house price developments (for owner-occupiers) at the time of writing only start in the early 2000s.We therefore decided to use the OECD estimates (see data appendix). While the main data source is the same (bulwiengesa), the OECD series contain some differences in the underlying sample of regions considered. However, using the bulwiengesa data for Germany post-unification instead of the OECD series produces very similar parameter estimates.

[31] International panel studies of house prices which neglect the fact that some data are interpolated moving averages based on raw annual data and some data are genuine quarterly data, risk specification error, given the distortions in the short term dynamics.

estimates suggest that house prices were driven up temporarily by 5 to 6%, other things equal. Since the tax break increased supply, which has a negative effect on house prices, the net effect of the intervention in the long run after the removal of the tax break would almost certainly have been negative for house prices.

Investigation of possible transfer tax effects on house prices found no long run effect and a negative but insignificant short run effect. Since the mortgage stock and consumption equations confirmed the lack of significance of transfer tax, it was not included in the system. As the discussion of local property taxes in Section 4 made plain, their lack of connection with house prices and the fact that they are already netted out of disposable income implies that they should play no distinct role in a house price equation.

Our evidence supports previous findings that for German house prices, it is the nominal interest rate rather than a real rate which is more relevant[32]. This suggests that the affordability constraints exercised by German mortgage lenders, which focus on debt service costs have a powerful influence on house prices. The coefficient on the log nominal mortgage rate is -0.12, a little lower than the estimate for France.

While a user cost variable is not significant, a momentum expectations effect still matters for Germany. There is considerable evidence that there is an important extrapolative element in expectations of future capital gains in housing, see Duca et al (2011) and Chauvin and Muellbauer (2013), who find that a four year memory is relevant for the US and for France. Checking weights in a weighted average of one-year and four-year appreciation, we can accept the hypothesis of a four-year memory also for Germany. Thus, home price appreciation over the previous four years has a positive effect on current home prices. The evidence suggests that there is a negative spill-over effect from home price appreciation in southern Eurozone countries, for which an average for Spain, France and Italy is a taken as a proxy. The estimates suggest that German 4-year appreciation *minus* foreign appreciation is the relevant measure. However, with monetary union, the relevance of this measure has increased: indeed the measure is not significant before monetary union.

One interpretation of such an effect is that German and international property investors, as well as recent or potential migrants, took advantage of the external house price boom to invest in parts in property abroad rather than in Germany. Until 2008, the external home price boom attracted investors and diverted funds outside the German real estate sector

[32] If the log nominal rate is replaced by the real rate, the fit is less good though the interest rate is still strongly significant.

due to more favorable (expected) return opportunities and so contributed to the weakness of German house prices. After 2008, when external home prices began to fall and Germany looked a safer bet for property investment, the situation reversed, and external weakness contributed to the rise in German house prices. What is unclear is the role played by German households as opposed to other investors or financial institutions in this mechanism. The spill-over effect on German mortgages, discussed below, is small in the period under review, but this may just mean that property investors mainly used cash or other assets or local mortgages to finance their purchases.

The house price model does not include the log ratio of permanent to current income, which freely estimated would have a negative but not quite significant coefficient. A negative effect could be interpreted through the 'saving for a rainy day' motive. German landlords have traditionally invested for income streams from rents since historically there was little capital appreciation. If income growth expectations fall, investors might put more capital into housing as a way of protecting future income streams.[33] Demographics are represented by the change in the proportion of the population aged 25 to 44 and by the same formulation of the working age population ratio or child/adult ratio as discussed for the consumption function in the previous section. This makes sense since the derivation of the house price equation as an inverted demand model should have common elements with the derivation of demand for other goods.

In the short run dynamics there is a small effect from the rate of acceleration of the population, and variations in risk appetite are important[34]. The general inflation rate has a negative effect on house prices, as in the mortgage stock equation discussed next, possibly proxying interest rate expectations. Finally there are some short-run dynamics in home prices: if home prices rose strongly one year ago relative to the year before, there is some negative feedback on current prices.

[34] The house price equation was chosen for the normalisation of the coefficient on risk appetite at one.

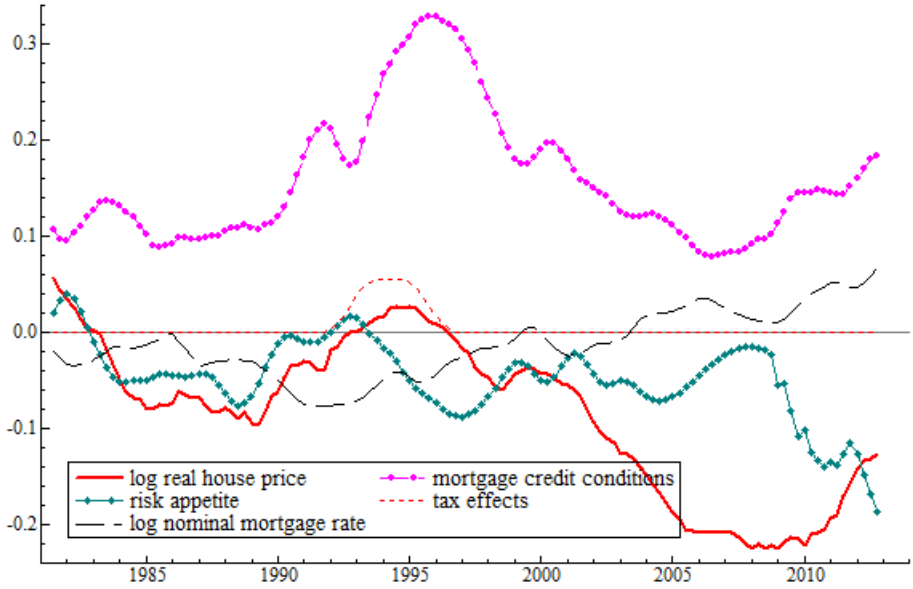

Figure 5.3a: Decomposing the long-run solution for log real house prices: mortgage credit conditions, risk appetite, 1990s tax break and log mortgage interest rate.

Figure 5.3a decomposes the long-run solution for log real house prices into the contribution of mortgage credit conditions, risk appetite, the effect of the 1991-8 tax-break and the effect of the log nominal mortgage rate. As noted in section 5.1, lower risk appetite partially offsets easier mortgage credit conditions, most clearly after 2008. Lower mortgage rates contribute an upward trend to the log house price to income ratio since the early 1990s.

Figure 5.3b decomposes the rest of the long-run solution into the contribution of log income per house, the change in the proportion of adults aged 25 to 44, and demography as measured by the ratio of working age to total population. The role of the spill-over effect measuring momentum in German house price appreciation relative to an average of France, Spain and Italy since monetary union is pronounced. As noted above, empirical tests suggested that before 2000 such an effect was not significant, perhaps because mortgage availability in France and Spain was more restricted, or because outside real estate investors were less important before the arrival of the euro. Demography is a composite of the population proportion of working age, with a negative coefficient, and of the change in the ratio of those aged 25 to 44 to the number of adults. The effect bottomed in the late 1990s and since then has trended up. Finally, log income per house has a downward trend since 1981: unlike the UK, Germany released a great deal of land suitable for housing since 1981.

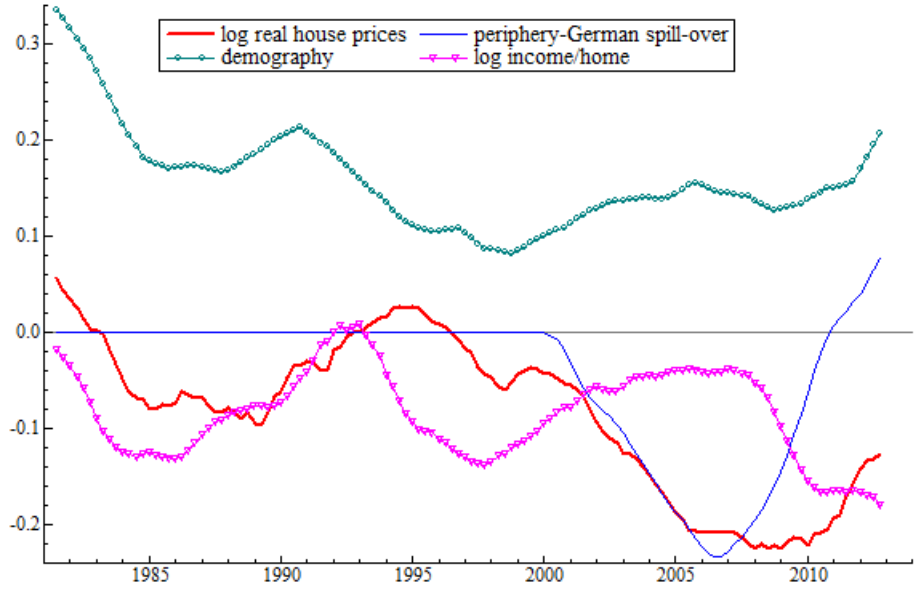

Figure 5.3b: Decomposing the long-run solution for log real house prices: the periphery spill-over, demography and log income per house.

Figures 5.3a and 5.3b throw some light on the question of risks of over-valuation of house prices in Germany. Muellbauer (2012) discusses the general issue and highlights two kinds of risks: overshooting due to extrapolative expectations and the risk of fragile fundamentals. For Germany, the non-fundamental momentum effect resting on the extrapolation of relative appreciation in the previous 4 years shown in Figure 5.3b is a potential risk: while the German boom continues, house prices in Spain have only just begun to recover while for France and Italy they are falling. However, the risks of German fundamentals turning negative seem relatively small: buoyant immigration suggests that the income per house factor shown in Figure 5.3b should be supportive of higher house prices, as should the evolving age structure of the population. The fundamentals shown in Figure 5.3a should also be supportive: risk appetite has almost certainly improved since 2012 and mortgage rates have fallen further, while credit conditions are unlikely to have retreated. The ECB's policy stance signals that these supportive conditions should continue for several years into the future. Removing the non-fundamental momentum effect, the estimated fundamentals suggested German house prices at the end of 2012Q4 were about 5 percent below the fundamental value.

5.4 The mortgage stock equation

The coefficient on the mortgage credit index is estimated at 0.46 and 0.47 for column 3.The long-run solution for log mortgage stock/income has a single interest rate, the log nominal mortgage rate. The coefficient of -0.17 or -0.18 is a little lower (in absolute size) than estimates for France in Chauvin and Muellbauer (2013) and for the UK in Fernandez-Corugedo and Muellbauer (2006) and other studies of the UK mortgage market. The real mortgage rate or user cost proved insignificant as additional regressors, suggesting that cash flows were the dominant concern of housing investors. If the log nominal rate is replaced by the real rate, the effect is significant, but the fit is less good. Higher risk appetite increases the mortgage stock, as it does house prices. The evidence is that mortgage demand in Germany has an income elasticity of about 1.34, like that of the demand for unsecured debt and liquid assets. The effect of total financial wealth relative to income is negligible. The effect of log house prices/income is negative while that of log housing wealth/income is positive, paralleling similar effects found for France. The interpretation is that when down-payment ratios are high, some people are excluded from the mortgage market by high house prices relative to income. This interpretation is confirmed by the inclusion of an interaction effect of *MCCI* with log house prices/income: this is positive and significant, indicating that as the down-payment constraint eases, the set of borrowers expands.

The spill-over effect of recent appreciation of house prices in Spain, France and Italy relative to Germany on domestic mortgages is small compared to its important role in influencing house prices, and not very significant.

The most important demographic effect is the proportion of adults in the 30 to 49 age bracket, though the 25 to 44 age group was more relevant in the house price equation. This is consistent with the fact that the average age of German first-time entrants to owner-occupation is 35 and entry to landlord status fits an even older age bracket.

There is one more important element in the long-run solution, a pension reform effect. The pension reform effect goes in the same direction as for consumption, though, a priori, the sign of the effect was unclear. The implication is that in the face of declining pension benefits and increased saving incentives, households are more wary about taking on long-term debt. The pension effect did not appear in the house price equation[35]. Thus, if investment in

[35] The point estimate has the opposite sign in the house price equation than in the mortgage stock equation, though not significant.

housing is to be a feature of private provision for retirement, it seems that German investors prefer to make it via cash injections rather than debt.

The speed of adjustment of around 0.10 per quarter is close to that for Canada in Muellbauer et al (2015). Short run dynamics include the inflation rate with a negative coefficient, perhaps a proxy for higher future interest rates. Before 1991, the mortgage stock data are quarterly interpolations of annual data and this distortion of dynamics is corrected for in the pre-1991 part of the equation. From 1991, there is a pronounced seasonal pattern in the data captured by post-1990 seasonal effects. A few impulse dummies remove large outliers, especially around unification.

A decomposition of the long-run solution similar to that shown for the other equations is visually problematic. Since the speed of adjustment for the mortgage stock is so much lower than for the other variables, the log mortgage stock to income ratio would lag years behind the long-term drivers. Therefore, we adjust the plotted dependent variable by adding the log change in the nominal mortgage stock, divided by the speed of adjustment, to the log mortgage stock to income ratio, and also adjust for the estimated seasonal factors. Figures 5.4a and 5.4b decompose this adjusted long-run solution.

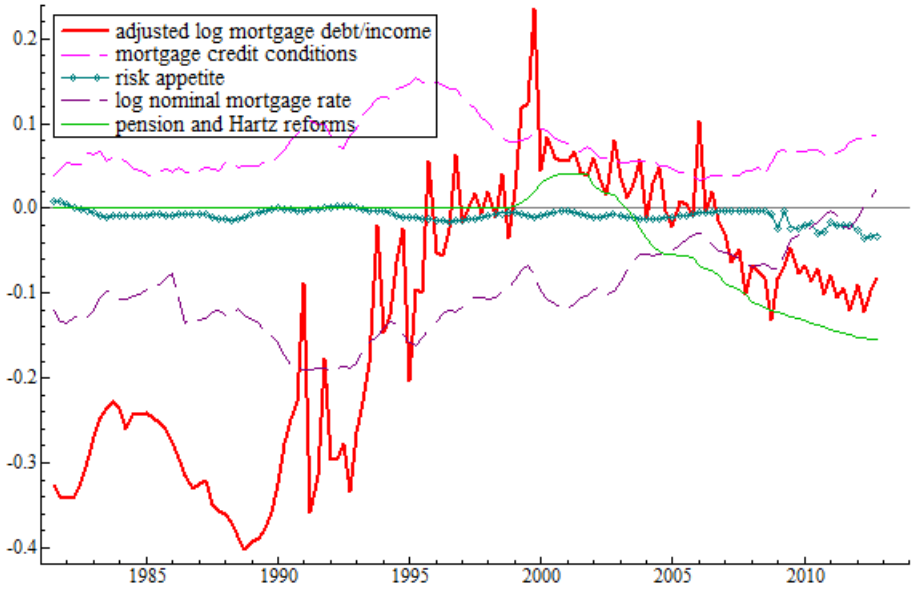

Figure 5.4a: Decomposition of adjusted long-run solution for log mortgage stock/income: mortgage credit conditions, risk appetite, the mortgage interest rate and pension and labour market reform.

The mortgage credit conditions index explains some of the rise in the mortgage to income ratio from the late 1980s to the mid-1990s, with a partial reversal in the 2000s discussed in section 5.1. Variations in risk appetite provide a small offsetting effect. The composite effect of the ratios to income of house prices and the housing wealth imply an upward trend for the mortgage to income ratio, as do the falls in mortgage rates from the early 1990s. A major reason for the decline in the ratio of mortgages/income after 2000, so different in Germany from so many other countries, seems to lie in pension and labour market reforms. As noted above, the Riester pension reforms created incentives for pension savings and probably reduced saving for a housing down-payment, so reducing mortgage demand. Increased income uncertainty may also have reduced the desire to take on debt. Figure 5.4b shows that given an income elasticity of 1.34, higher real per capita income contributed to the rise in mortgages/income, but rising housing wealth/income, though partially offset by higher house prices/income, accounts for even more of an upward trend. Offsetting this was an important demographic effect, the increasing share of adults in the pre-retirement age group, which as Figure 5.4b suggests, accounts for some of the post-2000 decline in the mortgage stock/income ratio as well as part of the late 1980s dip.

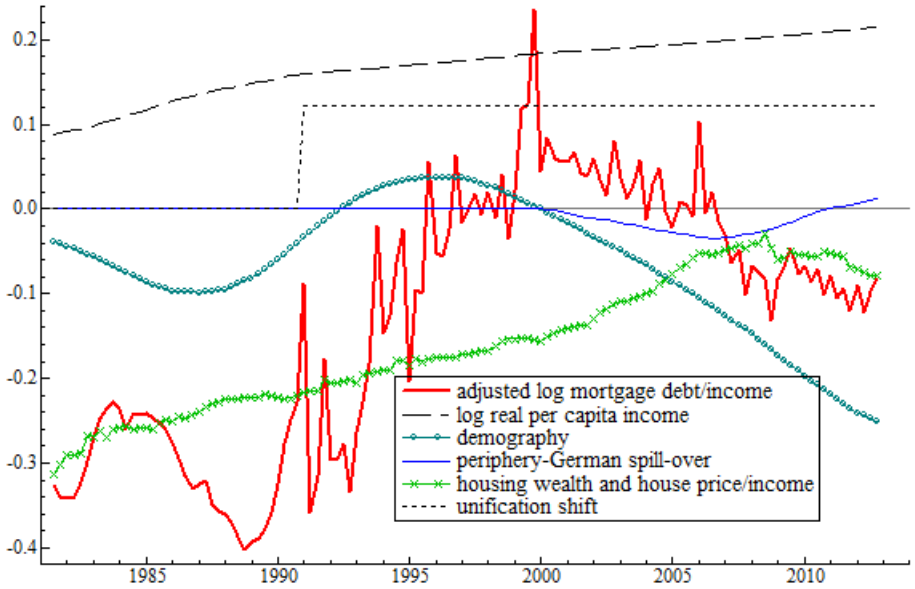

Figure 5.4b: Decomposition of adjusted long-run solution for log mortgage stock/income: log real per capita income, demography, the periphery house price spill-over, combined housing wealth/income and house prices/income, and unification.

5.5 The consumer credit equation

The latent variable for consumer credit conditions enters with a coefficient normalised at 1. The shape of the latent variable suggests two phases of easing of credit conditions, one in the late 1980s and the other in the late 1990s with a small reversal in between. The level of the real interest rate has a negative coefficient, as does the log of the nominal rate, though the latter is less significant.

The short-term financing purpose of household spending by consumer credit is represented by the composite long-run solution for the consumption equation. The coefficient on this composite term, freely estimated, is close to 1, and this natural restriction was imposed.

The equation includes the log ratios to income of housing wealth and house prices, the former with a positive coefficient and the latter with a negative one. It is possible that many durables financed with unsecured credit, such as furniture are complementary to housing expenditure. When housing becomes more expensive, the derived demand for unsecured credit would then diminish. Demography is also important in the form of the proportion of adults aged 25 to 44 and the proportion aged 60 or over, the former positive, the latter with a negative coefficient.

The speed of adjustment is high, at 46% per quarter, suggesting that much of unsecured credit has short duration. Short-term influences include the change in the unemployment rate with a *positive* coefficient, consistent with the use of consumer debt as a buffer stock to sustain consumption in temporary downturns in income. The inflation rate has a negative effect, probably proxying interest rate expectations.

The next two figures decompose the long-run solution for log consumer credit/income. Figure 5.5a suggests that two phases of easing of credit constraints explain much of the rising time profile of consumer credit/income to around 2000. There is remarkable stability in the composite, imported from the consumption equation, of wealth, house price, income growth expectations and pension reform variables, and also in the effect of the real interest rate on unsecured borrowing. We can accept the hypothesis that the income elasticity of unsecured debt is similar to that for the mortgage stock and for liquid assets at around 1.34, and imparts an upward trend to log consumer credit/income. However, Germany has a very different post-2000 profile of consumer debt to income than Anglo-Saxon economies where the ratio rises strongly and, even in France, the ratio is stable after 2000 rather than falling sharply as in Germany. It seems highly implausible that a huge

contraction in credit conditions unique to Germany could have accounted for the decline. However, demography provides the answer, see Figure 5.5b.

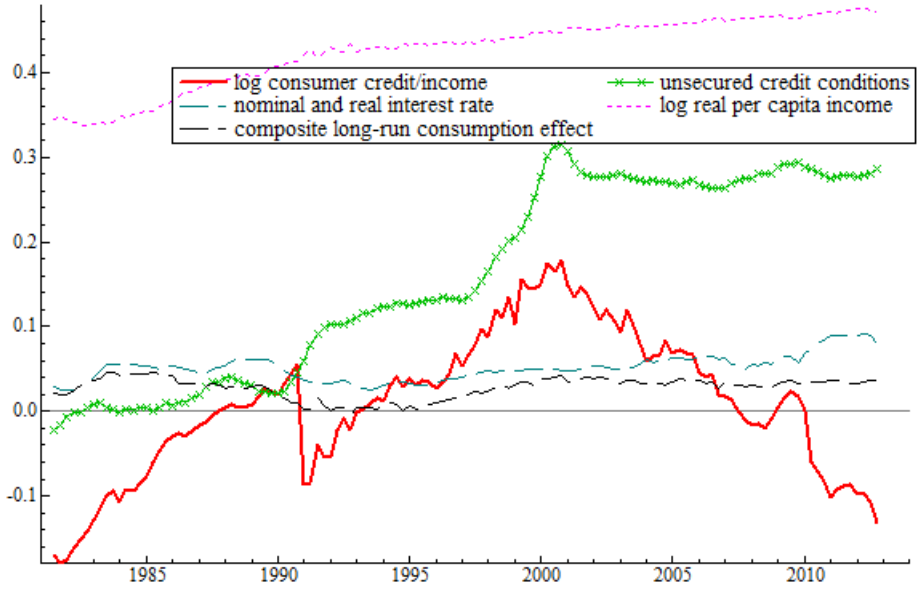

Figure 5.5a: Decomposition of long-run solution for log stock of consumer credit/income: credit conditions, real interest rate, income and composite consumption function effect.

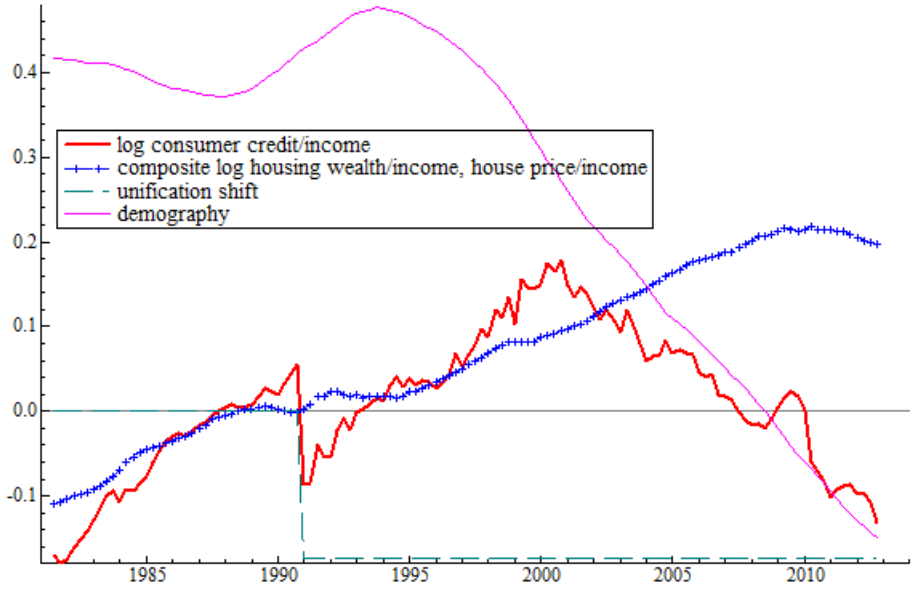

Figure 5.5b: Decomposition of long-run solution for log stock of consumer credit/income: housing wealth and house prices relative to income, unification and demography

Retired people generally do not use consumer credit so the trend rise in the proportion of adults over 60 helps accounts for the later decline in consumer credit/income. Even more important is the evolution of the proportion of adults in the 25 to 44 age group, the group most likely to use unsecured borrowing. This rose from the mid-1980s to the latter half of the 1990s and then fell away sharply, more than offsetting the positive forces from lower interest rates and housing wealth/income shown in Figure 5.5a.

5.6 The liquid asset model

The liquid assets equation has a well-determined long run solution with plausible interest rate effects, both on the own-rate and for the difference with the bond yield. The scale elasticity is 1.34 (constrained to be the same for mortgages and unsecured debt). The strong effect of housing wealth found by Greiber and Setzer (2007) and others is confirmed. What is really new are the estimated effects of the two credit conditions indices, highly significant and negative, especially for unsecured credit, consistent with a buffer-stock interpretation of liquid assets: as access to credit improves, households hold fewer liquid assets. Risk appetite has a negative effect: an increase in risk aversion thus leads to greater saving in liquid form, thereby confirming the results of Deutsche Bundesbank (2015). In addition, a measure of downside risk in equities has a strong effect on liquid saving, accounting for a substantial surge after the collapse of the dotcom bubble after 2001. Demography is also relevant: a higher proportion of adults in the high saving age groups between 40 and 59 is associated with higher levels of liquid assets.

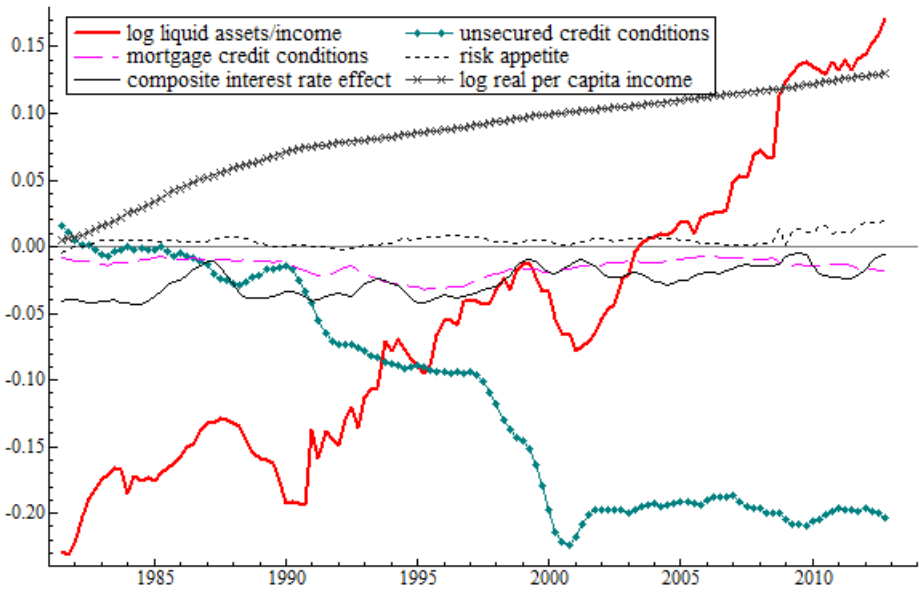

Figure 5.6a: Decomposition of long-run solution for log stock of liquid assets/income: unsecured credit conditions, mortgage credit conditions, interest rate effects and income effect.

Figure 5.6a shows the strong negative effect on liquid assets holdings of increased availability of unsecured credit, and much smaller parallel effects of increased mortgage availability and greater risk appetite. The upward trend in real per capita income accounts for some of the positive trend in liquid assets/income and a small contribution also comes from interest rates, mainly the decline in the spread relative to bond yields.

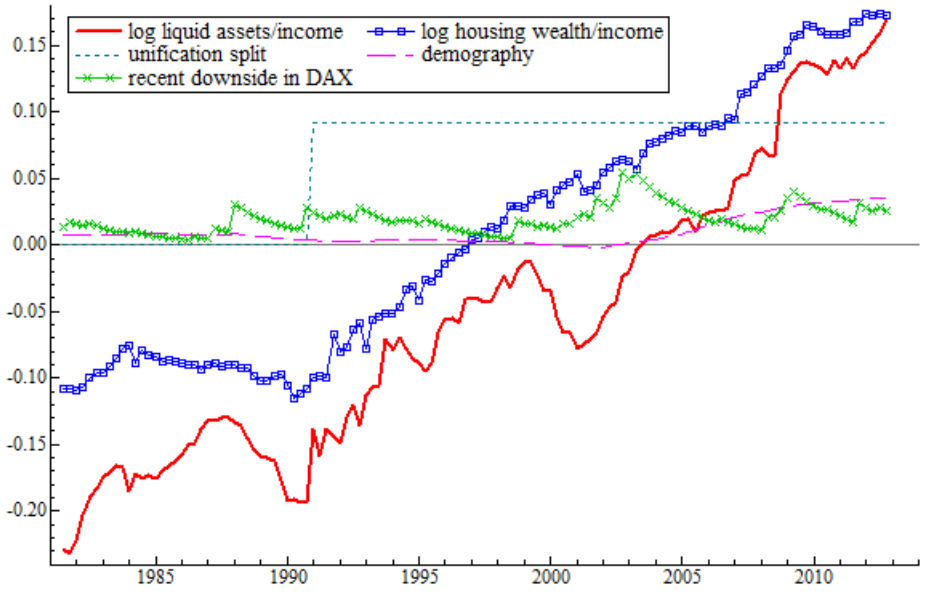

Figure 5.6b: Decomposition of long-run solution for log stock of liquid assets/income: log housing wealth/income, unification, demography and downside stock market indicator.

Figure 5.6b shows the major estimated source of the upward trend in liquid assets/income, namely housing wealth/income, confirming findings of other recent studies. A small contribution also comes from demography – the rising share of adults in the high saving pre-retirement age group. The size of the effects of recent falls in the stock market, for example after 2001 and after the recent financial crisis can also be seen in Figure 5.6b.

The speed of adjustment of liquid assets stocks is fairly rapid at 28% per quarter. In the short-run dynamics, an increase in the unemployment rate leads to a run-down in liquid assets, more evidence for the buffer stock role of liquid assets. The pre-unification switch in short-term dynamics resulting from the use of interpolated data is taken into account.

5.7 The permanent income forecasting model

The construction of log ratio of permanent to current income was set out in equation (2). To fit a forecasting model, we have to make some assumptions of what happens to per capita real income growth beyond the end of the sample. We take actual data to 2015Q3 and then adopt forecasts from Oxfordeconomics.com.

The dependent variable is log permanent/current income. This is explained by the deviation of log current income around some trending variables and by forward looking consumer confidence and a few economic variables. The key trending variables are a linear trend and the log ratio of working age to total population. Since income is per capita, one would expect a falling ratio of working age population to the total population to reduce future income and this effect is highly significant. The most important of the economic variables is, of course, log current per capita income since temporary falls in income relative to trend will raise expected income growth relative to current income. The other variables include a real interest rate and log real oil prices with the expected negative coefficients, consumer confidence and log real equity prices with positive coefficients.[36] Changes in German long-short spreads, a (negative) measure of risk appetite, which also appears in the equation for risk appetite, have the expected negative sign. The lagged inflation rate appears with a negative sign, possibly as an indicator of interest rate expectations or measuring a short term effect of higher inflation on real income growth. The equation also includes a smooth dummy for 1999 to capture some of the euphoria of the time which does appear to translate into a more persistent increase in growth expectations. The fitted log ratio of permanent to current income, and the two components, fitted log permanent income and log current income are shown in Figure 5.7 below. The fit of the equation is remarkably good with an equation standard error of only 0.0018, though the residuals are, of course, massively auto-correlated.

[36] The relationship with log real house prices was not stable and this variable was therefore excluded.

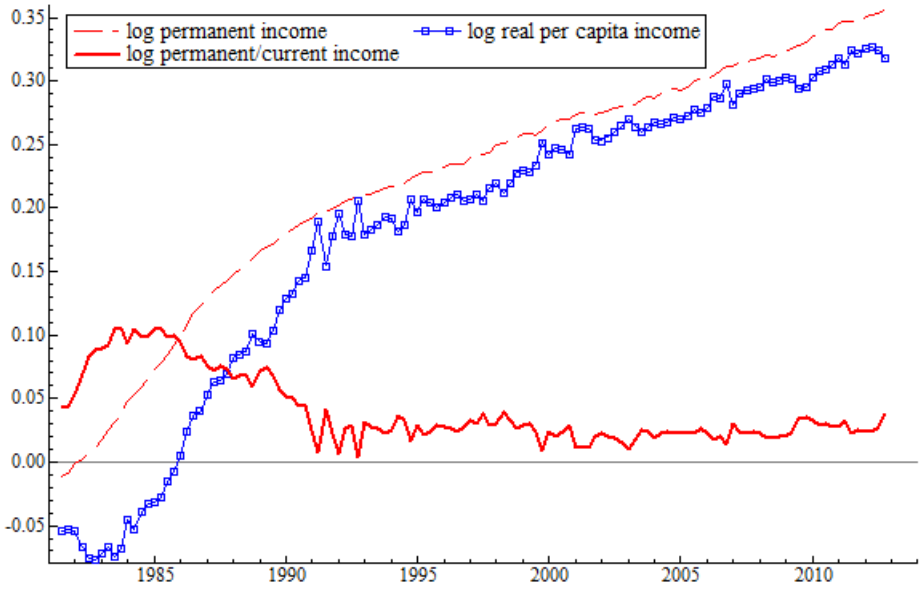

Figure 5.7: fitted log real per capita permanent income, log current real per capita income and fitted log permanent/current income.

5.8 The system without credit conditions and risk appetite

It is interesting to consider the impact on the six-equation system of omitting the two credit conditions indices and the expression for risk appetite. Unsurprisingly, all equations fit less well, with the largest deterioration in the house price equation. What is worse, economic interpretability becomes problematic in some equations and speeds of adjustment drop. To give the model the best chance of making economic sense, some data-based parameter restrictions imposed on the full model were re-tested and relaxed where required. The most important of these was the level proportion of adults aged 25 to 44 in the house price equation, which now becomes very significant. Another concerns the log house price to income ratio in the liquid assets equation which is now significant. The third parameter to be relaxed (from a value of 1) was the coefficient on the long-run consumption solution in the unsecured debt equation. However, the freely estimated value greater than 5 is wildly implausible and the value was therefore set at 2, see further discussion below. In the house price equation, the long-run elasticity of house prices with respect to income per house falls to an implausibly low freely estimated value, implying an implausibly high price elasticity of demand for housing of around -2. We impose an elasticity of 1 for a better economic interpretation.

We now discuss the results shown in the respective column 4 of the tables. Beginning with the consumption equation, the most notable differences are the lower speed of adjustment at 0.65, the far weaker negative effect of the log house price to income ratio but stronger net positive effects of real interest rates, the smaller demographic effect, and stronger financial wealth effects both from net liquid assets and from illiquid financial assets. The estimated pension reform effect is smaller than in the full model at 1.4% but the labour market reform effect is similar at 1.5%. The equation standard error is 19% higher than for the full model. The relatively moderate increase reflects the fact that shifts in credit conditions in Germany had moderate effects on consumption. The weaker negative house price effect can be interpreted as the effect of omitted variable bias: if shifts in mortgage credit conditions which explain part of house price appreciation are omitted from the model, then the coefficient on house prices will be biased up, in other words, be less negative. The sum of real interest rate coefficients is 0.182 as compared with 0.025 in the full model shown in column 1. It seems as though the data are compensating for the weaker 'perverse' monetary transmission effect working indirectly via house prices by increasing the size of the estimated 'perverse' transmission via real interest rates directly.

Aron and Muellbauer (2013) find that for South Africa, the omission of the credit conditions index destroys the long run solution for consumption completely since the index is both important for consumption and also uncorrelated with other variables in the consumption function. For the US, Canada and UK, fit, parameter stability and adjustment speeds deteriorate sharply when credit conditions are not included, but for Japan, where there seems to have been little variation in household credit conditions, a stable and well-fitting consumption function is found without trying to control for credit conditions, see Aron et al. (2012). For France, see Chauvin and Muellbauer (2013), the speed of adjustment halves when credit conditions are omitted. In France, the US and UK, large upward biases in the apparent housing wealth effect appear when the controls for credit conditions are excluded. This is explained by standard omitted variable bias: for Germany, the omitted variable bias is in the same direction but converts a very significantly negative coefficient on log house prices/income into one close to zero.

For the house price equation, as already noted, the elasticity of house prices w.r.t. income per house has been imposed at 1 compared to 1.21 estimated in col. 1 for the full model. The other major difference is the demographic effect of the proportion of adults aged 25 to 44 which is highly significant but not so in the full model. The other key long-run parameters are quite similar, including the interest rate effect and spill-over effects from

relative house price appreciation. The only other major parameter difference is in the missing negative feedback effect of the previous year's appreciation. The standard error of the equation is dramatically worse, 0.010 vs. 0.0029, as is the positive residual autocorrelation. The mortgage stock equation, by contrast, only deteriorates modestly in fit by a 26% increase in the equation standard error, and the speed of adjustment is actually slightly higher. The interest rate elasticity is similar while the pension reform effect is weaker. With the credit conditions index now missing, the coefficients on three variables adjust to compensate: there is an increase in the effect of the proportion of adults aged 30 to 50, an increase in the effect of income and a dramatic increase in the effects of ratios to income of housing wealth and house prices. Since the latter partly reflect the indirect influence of credit conditions, it is less surprising that the fit of the mortgage stock equation is only modestly worse.

The standard error of the equation for unsecured debt increases only by 19%, with the adjustment speed down from 46% to 23%, but at the cost of rather implausible parameter estimates. The nominal interest rate response switches from negative and significant to positive and insignificant. The income effect is higher with an implied elasticity of 1.62 instead of 1.34. Had it been freely estimated, the composite effect derived from the long –run solution for the consumption function would have jumped from 1 to 5.6, which makes no sense at all. The imposed value of 2 might just be credible if unsecured debt is mainly used to finance durable goods and if these have an income elasticity more than twice as high as for consumption as a whole.

The equation for liquid assets has a standard error 35% higher than for the full model, and the speed of adjustment drops from 28% per quarter to 14% per quarter. Economic interpretability is worse: the relative interest rate effect which was plausible and strongly significant in the full model now has the wrong sign, though insignificant. The impact of the proportion of high saving adults increases markedly, while the impact of the change in the unemployment rate, negative in the full model, disappears. The downside stock market risk proxy remains strong and significant.

6. Conclusions

The main findings of the paper are as follows. Firstly, Germany differs greatly from the Anglo-Saxon economies in the effective absence to date of home equity withdrawal, in the conservative lending standards historically applied for housing loans and in the low level of owner-occupation. The implication is that higher house prices at given incomes and given

income growth expectations are likely to reduce aggregate consumption: households with ambitions to become owner-occupiers need to save harder for a housing down-payment. Renters can anticipate higher rents in future and are likely to be more cautious in their spending decisions. With the appropriate controls in our model for aggregate consumption, we find evidence consistent with this interpretation.

Secondly, though there appears to have been some liberalization of mortgages since the 1980s, the scale was tiny in comparison with Spain or France. There is no sign of a worrying recent credit explosion as occurred in the US, Ireland or Spain. This major source of house price vulnerability is absent in Germany and prospects for other fundamentals look favourable. There is evidence that the momentum effect of the house price boom in the euro area periphery associated with monetary union induced institutional investors (including banks) and probably private investors, foreign as well as German, to directly or indirectly invest in the euro area periphery rather than in the German housing market. Thus, the boom there helps explain the relative weakness of German house prices in the 2000s. Conversely, the collapse of the boom in the periphery, together with low interest rates, helps explain the very recent German house price boom. Its relative continuation poses risks that, at some stage, house price rises in Germany will over-shoot.

A third implication of this research is into the household component of monetary transmission. In this respect, Germany resembles the Japanese case discussed in Muellbauer and Murata (2011). There is a slightly negative direct effect of lower interest rates on consumption, holding constant income and asset prices, given that German households have far more liquid assets than debt. While there should be a conventional positive effect of lower interest rates on consumption via equity prices, stock market wealth relative to income is low in Germany compared to many other industrial countries. And the effect of lower interest rates on consumption via house prices is negative, since higher house prices reduce spending. This takes income as given: lower interest rates are likely to increase income via the conventional channels: corporate finance, investment including residential housing, net exports and employment. But monetary transmission via households is likely to be much weaker than it would be in the US where households in aggregate own a lot of stock market wealth, are heavily indebted, and where equity withdrawal and high LTVs rule in the mortgage market.

The paper throws new light on the buffer-stock roles of unsecured debt and liquid assets: increasing availability of unsecured credit increases such credit holdings, but other things equal, significantly reduces demand for liquid assets. An increase in unemployment

increases unsecured debt but liquid assets are reduced, presumably to sustain consumption during temporary down-turns.

On the perennial questions, we find evidence of a well-specified aggregate consumption function in which current income, income growth expectations and financial wealth have plausible positive effects, once the effects of pension reform and demography are taken into account. But higher house prices relative to income reduce aggregate consumption, as noted above. The adjustment of consumption to its long-run determinants is rapid in international terms, contradicting some other models in the literature. House prices are fairly well explained by an inverse demand model in which mortgage interest rates play an important role.

An implication of this research is that recent German house prices rises will not directly feed into consumer spending unless there are major changes in German mortgage markets including the introduction of home equity loans, for example via the spread of flexible mortgages and more generous loan-to-value rules. Indeed, it is likely that the consumption to income ratio in Germany will fall in the medium term as a result of rising home prices, other things being equal, though higher construction activity should provide some compensating support for economic activity. Therefore, (recent) monetary policy measures in the Eurozone are more likely to transmit to Germany via investment, net exports and a corresponding increase in income which will contribute to a rebalancing in the euro area.

This paper has provided further striking evidence against the net worth formulation common in empirical consumption functions, e.g. in the FRB-US model. Economic theory implies that housing wealth is quite different from financial wealth and few would reject the idea that cash is more spendable than pension assets. The logic is to split net worth into different elements to study consumption. To integrate such a consumption function into a general equilibrium macro-econometric model then requires equations for the major components of net worth. This paper achieves a large part of this objective with equations for liquid assets, both components of debt and house prices, the one asset price which can be closely linked to domestic household decisions. To fully endogenise housing wealth and illiquid financial wealth, we still need an equation for two more elements of the flow of funds: net acquisition of housing and net acquisition of illiquid financial assets, and an equation or equations for prices of the main illiquid financial assets, primarily equities. Prices of illiquid financial assets are not mainly driven by domestic household decisions, unlike

house prices. This suggests an extension of the present integrated six-equation model to an eight-equation model adding the two net acquisitions equations.

Systems estimation of such a household block has multiple advantages. Logically, households make joint consumption and portfolio decisions so that many factors appearing in one equation also appear in others. Even in Germany, where shifts in credit market architecture and financial innovation have been small compared to the revolutions that took place in the US and the UK, this paper suggests that shifts in the supply of credit need to be taken into account to plausibly model the household behaviour block. The use of latent variables jointly estimated in the system throws a great deal of light on these shifts, which have ramifications not just for levels of debt but also for buffer-stock demand for liquid assets and, of course, for house prices.

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Annex 1 – Estimation results

Table 5.1a: Estimates for unsecured credit conditions index

Dependent Variable =	**1981Q3-2012Q4**		**1981Q3-2005Q4**	
	coefficient	*t- ratio*	*coefficient*	*t- ratio*
Change in credit rate - money market spread	0.0064	2.6	0.0041	1.7
Tightness index for unsecured credit	-0.017	-3.3	-0.0058	-0.6
Ogive dummy 1986	0.027	4.0	0.0068	0.9
Ogive dummy 1990	0.083	3.1	0.0865	3.6
Ogive dummy 1997	0.077	7.8	0.0678	6.1
Ogive dummy 1999	0.149	11.0	0.1372	9.6
Ogive dummy 2000	-0.077	-5.8	-0.0608	-4.6

Table 5.1b: Estimates for mortgage credit conditions index

Dependent Variable =	**1981Q3-2012Q4**		**1981Q3-2005Q4**	
	coefficient	*t- ratio*	*coefficient*	*t- ratio*
Mortgage rate- 0.5(10 year + deposit rate)	0.033	6.2	0.033	4.9
10year – 1year bund spread	0.020	5.6	0.021	4.2
Downside in recent house price index	1.456	7.6	1.373	5.5
Ogive dummy 1981	-0.069	-4.7	-0.077	-3.4
Ogive dummy 1986	0.019	2.2	0.010	0.9
Ogive dummy 1988	0.041	4.6	0.043	3.8
Ogive dummy 1990	0.103	7.3	0.108	6.6
Ogive dummy 1991	-0.138	-8.3	-0.142	-6.2
Ogive dummy 1992	0.168	15.7	0.165	8.4
Ogive dummy 1996	-0.025	-3.1	-0.019	-2.1
Ogive dummy 1997	-0.033	-3.8	-0.029	-2.3
Ogive dummy 2000	-0.061	-12.0	-0.061	-4.9
Ogive dummy 2011	0.048	2.8	0.045	0.0

Table 5.1c: Estimates for risk appetite

Dependent Variable =	**1981Q3-2012Q4**		**1981Q3-2005Q4**	
	coefficient	*t- ratio*	*coefficient*	*t- ratio*
10 year-1 year bund spread	-0.025	-6.6	-0.024	-4.9
Euro sovereign spread deviation, 1Q lag	-0.058	-6.0	-0.037	-1.3
Downside in recent Dax	0.026	3.5	0.012	0.8
$\Delta 2008Q4$ *impulse dummy*	-0.083	-5.8	-	
MA2 2010Q2 impulse dummy	-0.162	-6.4	-	

Table 5.2: Estimates of the long-run solution of the German consumption function

Dependent Variable = $\Delta \ln c_t$	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2005Q4**		**1981Q3-2012Q4***		**1981Q3-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients for log c/y									
Speed of adjustment	λ	0.86	15.9	0.88	15.3	0.88	16.0	0.65	11.1
Constant	α_0	0.647	3.4	0.59	3.5	0.56	3.0	0.042	0.2
Mortgage credit conditions index: *MCCI*	α_{0c}	0.092	7.7	0.091	6.3	0.089	6.8	0	
Consumer credit CCI: *UCCI*	α_{00c}	0.025	1.2	0.025	-	0.021	0.8	0	
Real mortgage interest rate	α_{11}	-0.238	-3.4	-0.229	-3.1	-0.225	-3.2	-0.200	-1.9
Real unsecured interest rate	α_{12}	-0.474	-4.6	-0.408	-2.9	-0.474	-4.6	-0.779	-5.2
Real deposit rate	α_{13}	0.737	5.7	0.674	3.8	0.718	5.4	1.161	6.0
Forecast future income growth: E $\ln(yperm / y)_t$	α_3	0.346	8.6	0.364	8.2	0.355	9.2	0.255	4.7
Net liquid assets$_{t-1}$ / y $_{t-1}$	γ_1	0.095	3.8	0.088	3.2	0.093	3.6	0.107	3.2
Illiquid financial assets$_{t-1}$ / y$_{t-1}$	γ_2	0.016		0.016		0.023	2.9	0.027	4.2
Log house prices$_{t-1}$/y$_{t-1}$	γ_4	-0.070	-3.4	-0.069	-3.4	-0.057	-2.6	-0.002	-0.1
1999 pension dummy		0.011	3.2	0.014	5.2	0.010	3.0	0.017	4.6
Riester pension		-0.045	-3.7	-0.045	-3.2	-0.042	-3.6	-0.037	-2.3
Hartz reform dummy		-0.016	-5.2	-0.017	-5.2	-0.014	-4.8	-0.015	-4.2
Working age pop/total population	γ_{51}	-0.0084	-4.3	-0.0074	-3.7	-0.0076	-4.0	-0.0023	-1.1
Adult proportion in pre-retirement age group	γ_{52}	-0.0014	-1.8	-0.0014		-0.0016	-2.1	-0.0007	-0.6
Split at unification		0.008	3.1	0.008	3.5	0.008	3.1	0.015	4.7

Diagnostics									
Equation standard error		0.00236		0.0223		0.00234		0.00282	
R-squared		0.9379		0.9510		0.9392		0.9113	
DW		2.29		2.23		2.32		2.00	

Note: *column 3 uses MA4 of illiquid asset to income ratio.

Table 5.3: Estimates of long-run solution for German house price equation

Dependent Variable = $\Delta_4 \ln hp_t$	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2005Q4**		**1981Q3-2012Q4**		**1981Q3-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients									
Speed of adjustment (annual)		0.59	23.9	0.58	8.5	0.58	23.4	0.537	14.3
Constant	h_0	12.83	21.4	12.65	7.5	12.81	21.0	8.81	34.3
Credit conditions index: *MCCI*	h_{0c}	1		1		1		0	
Risk appetite	h_{0r}	1		1		1		0	
Log nominal mortgage rate	h_1	-0.123	-6.8	-0.120	-4.2	-0.123	-6.7	-0.061	-3.1
Log (real income/house)	h_4	1.21	13.5	1.18	5.9	1.20	13.3	1	fixed
Tax effect		0.054	8.7	0.058	6.4	0.056	8.8	0.053	5.1
Working age pop. ratio	h_{81}	-0.073	-12.3	-0.074	-8.2	-0.074	-12.3	-0.040	-8.9
Annual change in proportion of adults aged 24-44	h_{82}	0.133	8.7	0.142	5.5	0.134	8.7	0.069	5.3
Proportion of adults aged 25-44	h_{83}							0.017	11.8
Periphery-German spill-over		-1.79	-24.1	-1.87	-12.6	-1.79	-23.8	-1.65	-32.8
Unification split		-						-	

Diagnostics									
Equation standard error		0.00289		0.00280		0.00289		0.01044	
R-squared		0.9902		0.9912		0.9902		0.8728	
DW		1.32		1.20		1.32		0.41	

Table 5.4: Estimates of the long-run solution for the German mortgage stock equation

Dependent Variable = $\Delta \ln mdebt_t$	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2005Q4**		**1981Q3-2012Q4**		**1981Q3-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients for log (real mdebt /y)									
Speed of adjustment		0.101	5.8	0.100	4.3	0.101	5.7	0.120	6.0
Constant	m_0	0.869	2.0	0.583	0.8	0.858	2.0	-0.046	-0.2
Credit conditions index: *MCCI*	m_{0c}	0.458	3.7	0.506	2.9	0.466	3.7	0	
Risk appetite	m_{0r}	0.169	1.7	0.208	1.0	0.175	1.7	0	
Log nominal mortgage rate	m_1	-0.173	-5.6	-0.157	-3.4	-0.176	-5.6	-0.106	-5.7
Log permanent income	m_4	0.340	7.6	0.229	4.5	0.334	7.2	0.6027	5.9
Composite pension and Hartz reforms		3.60	3.2	2.76	3.1	4.01	3.0	1.99	3.2
Log (housing wealth/y)	m_{81}	0.313	1.9	0.685	2.2	0.313	1.9	0.143	1.0
Log (house prices/y)	m_{82}	-0.452	-4.0	-0.496	-2.6	-0.450	-4.0	0.044	0.6
Log(house prices/y) * *MCCI*	m_{83}	1.88	2.6	1.82	1.5	1.82	2.5		
Periphery-German spill-over		0.148	1.5	0.396	1.8	0.148	1.5	0.029	0.4
Unification split		0.122	4.5	0.112	3.1	0.122	4.4	0.148	4.9
Proportion of adults aged	m_{10}	0.030	6.0	0.021	2.3	0.030	5.8	0.035	9.7

24-44									
Diagnostics									
Equation standard error		0.00204		0.00209		0.00204		0.00257	
R-squared		0.9504		0.9403		0.9505		0.9222	
DW		2.04		1.92		2.04		1.38	

Table 5.5: Estimates of the long-run solution for the stock of unsecured consumer credit for Germany

Dependent Variable = $\Delta \ln cdebt_t$	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2012Q4**		**1981Q3-2005Q4**		**1981Q3-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients for log (real cdebt/y)									
Speed of adjustment		0.462	10.7	0.49	9.1	0.46	10.7	0.23	5.8
Constant	u_0	1.58	5.5	1.23	4.2	1.50	5.2	0.90	1.6
Credit conditions index: *UCCI*	u_{0c}	1		1		1		0	
Risk appetite	u_{0r}	0.088	1.3	0.203	1.8	0.090	1.3		
Log nominal short rate	u_1	-0.068	-2.7	-0.102	-2.9	-0.067	-2.6	0.013	0.3
Real rate	u_2	-0.565	-2.1	-0.283	-0.9	-0.567	-2.0	-0.65	-0.9
Log real per capita income	m_4	0.340	7.6	0.229	4.5	0.334	7.2	0.603	5.9
Composite wealth etc term from consumption equation	u_6	1		1		1		2	
Log housing wealth/income	u_7	0.260	1.9	-0.004	0.0	0.248	1.8	-0.017	-0.1
Log house prices/income	u_8	-0.368	-6.8	-0.510	-6.4	-0.375	-6.7	-0.408	-4.6
Proportion of adults aged 25-44	u_{91}	0.025	12.5	0.038	8.1	0.025	12.3	0.038	10.7
Proportion of adults 60 and over	u_{92}	-0.064	-7.3	-0.052	-5.3	-0.064	-7.2	-0.022	-1.7
Unification split		-0.174	-7.7	-0.181	-9.1	-0.171	-7.4	-0.137	-4.9
Diagnostics									
Equation standard error		0.00702		0.00632		0.00698		0.00836	
DW		0.8556		0.8861		0.8569		0.7936	
R-squared		1.62		2.01		1.64		1.44	

Table 5.6: Estimates of the long-run solution for the stock of liquid assets for Germany

Dependent Variable = $\Delta \ln LA_t$	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2005Q4**		**1981Q3-2012Q4**		**1981Q3-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients for log (real LA/y)									
Speed of adjustment		0.28	9.6	0.32	9.7	0.28	9.5	0.14	4.7
Constant	s_0	0.075	0.5	-0.47	-1.7	0.063	0.4	0.41	1.3
Credit conditions index: *UCCI*	s_{0uc}	-0.71	-7.6	-0.72	-6.9	-0.71	-7.5	0	
Mortgage credit conditions index *MRCCI*	s_{0mc}	-0.095	-2.1	-0.075	-1.8	-0.094	-2.0	0	
Risk appetite	s_{0r}	-0.094	-1.8	-0.101	-1.3	-0.097	-1.8	0	
Bond yield –deposit rate spread	s_1	-0.022	-4.4	-0.025	-5.1	-0.022	-4.4	0.011	1.1
Real deposit rate	s_2	0.50	3.4	0.67	3.8	0.501	3.4	0.51	1.5
Log real per capita permanent income	m_4	0.340	7.6			0.334	7.2		
Log housing wealth/income	s_8	0.760	9.9	0.79	10.1	0.75	9.8	0.22	1.9
Log house prices/income	s_9							0.10	1.5
Adult proportion in pre-retirement age group	s_{10}	0.004	2.9	0.006	2.2	0.004	2.9	0.016	6.5
Measure of recent falls in stock market		-0.053	-5.4	-0.062	-6.4	-0.052	-5.2	-0.060	-2.5
Unification split		0.091	4.5	0.088	4.8	0.090	4.4	0.086	2.6
Diagnostics									
Equation standard error		0.00309		0.00261		0.00309		0.00418	
R-squared		0.915		0.9437		0.9115		0.8380	
DW		1.88		1.97		1.88		1.42	

Table 5.7: Estimates of the equation for log permanent/current income for Germany

Dependent Variable = log yperm/y	**Symbol**	**1981Q3-2012Q4**		**1981Q3-2005Q4**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*
Constant	f_0	-8.49	-58.2	-8.75	-64.8
Log real per capita income	f_1	-0.919	-62.8	-0.949	-68.2
Time trend	f_2	0.0022	44.1	0.0024	45.4
Log working age/ total population	f_3	1.312	49.6	1.347	56.6
Consumer confidence about future/100	f_4	0.0110	6.1	0.0144	7.9
Log real DAX index, moving average at t-1	f_6	0.0040	4.0	0.0033	3.4
Log relative price of Brent oil, moving average	f_7	-0.0065	-7.8	-0.0042	-4.5
Smooth transition dummy for 1999		0.0169	16.6	0.0131	11.8
Annual inflation at t-1		-0.0899	-5.2	-0.0740	-4.5
Annual change in 10 yr-1yr bund yield spread		-0.0017	-11.2	-0.0016	-10.3
Annual change in 10 yr-1yr bund yield spread, t-4		-0.0014	-8.3	-0.0012	-7.2
Real money market interest rate		-0.1095	-6.2	-0.0670	-3.4
Diagnostics					
Equation standard error		0.0018		0.0015	
R-squared		0.9956		0.9974	
DW		0.7049		0.9495	

Annex 2 - Data Sources

Consumption aggregates and consumption deflators

Data on *quarterly seasonally adjusted household consumption aggregates* and the corresponding *consumption deflators* are available from the NSI. The figures cover Germany back to 1991 and data for West Germany are available for the remaining sample period 1980 to 1991.

Income measures

Data on *quarterly seasonally adjusted household income* are available from the NSI and go back until 1991 for Germany. Data prior to 1991 for West Germany on the basis of recent national accounting conventions, ESA1995, are only available on an annual basis and were made quarterly using quarterly seasonally adjusted income data based on ESA1979 from the NSI. *Property income receivable and payable* are made quarterly by interpolation according to the Denton method. *Non-property income adjusted for taxes* is calculated as disposable income less property income (before taxes) plus taxes on property income. The tax rate is approximated by taking the ratio of disposable income to primary income.

Financial assets and liabilities

The *outstanding amounts of household financial assets and liabilities* are available for the period 1980-2013 from the financial accounts of the Bundesbank. However, data prior to 1991 were transformed in order to be comparable with data from 1991 onwards. The financial accounts section of the Bundesbank kindly provided us with estimates. To make the series from 1980 – 1991 quarterly, they were interpolated with a cubic spline (with the last observation matched to end of year figures).

Housing wealth and housing stock

Figures on *housing wealth (including land) and housing stock owned by households* are annual and reach back to 1991. They are provided by the NSI. They are interpolated with a cubic spline (with last observation matched to end of year figures) to get quarterly series.

Prior to 1991, annual data for housing wealth and housing stock are not officially available on a detailed sectoral level but only for the total economy less the public sector. Data on land is not available at all for the years before 1991. Therefore, we needed to approximate sectoral housing wealth and housing stock. To do this, we calculated the average ratio of dwellings held by households to total dwellings of the economy less the public sector for the period 1991-2013 to allocate total dwellings to households by this ratio for the period 1980-1990. In order to estimate data on land, we calculated the average share of land in housing wealth for

the period 1991-2013. Subsequently, we use this ratio to add the land figure to the dwelling figures on a sectoral level. These estimations are based on annual housing figures both in current and in constant prices and are interpolated with a cubic spline to get quarterly series.

House price index

Data on *house prices* in Germany come from the house price database of the OECD.

Interest rates

Data on *mortgage rates and deposit rates* are taken from the MIR statistics of the Bundesbank. They are calculated as a weighted sum of various rates with different maturities based on new business volumes for the period 2003-2013. Prior to 2003, rates with various maturities are weighted according to the latest available weighting scheme, i.e. January 2003 as information on new business volumes prior to 2003 is not available. The weights take into account that some bank deposits are non-interest bearing. The *money market rate* is FIBOR (1980-1998) and Euribor (from 1999 onwards). The benchmark *government bond yield* is the 10-year zero-coupon bond yield according to the Nelson-Siegel-Svensson yield curve model calculated by the Bundesbank. The 1-year yield was constructed similarly. Real interest rates for households are tax adjusted nominal rates minus the annual inflation rate.

Population

Information on population is from the NSI. Annual 5-year age bands are available from 1970 onwards. Where necessary, these were linked to data back to 1950 for 20-year age bands.

Other data

The unemployment rate is from the ILO, consumer confidence from GfK, the number of Riester pension contracts outstanding is from the Federal Ministry of Labour and Social. Affairs and bank lending survey information are from the Bundesbank. The consumer confidence series begins in 1983 and its changes were back-cast to 1981 from a regression on changes in the log real DAX index, the unemployment rate and the inflation rate. The oil price is the US dollar price of Brent crude, converted at the dollar-domestic currency exchange rate. House price indices for Spain, France and Italy come from the OECD.

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