"The Housing Market, Household Portfolios and the German Consumer"

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Abstract: Germany is undergoing its first house price boom in many years. House price booms in Anglo-Saxon economies and their subsequent collapse were an important part of a 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 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?

To answer these and more perennial questions about links between household portfolios, income and consumption, this paper analyses the links between German household consumption and household portfolios of assets, including housing, financial assets and debt. A four-equation system for consumption, house prices, consumer credit and housing loans 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 reform. 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 flow of funds balance sheet data.

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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. 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 German 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 flow of funds 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 four-equation system for consumption, house prices, consumer credit and housing loans 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 reform. 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.

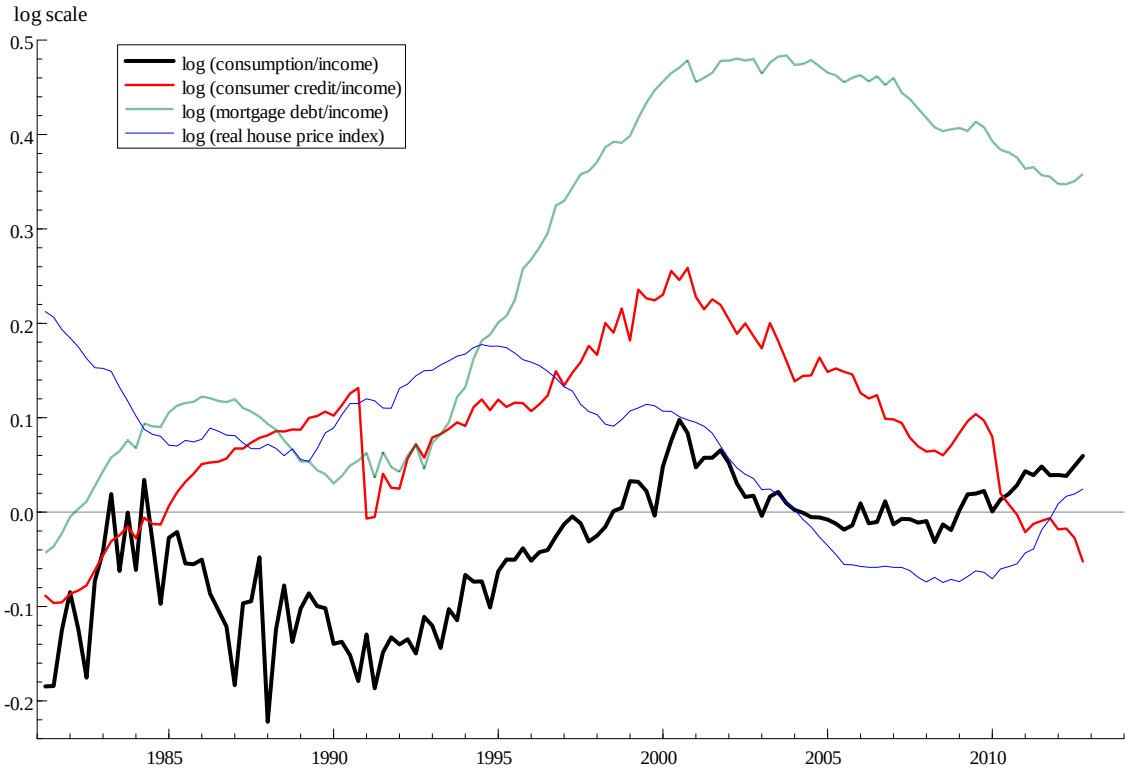

Figure 1: The log consumption/income ratio (scaled up), log consumer credit/income, log mortgage debt/income and log real house price index (intercept adjusted).

Section 2 provides a brief theoretical background for the econometric specifications. Section 3 discusses the German institutional background and previous literature for models of consumption, debt and house prices for Germany. Section 4 sets out the specification of the empirical models and discusses the estimation results, including for forecasting permanent income. Section 5 concludes. A data appendix concludes.

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

2.1 Consumption

The basic solved-out Friedman-Ando-Modigliani basic 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

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

where c is real consumption, A is real net worth, y is current real non-property income and y^p.[1] is permanent real non-property income The log ratio of permanent to current income $\ln\left(y_t^p/y_t\right)$ reflects expectations of income growth. To reflect habits or adjustment costs, a partial adjustment form of (1) would define the change in log consumption to depend on the deviation between lagged log consumption and the RHS of equation (1).

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:

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

Here δ is a discount factor, for example 0.95, 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.

Standard consumption theory suggests augmenting (1) with a variable real interest rate r_t and income uncertainty θ_t. More fundamentally, the originators of the 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 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 rise in real house prices on a standard national accounts consumption aggregate. 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

[1] 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.

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:

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

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, all in real terms. 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 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) and from increases in debt burdens (scaled by current non-property income, DB_{t-1}/y_t). The speed of adjustment is given by λ, and the γ parameters 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).[2] The term in the log change of income allows for the possibility that some households'

[2] 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. The change in the unemployment rate makes less sense as part of the long-run solution for consumption.

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 within 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 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, in the population – 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 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 consumer credit loans (*CRCCI),* it would be possible to make each potentially time-varying parameter a linear function of the *CCIs* and test hypotheses about time variation.

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 $\Delta \ln y_t$.[3]

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

[3] 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 here.

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:

$$ln\ h = -\alpha\ ln\ rhp + \beta\ ln\ y + z \tag{4}$$

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

$$ln\ rhp = (\beta\ ln\ y - ln\ h + z)/\alpha \tag{5}$$

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 β 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 β/ α, which is typically substantially above 1 since the own-price elasticity, α, 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:

$$uc = rhp(r + \delta + t - \Delta rhp^{e} / rhp) = rhp(uch), \quad (6)$$

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 formulation adopted in the present paper is to proxy expected appreciation by a weighted average of the lagged 1-year and 4-year appreciation rates and to estimate the weight.

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

$$\ln rhp_t = h_{0t} + h_{1t} \ln nmr_t + h_{2t} \ln user_t + h_{3t}\, \theta_t + h_4 ln(y_t/hs_{t-1}) + h_{5t}\, E_t \ln(y_t^p / y_t) + h_6 NLA_{t-1}/y_t + h_7 IFA_{t-1}/y_t + h_8\, subs_t + h_9\, trans_t + h_{10}\, demog_t \quad (7)$$

Here the intercept is time varying and increasing with *MCCI*, the credit conditions index for the mortgage market. The next term, the log of the tax adjusted nominal 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 broadly analogous to its effect on 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. 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 80 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. Given asymmetric information between lenders 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.

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 demand for mortgages by excluding larger fractions of potential buyers from the mortgage market. Credit market liberalisation should reduce this potentially negative influence. 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:

$$\ln mdebt_t = m_{0t} + m_{1t} \ln nmr_t + m_{2t} \ln user_t + m_{3t}\theta_t + m_4 lny_t + m_{5t}E_t \ln(y_t^p / y_t) + m_{6t} ln(LA_t/y_t) + m_7 \ln(IFA_{t-1}/y_t) + m_{8t} \ln(HA_{t-1}/y_t) + m_9 demog_t \quad (8)$$

This equation incorporates the log[4] of the nominal tax-adjusted mortgage rate, nmr. The latter reflects the cash-flow constraint on the ability to finance debt and both would be expected to have a negative coefficient. A second interest rate influence potentially enters via the user cost term, a kind of real interest rate, which subtracts the expected rate of house price inflation from the tax adjusted interest rate, discussed further in the next 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, three log asset to income ratios[5] and demographic composition since a younger age structure should be associated with higher levels of debt.

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 u_{0t} should increase with *MCCI*. There may also be interaction effects from credit liberalization reflected in time subscripts on some other parameters in the equation but in Germany, where as we shall see, little liberalisation has occurred, these are likely to be of third order of importance.

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

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

[4] 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.

[5] 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.

drivers to those for consumption, and interest rate effects would be expected, given controls for increased credit supply. One might expect the long run income elasticity to be greater than one, for example, inheriting income elastic demand from the demand for durables. Income growth expectations should have a positive effect, greater with greater credit availability.

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

$$\ln cdebt_t = u_{0t} + u_{1t} \ln ncr_t + u_{2t}\ rcr_t + u_{3t}\,\theta_t + u_4 lny_t + u_{5t}\,E_t \ln(y_t^p/y_t) + u_6(\gamma_1 NLA_{t-1}/y_t + \gamma_2 IFA_{t-1}/y_t + \gamma_{3t} HA_{t-1}/y_t) \quad (9)$$

Here, the intercept is time-varying and increases with *CRCCI*, the credit conditions indicator applying to consumer credit. The nominal interest rate on consumer credit, *ncr* and the real rate *rcr* would be expected to have a negative sign and could be time-varying with *CRCCI*. In this formulation, the same linearization and relative coefficients of the asset to income ratios as used for the consumption function is assumed, a testable hypothesis.[6] The income and income growth expectations effects enter in similar form into the consumption and mortgage debt equations, though one would not necessarily expect similar coefficients across the three equations. In the early 1980s, aggregate consumer credit in Germany (as in France) was so small relative to income, that it may well have been concentrated among an unrepresentative minority of households, making aggregate income growth expectations less relevant.

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

[6] To anticipate the empirical results, the hypothesis is accepted.

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 findings 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 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 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 Reimer, 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 et al., 2011). 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 household wealth is composed of. 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 dominant in the US or UK (IMF 2008, Slacalek, 2009, Sousa, 2009, 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).

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, in particular 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 degree 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 euro area countries. However, most research focuses on the impact of changing credit supply (both in terms of volumes and in terms 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 (Capiello et al., 2010, Blaes, 2011, Van der Veer and Hoeberichts (2013)).

Research on house price models has so far focused on the determinants of house price dynamics. This is also related to our work. 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 asses 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, 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) imply that for the period 2004-2010 income has 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's middle-aged group and the population density are important to explain house price dynamics in Germany throughout the whole sample period. Moreover, 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, Dreger and Kholodilin, 2011). Kajuth et al. (2013) attribute their findings to the fact that interest rates mirror more or less growth expectations for which they account separately in their analysis. Therefore, it is difficult to identify the effects of interest rates on house prices separately. 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.[7]

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 e.g. Huelsewig et el., 2004, Huelsewig et al., 2006, 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.

4. Institutional 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. This would have

[7] One notable exception is Duemmler and Kienle (2010) who extent 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*.

contributed to weaker house prices and mortgage growth than otherwise in the years following. In Germany, there is no law which explicitly prohibits banks from offering home equity loans. However, according to the general regulation,[8] 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 mortgage rate mark ups). 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 rather 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 combined 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

[8] 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.

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 – a.o. 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 with lower tax advantages for projects initiated between 01.01.97 and 31.12.98. Some authors[9] 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 based on PAYGO. Due to continuing increases in life-expectancy and past 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 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 E2100 in 2008. There were 4m 'Riester' contracts by the end of 2003 and 10.75m at the end of 2007.

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

[9] See for instance Belke (2010).

2004 the 'retirement income act', announced phased 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. It would be astounding if these reforms had not had a significant impact on the household saving rate.

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

5.1 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 extended life-cycle model of equation (3). The temporary tax breaks for investment in East German property are probably more directly relevant for house prices and the mortgage stock.

The discussion of pension reform and the information on the gradual extension of saving incentives and on the take-up of the new saving vehicles suggests the construction of a pension dummy which makes a transition from zero to one from 2001Q2 to the end of 2008. A four quarter moving average phases in the introduction and conclusion of these pension reforms.[10] We expect a significant negative effect. We also allow a small effect in the opposite direction for the temporary relaxation of pension policy in 1999 by the Schroeder government. The years 1999 and 2000 just before and after formal monetary union, were also

[10] It is possible that use of data on take-up of the various new savings schemes might allow some future refinement of the time profile of this effect.

years of high consumer confidence, booming stock markets, particularly on Germany's Neue Markt, and probably easy credit. We introduce 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 very complex. 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. 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 dissaving then is far less than simple models predict. Among reasons for the latter are uncertainty about life expectancy and medical bills in retirement, 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.

A calibrated life-cycle model suggests little difference in the aggregate saving rate between household cohorts differing only in the ratio of children to adults. Families with children will be saving less while the children are present and will then tend to compensate by saving more in the pre-retirement period when the children have left home and also spending a little less in retirement. Childless couples or single adults with similar incomes will be able to save more at the ages when couples with children are saving less but will then not have to save as much in the pre-retirement years. They are also likely to have higher consumption levels during retirement. However, when the aggregate ratio of children to adults falls, in the process of transition, there is likely to be a substantial rise in the aggregate saving rate before it falls again to a more normal level. Households in the pre-retirement age groups whose children previously left home will have high saving rates while retired households who had children earlier will also have lower consumption than equivalent childless households. The increased fraction of younger households who are childless or have fewer children will have higher saving rates than the households with children they are replacing. Eventually, these effects will wash out as the lower saving rates in the pre-and post-retirement years of households who are childless or have fewer children become more dominant for aggregate data. Though the effects are transitional, this discussion suggests they are liable to take as long as 40 years before they are complete.

In our model, the aggregate consumption to income ratio is conditioned on the last quarter's household portfolios and so recent demography will already be partly reflected in average portfolios. This strengthens the argument that in our model for the consumption to income ratio, the effect of the decline in the child/adult ratio is transitional rather than permanent. 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 this moving average.

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.[11] Adapting the specification in equation (3), the housing wealth to income ratio was replaced by the log house price to income ratio as early indications were of a negative coefficient. This suggests the down-payment constraint dominates any wealth effect for German aggregate data. Empirical results for the long-run coefficient of the consumption function as part of the four-equation system, estimated by maximum likelihood, are shown in Table 5.1. Two real interest rate effects were introduced: both a deposit rate on savings accounts and a borrowing rate on consumer credit. The former has a significantly positive effect while the latter is significantly negative. The sum of the two effects is positive. This means that a common increase in both real 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 Muellbauer and Murata (2011).[12] The real mortgage rate also has a negative effect but is not significant. The ratio of log permanent to current income, and the ratios to income of net liquid assets and of illiquid financial assets have significant and plausible effects in all specifications as do the 2001-8 pension reform dummy and the demographic effect for the child/adults ratio described above. Always significant effects in the short run dynamics are the change in log current income and a proxy for changes in global risk appetite, constructed from the two-quarter

[11] 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 income is just the return on assets owned by the household.

[12] Economic theory suggests a positive effect is likely where the net liquid asset to income ratio is high and the intertemporal elasticity of substitution is low (i.e. aversion to volatile consumption is high), see Muellbauer and Murata, op cit. For discussion of the policy implications, see http://www.voxeu.org/article/mistaken-monetary-policy-lessons-japan

change in the US long-short treasury bond spread, using 10 and 1-year yields[13]. More marginal in the short-run dynamics is the change over three quarters in the post-unification unemployment rate.[14] Impulse dummies capture outliers during the unification period, anticipation effects of VAT rises and two other outliers.[15] In all specifications, the speed of adjustment of consumption to the long-run solution is high, of the order of 70 to 80 percent, confirming previous findings by Hamburg et al. (2008) and other studies discussed above.

The estimated size of the controversial house price to income effect depends on whether the specification is from the four equation system incorporating the latent variables for credit conditions or for a free-standing single consumption equation. For the latter, see column 2 of Table 5.1, the effect is negative but not significant; for the system, which also produces a better fit for the consumption function, the effect is estimated to be of the order of -0.05 to -0.07, see column 1 of Table 1. The estimated parameters are stable running from 1987 to 2012, or from 1981 to 2005. 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 identification of the model.

The asymptotic t-ratio for the negative log house price/income effect is only around 2.4. This reflects a lower signal to noise ratio than consumption/income and house price/income observed for France, Spain, the US or the UK, and there are also notable trend-like effects of demography and pension reforms. The estimates suggest that pension reforms from 2001 to 2008 lowered the consumption to income ratio by 3.5 percent. If one imposes this parameter, the coefficient on log house price/income is -0.065, t=-4.7. If one assumes the pension reform effect was lower, say 3 percent, the coefficient is -0.049, t=-3.5, and for a pension effect of 4 percent, the coefficient is -0.080, t= -5.8. Given the limitations of the information content in the data, making a quasi-Bayesian choice of this kind seems inevitable. These estimates were exhaustively checked for a range of different specifications of the two debt equations which are the primary source of information for pinning down the

[13] The change in the yield spread might not only reflect risk appetite but it also determines banks' profitability and the margin and the willingness to provide credit to the economy

[14] In countries such as Germany and France with high replacement rates, changes in the unemployment rate tend to matter 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.

[15] These are in 1987Q1 and 1988Q1 and may reflect interpolation errors in pre-1991 income data which are annual. 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

latent variables. They are also fairly robust to different definitions of the lag over which the long term change in the child/adult ratio is measured.

To obtain an idea of the empirical magnitudes of the estimated effects, Figures 5.1a to 5.1c, show the fitted components of the long run solution for the consumption to income ratio. Figure 5.1a plots the contribution of the two latent variables proxying credit conditions, of the ratio to income of net liquid assets and of the log of the house price/income ratio. The decline in the house price/income ratio is reflected in the upward trending contribution to the log consumption/income ratio as potential home buyers did not need such large deposits and renters could look forward to moderate future rents. The build-up of debt in the late 1990s, 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, discussed below. 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 0.075 is a little below propensities for the UK and the US reported in Aron et al. (2012). This may be because of the high proportion of not quite so liquid term deposits in German household liquid assets, unlike those of US and UK households.

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. 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 1 percent each. Since both latent variables are trending over time, it is not surprising that when they are omitted, one can still obtain a well-fitting consumption function for Germany. Note that the time profiles suggest some credit market liberalization in the 1980s, beginning with non-mortgage credit. In the 1980s, there is a slight negative correlation for a time between the two, even after separately accounting for the tax break for investing in the former East Germany between 1991 and 1997. In the late 1990s credit conditions for non-mortgage credit appear to have eased significantly but not for mortgage credit, except temporarily in 1999. This may be connected with the decline in real house prices since about 1996, particularly in the former East Germany which could have made mortgage lending look more risky to German banks.

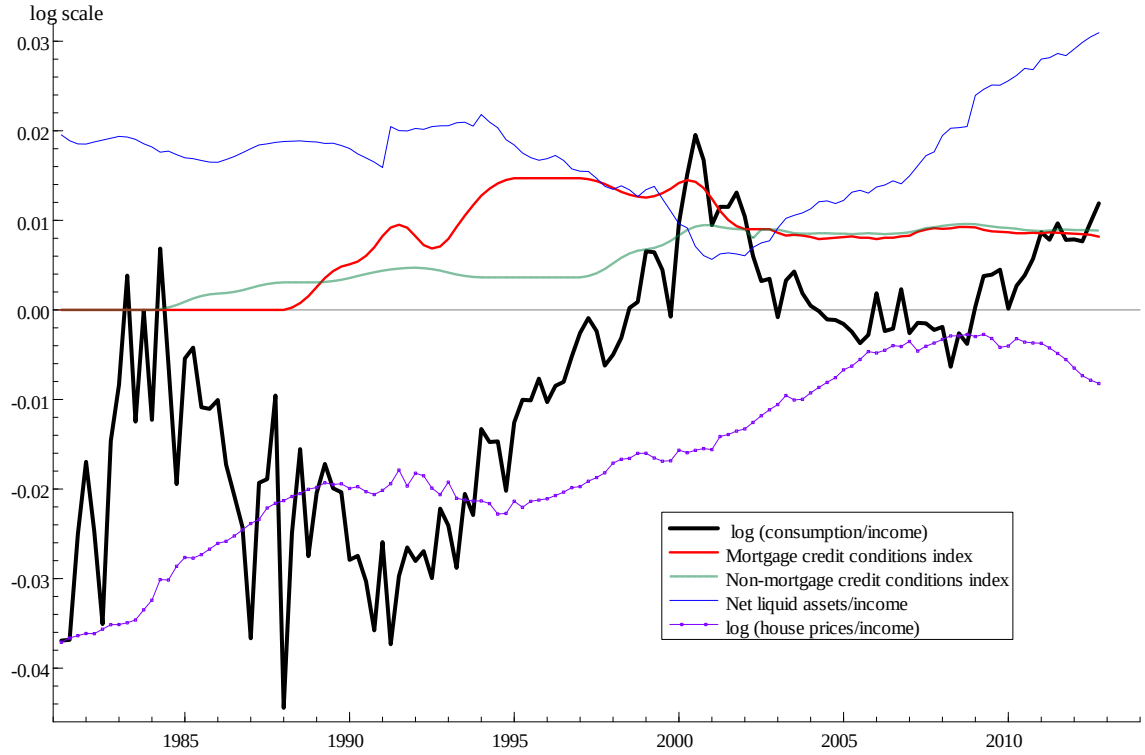

Figure 5.1a: Effects of mortgage and non-mortgage credit conditions, net liquid assets/income and log house prices/income on log consumption/income in Germany.

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 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 household wealth effect appear when the controls for credit conditions are excluded. This is explained by standard omitted variable bias: in those countries, credit conditions are positively and strongly correlated with house prices. Judging by the comparison of the coefficients on ratios to income of illiquid asset between columns 1 and 2 of Table 2, the omitted variable bias for Germany is positive for this component of wealth. This is understandable given the positive correlation with the credit conditions indices visible in Figures 5.1a and 5.1b.

The coefficient on the log ratio to current income of fitted permanent income is around 0.5 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 explain the rise in the consumption to income ratio since 2008.

Figure 5.1b shows the contributions of ratios to income of the fitted ratio of log permanent to current income, real interest rates and illiquid financial assets. The rise in financial wealth relative to income over time is, of course, related to relatively high saving ratios for Germany as well as equity price movements. The marginal propensity for illiquid financial assets is broadly similar to estimates for the UK, US and France at around 0.015.

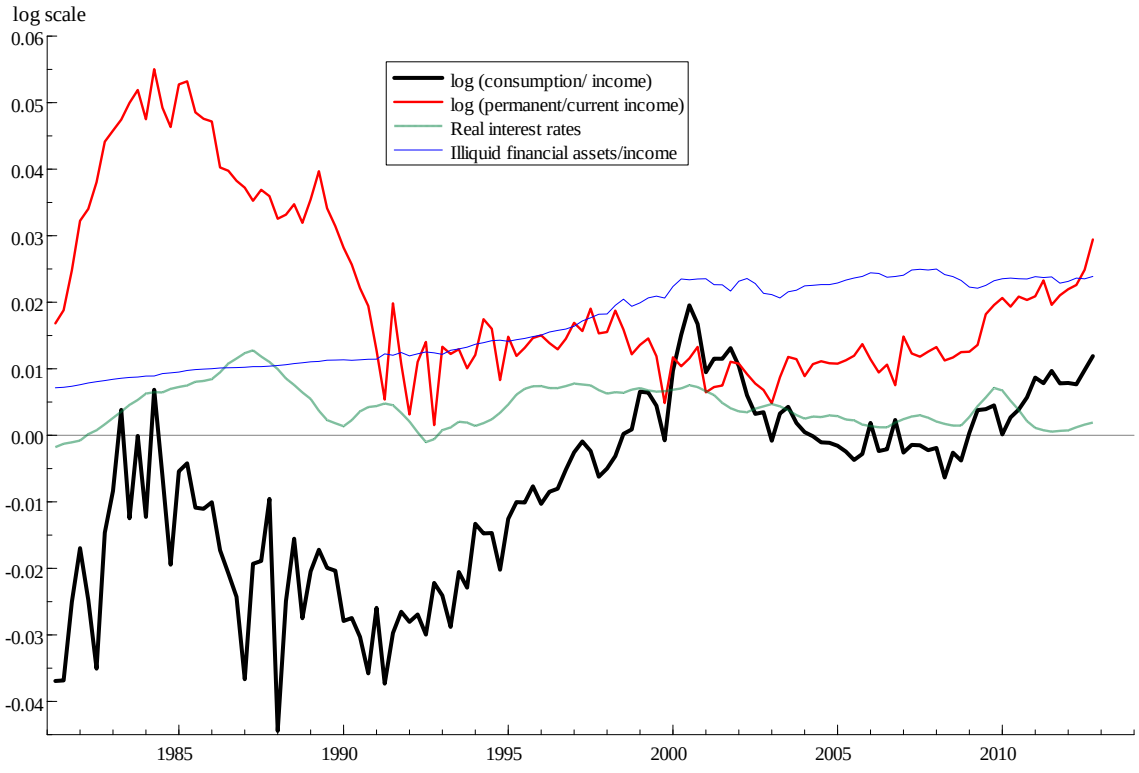

Figure 5.1b: Effects of log permanent to current income, real interest rates and illiquid financial assets/income on log consumption/ income in Germany.

Figure 5.1c shows the effects of the pension reform dummies, unification and of demography. The pension effects suggest that by 2009 the German household saving rate had risen by

around 3.5 percentage points (or the consumption/income ratio had fallen by the same amount) relative to 1998 as a result of the pension reform process that began in 2001. This is large relative to variations in the ratio since 1980. However, given the decisive series of policy responses since 2001 to Germany's looming sustainability crisis for its PAYGO pension system, this seems an entirely plausible magnitude.[16] In the 1980s, the decline in the child/adult ratio relative to the historical average had made a notable negative contribution to consumption/income: this effect bottoms around 1990 and then reverses slowly. The unification dummy effect is small and positive and is probably a mix of correcting for measurement bias and structural shift.

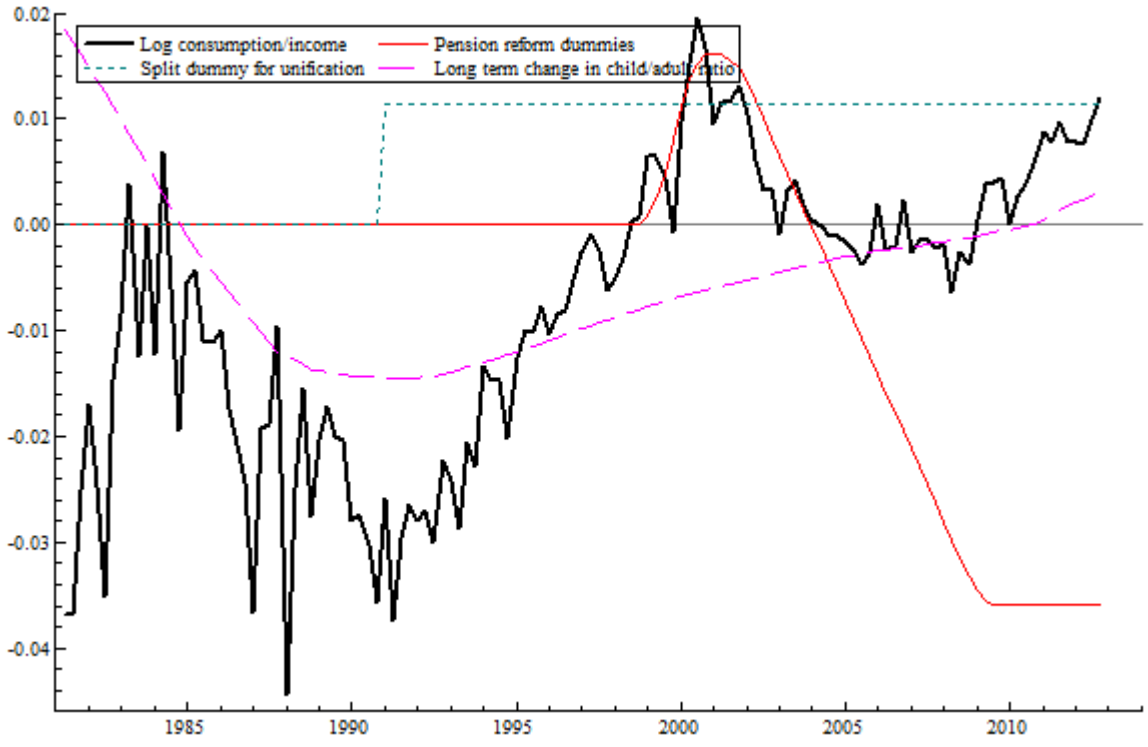

Figure 5.1c: Effects of pension reform dummies, unification and the evolution of the ratio of children to adults on log consumption/ income in Germany.

[16] The coalition government elected in 2013 has implemented a relaxation of these policies by reducing the retirement age to 63 for certain cohorts and increasing benefits for older mothers. This is likely to reduce the saving rate for the people affected and probably the aggregate saving rate.

5.2 The house price equation

The German data on house prices which come via the OECD are based on annual averages. This means that the house price model set out in equation (7) 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.[17] The coefficient on the log level of real house prices lagged 4 quarters should be far higher than for a quarterly specification. Empirical results are reported in Table 5.2. The point estimate of 0.667 from initial maximum likelihood estimates of the four-equation system seems somewhat high. It implies that only one third of a full adjustment is still missing after 4 quarters. If s is the quarterly speed of adjustment, then $(1-s)^4 = 0.333$, so that s=0.24, which is somewhat above the norm in international studies on quarterly data. The coefficient on income per house is 1.51, in line with international evidence typically in the 1.4 to 2.4 range. This implies that an estimate of the price elasticity of the demand for housing of -1/1.51=-0.66. We can accept the hypothesis that the income elasticity is one.

The quality and representativeness of the German home price data can be questioned, given the substantial disparities between home price movements in the big cities and the country as a whole (see also on this account Kajuth et al, 2013). An alternative weighting scheme which gives the cities a bigger weight would result in a smaller fall in real house prices than that recorded in the data. We therefore included a bias term based on a linear time trend wherever in the equation system the home price index appears. In practice, this cannot be identified separately from demographic trends also in the model, though point estimates are consistent with a downward bias. We therefore calibrated the bias term to -0.001 per quarter, which over 127 quarters in our data set amounts to a 12.7 percent downward bias. This calibration has virtually no consequences for any of the parameter estimates except for the credit conditions index. The assumption produces a more plausible shape than assuming a zero bias, for the mortgage credit conditions index, which otherwise would be implausibly low towards the end of the sample.

[17] 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.

The mortgage credit conditions index has a coefficient calibrated at 1 in the house price equation. It is important to control for the effect on house prices of the tax breaks announced in 1991 and finally withdrawn in 1998 for investors in the former East German. Failure to do so would lead to mis-interpretations of the latent variable. The tax effect is represented by 3 smooth transition 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.

Our evidence supports previous findings that for German house prices, it is the nominal interest rate rather than a real rate which is relevant. 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 -0.07, however lower than our -0.13 estimate for France.

While a user cost variable is not significant, a momentum expectations effect still matters for Germany. Home price appreciation over the previous four years has a positive effect on current home prices. The evidence is that there is also 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 0.8 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 home price boom to invest in property abroad rather than in 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 the four year memory is relevant for the US and for France. Checking weights from a weighted average of one-year and four-year appreciation, we can accept the hypothesis of a four-year memory for Germany. The implication is that until 2008, the external home price boom attracted investors and diverted funds outside the German real estate sector due to more favorable (expected) return opportunities and so contributed to the weakness of German home 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 home prices. What is unclear is the role played by households as opposed

to other investors or financial institutions in this mechanism. The spill-over effect on German mortgages, discussed below, is small, but this may just mean that property investors used cash or other assets or local mortgages to finance their purchases.

The house price model also contains a significant effect from the log ratio of permanent to current income, and we can accept the hypothesis that the coefficient is similar to that in the consumption function. Demographics are represented by the change in the proportion of the population aged 25 to 44 and by the same formulation of the 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 population growth, and the same risk appetite proxy discussed above, based on the US long-short yield spread. 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. A dummy for the Lehman Bros collapse is also present.

Figure 5.2a decomposes the long-run solution for log real house prices into the calibrated bias term, the contribution of mortgage credit conditions, the effect of the 1991-8 tax-break, the effect of the log nominal mortgage rate and the momentum and foreign spill-over effect. The importance of the mix of momentum and spill-over for helping explain the down-turn of German real house prices from 2000 to 2007 is apparent, as is the role of the latent variable in the late 1980s and mid-1990s. The tax effect accounts for a 5% rise from 1992, followed later by a 5% fall starting in 1995 and ending in 2008.

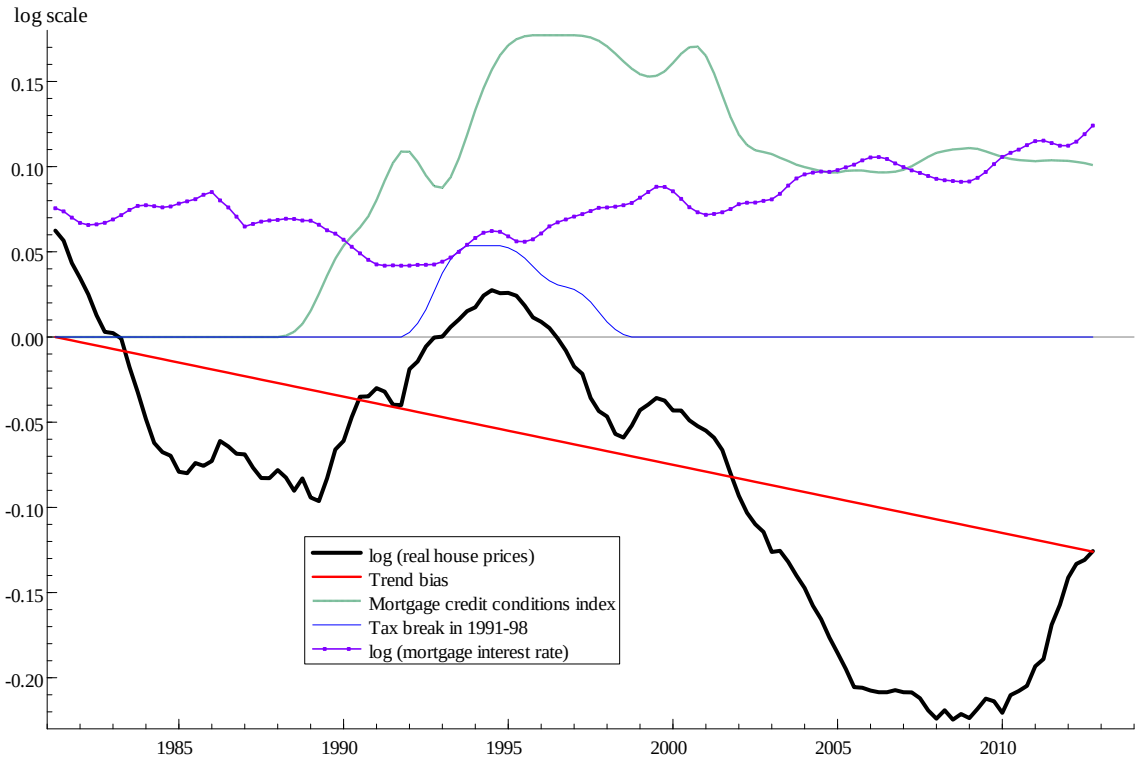

Figure 5.2a: Decomposing the long-run solution for log real house prices.

Figure 5.2b decomposes the rest of the long-run solution into the contribution of log income per house, the log of permanent to current income, the change in the proportion of adults in the 25 to 44 age group, and the child/adult variable.

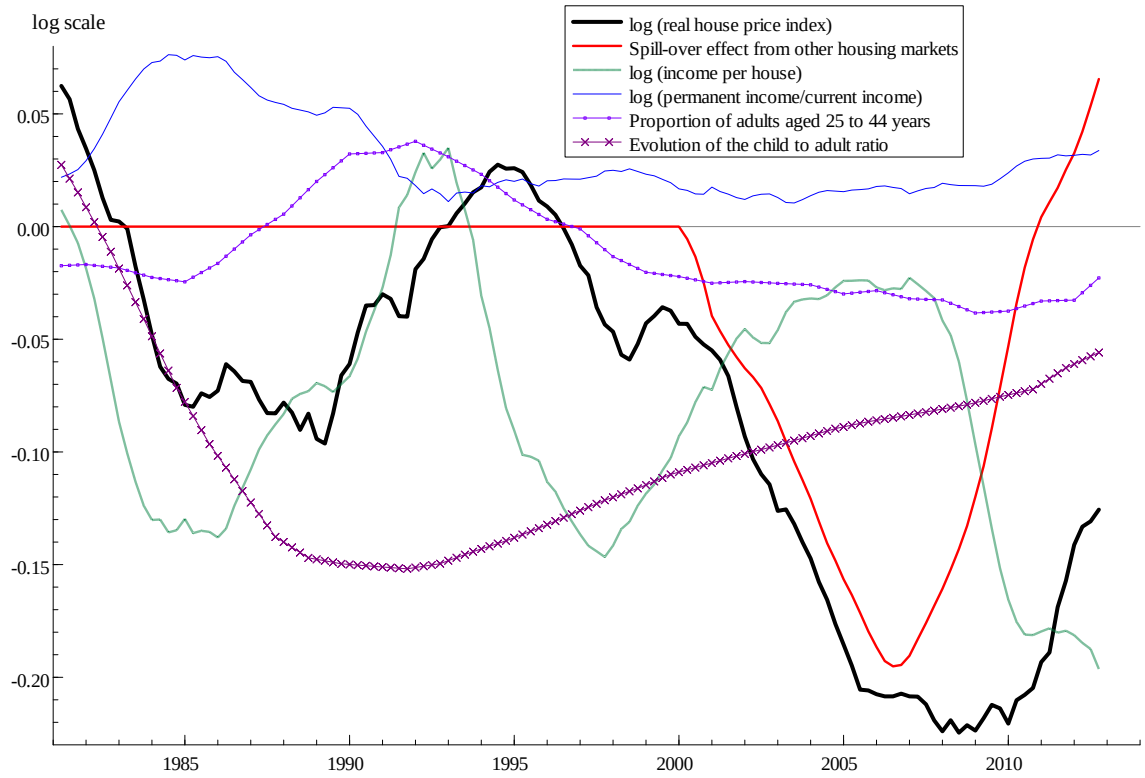

Figure 5.2b: Decomposing the long-run solution for log real house prices.

Table 5.2.column 2 reports results when the mortgage credit conditions index is omitted. One can still obtain coherent results, though the fit is worse and the coefficient on log income per house is well below international consensus estimates.

5.3 The mortgage stock equation

The coefficient on the mortgage credit index is calibrated at 1.[18] The long-run solution for log mortgage stock/income has a single interest rate, the log nominal mortgage rate. The coefficient of -0.20 is just 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 suggesting that cash flows were the dominant concern of housing investors. However, given the relative stability of German inflation over the period, it may be that inflation expectations were so steady that real and nominal interest rates meant more or less the same thing. The evidence is that mortgage demand has an income elasticity of 1, like

[18] It needs to be normalised in either the house price or the mortgage stock equation to identify the coefficients in the latent variable for mortgage credit conditions. In the event, the hypothesis that the coefficient is the same in the two equations is easily acceptable.

that of the demand for housing. 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. However, there is a volume effect: an increase in the housing stock owned by households results in increased mortgage demand.

The one demographic effect is the proportion of adults in the 25 to 44 age bracket, in preference to the 30 to 50 age bracket which fits less well. While it is true that German first-time entrants to owner-occupation fit the older age bracket, the slightly younger age bracket is the key one for household formation and demand for rented accommodation is part of what drives mortgage demand, since many private landlords also have mortgages.

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. Thus, if investment in 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 momentum and spill-over effect from booming house prices in Spain, France and Italy proved not significant for mortgages, see the discussion above of this effect on German house prices.

The speed of adjustment of around 0.084 per quarter is a little higher than UK evidence suggests and makes sense: though mortgages have long durations, German durations are shorter on average than the UK's. Short run dynamics include the inflation rate with a negative coefficient, perhaps a proxy for higher future interest rates, and the same US yield spread proxy for global risk appetite used in the consumption and house price functions. 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 range of 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 5.3a and 5.3b decompose this adjusted long-run solution.

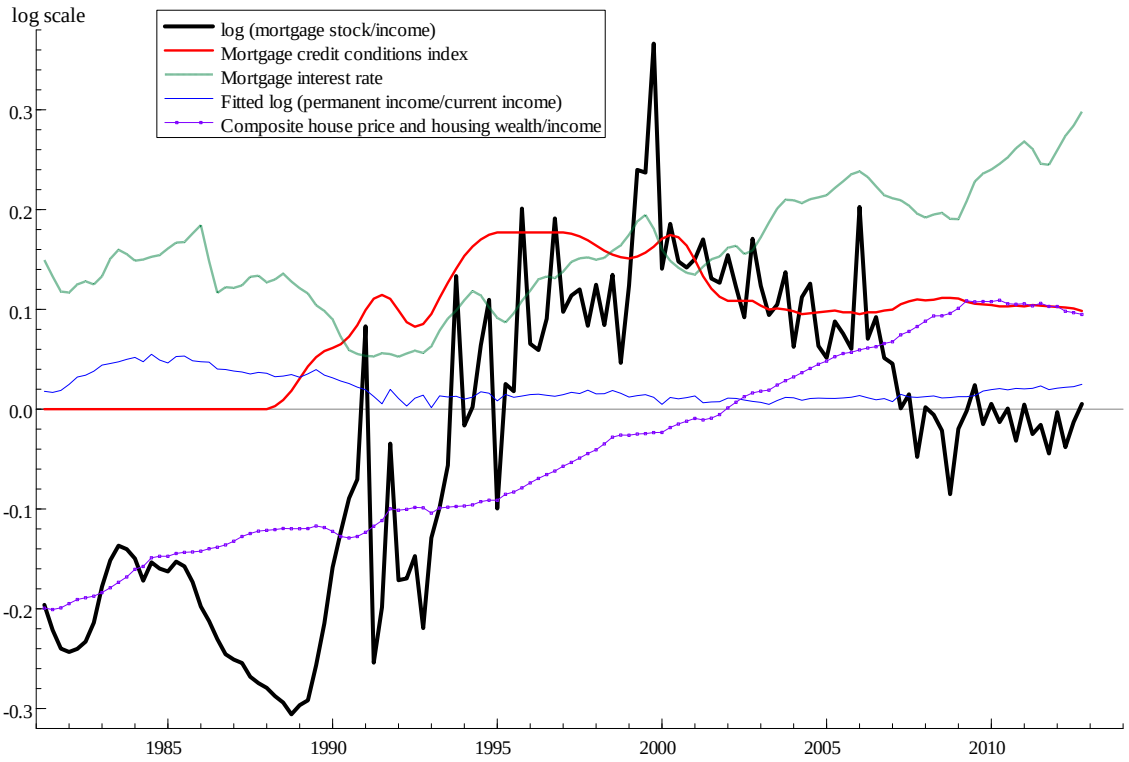

Figure 5.3a: Decomposition of adjusted long-run solution for log mortgage stock/income.

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 small reversal in the 2000s, perhaps as a consequence of a long period of low returns on housing investment. 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. How the model accounts for the downward trend in the dependent variable in the 2000s is shown in Figure 5.3b. The decline in the proportion of adults aged 25 to 44 after the mid-1990s and the pension reforms from 2001 are the key.

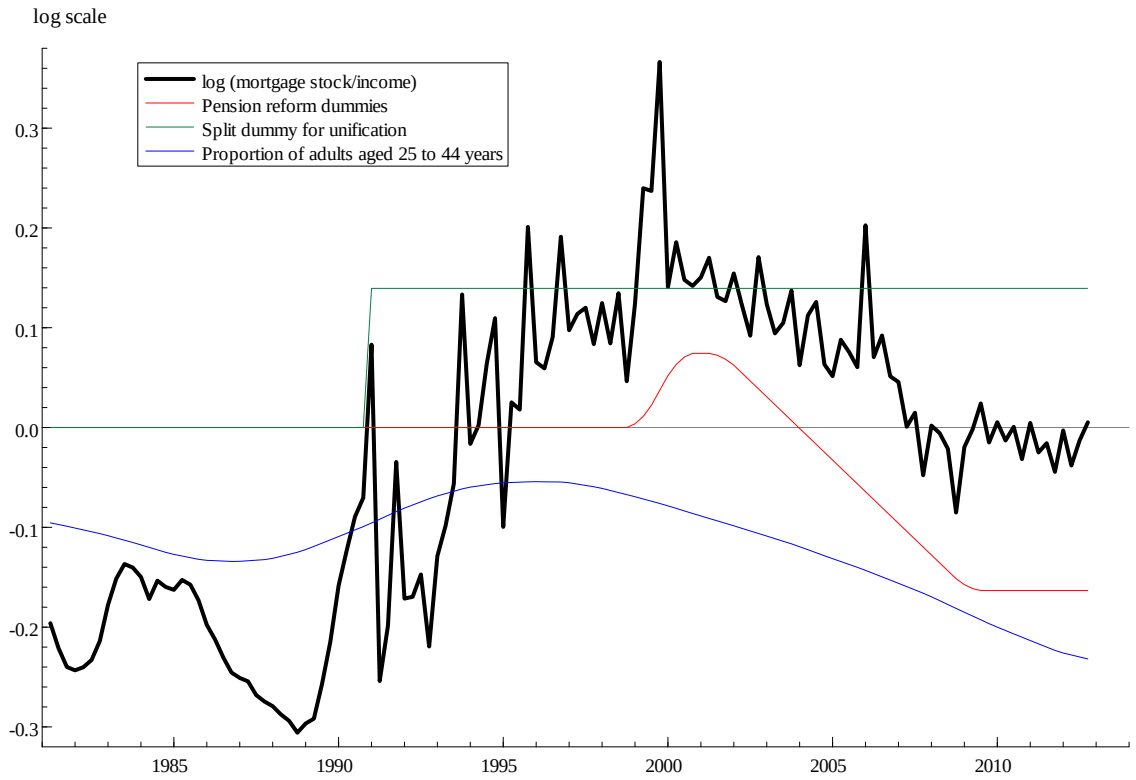

Figure 5.3b: Decomposition of adjusted long-run solution for log mortgage stock/income.

5.4 The consumer credit equation

There is very little published research on what drives the ratio of consumer credit to income. However, unsecured consumer credit probably has three main functions. One is for short-term finance of consumption, particularly of durable goods. The second, particularly in Germany where lenders impose strict limits on LTVs for mortgages, is to help bridge the gap between the price of a home and the available mortgage. The third is consumption smoothing, particularly through temporary income down-turns. The first function is represented in equation (9) by the composite term which appears in the consumption function for the ratios to income of net liquid assets and illiquid financial assets and log house prices/income. It turns out that this composite term can be expanded by adding the log permanent to current income and the pension reform effect with the same weights as in the consumption function: the implied restriction on coefficients is accepted by the data. The overall coefficient on this

composite term is estimated at almost exactly 1 and so has the same proportionate effect on the consumer credit to income ratio as it does on the consumption to income ratio.

The second function of consumer credit is represented by adding to equation (9) 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. Freely estimated, this coefficient is over 0.5, but the hypothesis that the more moderate figure of 0.5 can be accepted, so this is imposed.

The latent variable for consumer credit conditions enters with a coefficient normalised at 1. Without this latent variable, the long-run solution, fit and speed of adjustment all deteriorate sharply, as column 2 of Table 5.4 strikingly demonstrates. 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. There are strong interest rate effects both from the log of the nominal rate and the level of the real rate. 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.

Short-term influences include the change in the post-unification unemployment rate with a positive coefficient, consistent with consumption smoothing. 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 5.4a suggests that two phases of easing of credit constraints explain a lot of the rising time profile of consumer credit/income to around 2000, while the composite of house price/income and housing wealth/income also help account for some of the trend rise. There is remarkable stability in the composite imported from the consumption equation of wealth, house price, income growth expectations and pension reform variables. Germany has a very different post-2000 profile of consumer debt to income from 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 5.4b.

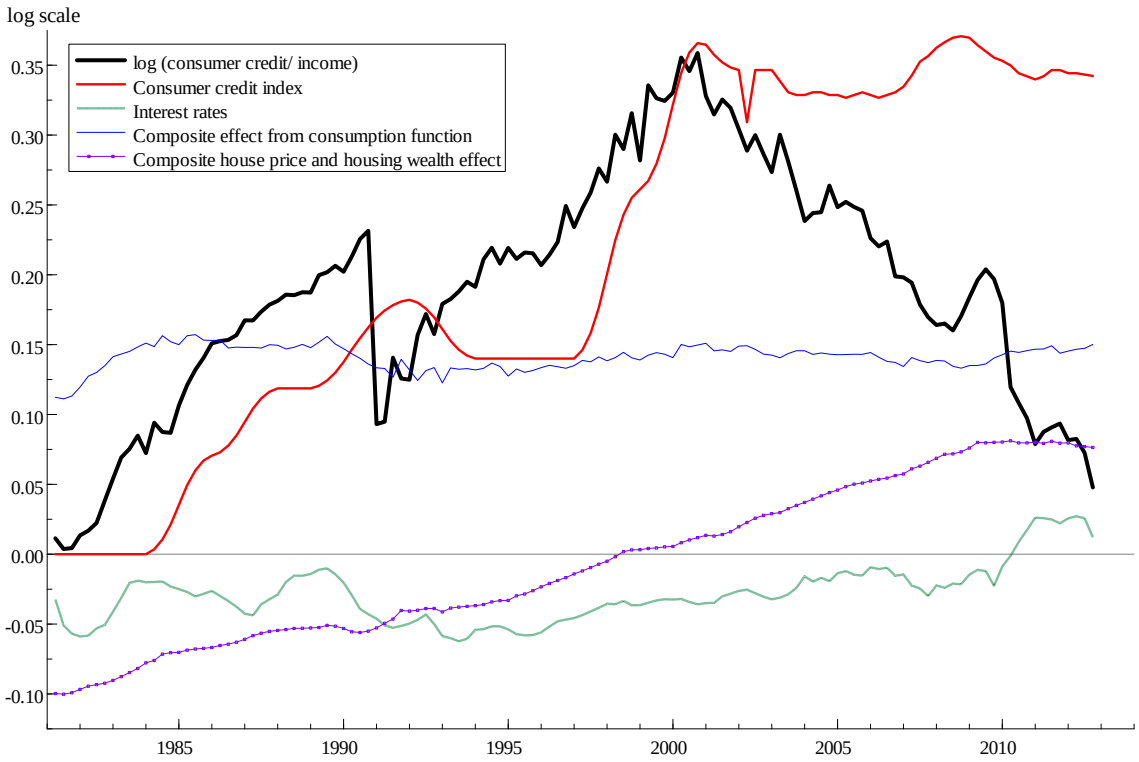

Figure 5.4a: Decomposition of adjusted long-run solution for log stock of consumer credit/income.

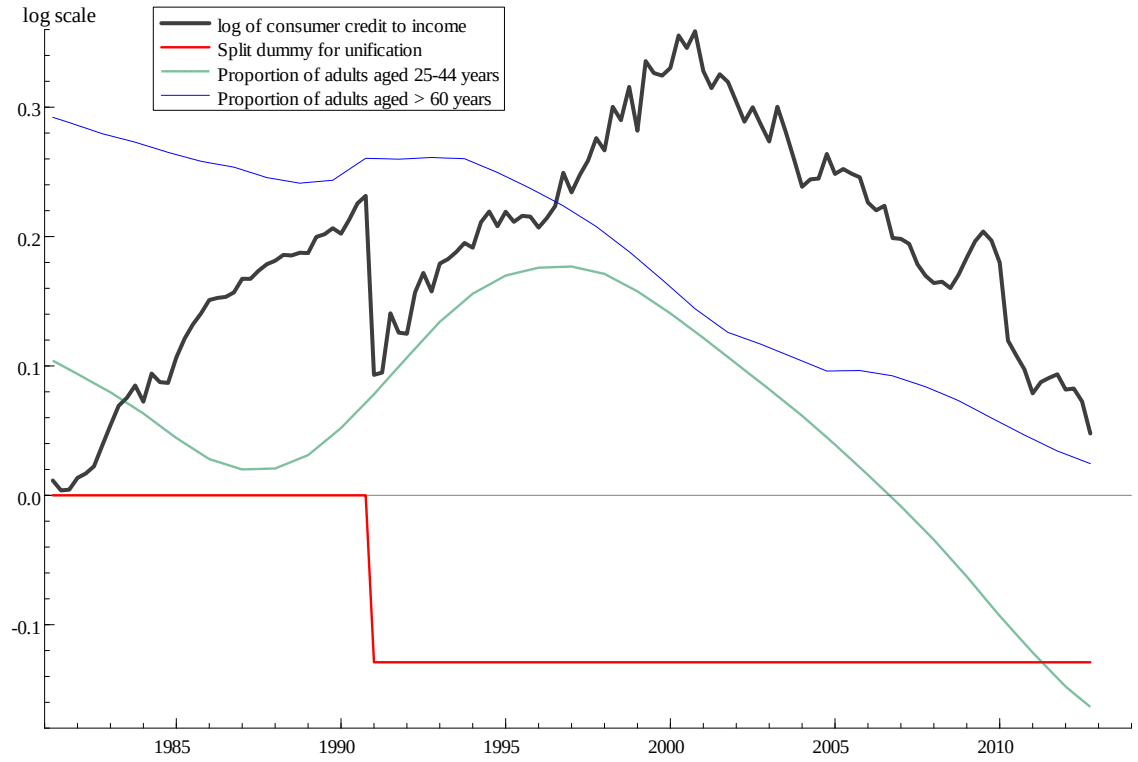

Figure 5.4b: Decomposition of adjusted long-run solution for log stock of consumer credit/income.

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. 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 5.4a.

5.5 The permanent income forecasting model

The construction of log 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 assume income growth of 1.2 percent per annum from 2013Q1 to 2014Q3 and 1.6 percent pa thereafter. But to avoid sensitivity to this assumption, the model is estimated to the end of 2007 to create forecasts for the entire sample to 2012Q4.

The dependent variable is log permanent/current income. This is explained by the deviation around some trending variables of log current income and by forward looking consumer confidence and a few economic variables. The key trending variables are a linear trend and the 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 with the expected negative coefficient, consumer confidence, log real house prices, log real equity prices, recent income growth – all with positive coefficients- and changes in US long-short spreads, a measure of global risk appetite. This has the opposite sign from that found in the consumption, mortgage debt and house price equations. The interpretation is that spreads tend to normalize, so that bad risk episodes tend to be followed by recovery of income growth. The equation also includes a smooth dummy for 1999 to capture some of the euphoria of the time.[19] The fit of the equation is remarkably good with an equation standard error of only 0.0026, thought the residuals are, of course, massively auto-

[19] Though the our consumer confidence measure peaks, other measures of consumer confidence which do not go back so far, show greater peaks in 1999-2000.

correlated. 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 5.5 below.

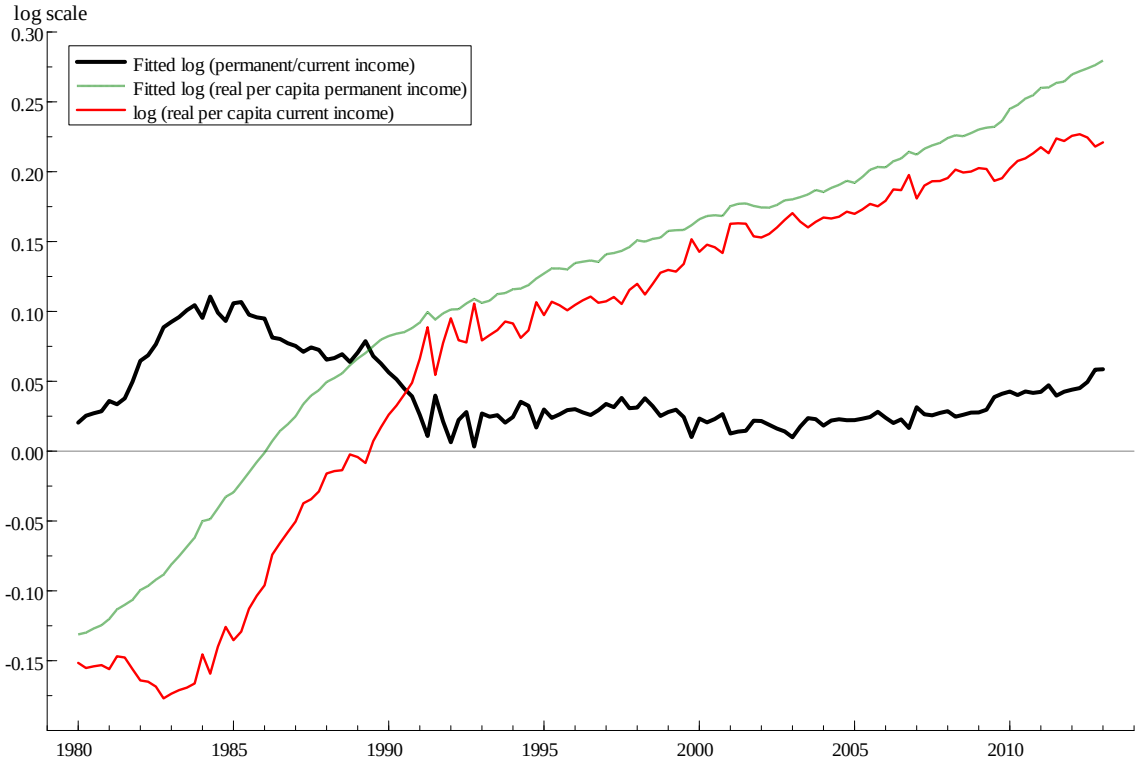

Figure 5.5: The log real per capita current income, fitted log real per capita permanent income and fitted log permanent/current income.

5.6 Estimates for the two credit conditions indices

For the period before 2002Q4 when the ECB's Bank Lending Survey (BLS) begins, both indices are specified as a linear combination of ogive[20] dummies which make a smooth transition from zero to one over eight quarters. The ogive dummy takes the values 0.05, 0.15, 0.3, 0.5, 0.7, 0.85, 0.95, 1 over an 8-quarter interval. From 2002Q4, a measure of credit conditions is constructed from the data on the proportions of banks reporting tightening of credit conditions respectively for consumer loans and mortgages. The BLS reports the change in conditions relative to the previous quarter, so the cumulated value since the survey began is a levels measure of the tightness of credit conditions. With estimated *negative* coefficients,

[20] Shaped like the cumulative frequency for a bell-shaped distribution.

this levels measure of tightness turns into a measure of ease of credit availability. The cumulated BLS data suggest that in Germany maximum credit availability since the survey began was reached in early or mid-2008, though conditions then deteriorated rapidly.

Eight dummies respectively are used in each latent variable to capture the evolving shapes before 2002. The estimated functions are shown in Figure 5.6.

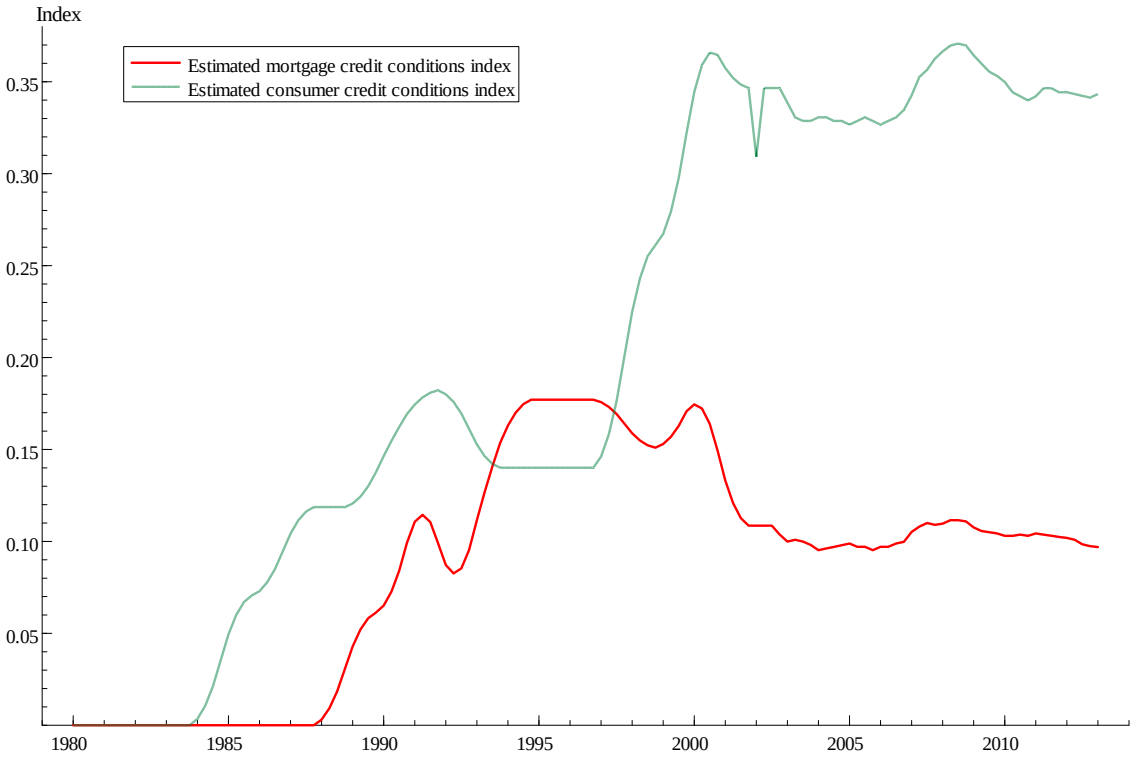

Figure 5.6: Estimated mortgage credit conditions index and estimated consumer credit conditions index

The rise in German consumer credit conditions in the mid-1980s parallels a similar rise in France, though on a much smaller scale. Credit conditions contracted in many countries in the early to mid-1990s and a modest decline 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 even after correcting for the effect of the 1991-1998 tax breaks for investors in the former East Germany. In the late 1990s, a time of general financial innovation, the latent variable for consumer credit availability rose strongly again, and broadly levelled out in the 2000s, while credit availability for mortgages contracted in the early 2000s. This may have been because German mortgage lenders such as Hypo Real

Estate, (mis)perceived better lending opportunities outside the Germany.[21] How these developments relate to changing bank leverage, the ratio of non-performing loans to total loans and other features of bank balance sheets would be interesting to examine.

6. Conclusions

The main findings of the paper 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 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 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. Given housing supply, income growth and low interest rates, house prices in Germany do not currently look overvalued. There might, however, be a small question mark over the continuation of recent house price increases in major German cities, potentially reflecting the role of outside property investors, and how sustainable the associated international cash-flows will be in future.

One 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 small positive direct effect of higher 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 negative effect via equity prices, stock market wealth relative to income is low in Germany compared to many other industrial countries. And the effect of higher interest rates on consumption via house prices is positive, since lower house prices boost spending. This takes income as given:

[21] HRE was rescued from failure in October 2008.

higher interest rates are likely to reduce income via the conventional channels: investment, 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.

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, 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 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.

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 compensate. However, there is potentially an alternative mechanism at work that may support the reduction in imbalances of competitiveness within the euro area via price and wage adjustments. Since the advent of the euro, German's relative unit labour costs within the euro area have fallen massively and only Ireland's have recovered the relative levels prevailing in 2000. As rising house prices feed into rents, a slow process, given Germany's system of flexible rent controls, there is the possibility that wage demands will respond to the higher cost of living thereby contributing to competitive adjustments within the euro area.

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α_2

Table 4.1: Estimates of the long-run solution of the German consumption function

Dependent Variable = $\Delta \ln c_t$	**Symbol**	**1981Q2-2012Q4**		**1981Q2-2012Q4 Excluding CCIs**	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients for log c/y					
Speed of adjustment	λ	0.774	17.7	0.70	14.6
Constant	α_0	0.097	0.9	-0.12	-1.2
Mortgage credit conditions index: *MCCI*	α_{0c}	0.084	3.7	-	-
Consumer credit CCI: *CRCCI*	α_{00c}	0.026	1.1	-	-
Real loan interest rate $_t$	α_1	-0.18	-2.8	-0.22	-3.0
Real deposit rate	α_2	0.38	5.5	0.43	5.1
Forecast future income growth: E $\ln(yperm / y)_t$	α_3	0.50	12.1	0.42	8.2
Net liquid assets$_{t-1}$ / y $_t$	γ_1	0.076	3.4	0.072	3.4
Illiquid financial assets$_{t-1}$ / y$_t$	γ_2	0.015	2.0	0.037	5.4
Log house prices/y$_{t-1}$	γ_3	-0.067	-2.3	-0.013	-0.5
Split at unification		0.011	3.8	0.014	4.8
1999 pension dummy		0.016	4.0	0.014	4.6
2001-8 pension dummy		-0.052	-4.8	-0.041	-3.6
Long-term change in child/adult ratio		0.0042	4.7	0.0019	1.9
Diagnostics					
Equation standard error	0.00249				0.00282
DW	2.03				1.97
R-squared	0.9313				0.8922

Table 4.2: Estimates of long-run solution for German house price equation

Dependent Variable = $\Delta_4 \ln hp_t$	**Symbol**	**1981Q2-2012Q4**		**1981Q2-2012Q4 Excluding *MCCI***	
		coefficient	*t- ratio*	*coefficient*	*t- ratio*
Long-run coefficients					
Speed of adjustment (annual)		0.667	14.8	0.385	10.9
Constant	h_0	10.9	12.1	6.55	5.6
Credit conditions index: *MCCI*	h_{0c}	1	-	0	-
Bias trend term		-0.001	fixed	-0.001	fixed
Tax effect for 1992		0.053	5.0	0.095	7.1
Tax effect for 1995[22]		-0.024	-2.9	-0.059	-2.9
Log nominal mortgage rate	h_1	-0.072	-2.4	-0.063	-2.0
Fitted log permanent/current income	a_3	0.50	12.1	0	fixed
Log (real income/house)	h_4	1.52	5.3	0.86	5.1
Momentum & spill-over		1.84	4.1	1.98	-11.4
Weight on external momentum		-0.77	-2.7	-0.77	fixed
Annual change in proportion of adults aged 24-44		0.045	3.9	0.061	2.2
Long-term change in child/adult ratio		0.023	11.0	0.026	4.9
Unification split		-0.029	-1.0	0.064	6.6
Diagnostics					
Equation standard error		0.00481		0.00756	
DW		0.93		0.57	
R-squared		0.973		0.9197	

[22] Note that sum of 1992, 1995 and 1997 tax effects is zero.

Table 4.3: Estimates of the long-run solution for the German mortgage stock equation

Dependent Variable = $\Delta \ln mdebt_t$	**Symbol**	**1981Q2-2012Q4**		**1981Q2-2012Q4 Excluding *MCCI***	
		coefficient	*t-ratio*	*coefficient*	*t-ratio*
Long-run coefficients for log (real mdebt /y)					
Speed of adjustment	π	0.084	12.1	0.12	9.6
Constant	m_0	-0.050	-1.9	-1.56	-6.8
Credit conditions index: *MCCI*	m_{0c}	1	fixed	0	fixed
Log nominal mortgage rate	m_1	-0.20	-7.2	-0.13	-5.9
Log (house prices/y)-bias term		-0.279	-5.7	-0.35	-7.4
Log (housing wealth/y)	m_7	0.463	4.0	1.06	10.4
Composite pension dummies		4.63	4.5	3.94	11.4
Unification split		0.14	4.5	0.10	3.9
Proportion of adults aged 24-44		0.0183	5.2	0.035	11.3
Diagnostics					
Equation standard error		0.00193		0.00241	
DW		2.09		1.53	
R-squared		0.9594		0.9431	

Table 4.4: Estimates of the long-run solution for the unsecured consumer credit stock equation for Germany

Dependent Variable = $\Delta \ln cdebt_t$	**Symbol**	**1981Q2-2012Q4**		**1981Q2-2012Q4 Excluding *CRCCI***	
		coefficient	*t-ratio*	*coefficient*	*t-ratio*
Long-run coefficients for log (real cdebt/y)					
Speed of adjustment	μ	0.55	10.9	0.048	1.4
Constant	u_0	-1.86	-8.8	1.68	0.5
Credit conditions index: *CRCCI*	u_{0c}	1	fixed	0	fixed
Log nominal short rate	u_1	-0.084	-2.9	0	fixed
Real rate	u_2	-0.980	3.8	-6.6	-1.0
Composite wealth etc term from consumption equation	u_6	0.97	3.6	4.7	1.6
Composite log house price & log housing wealth		0.5	fixed	2.8	2.0
Proportion of adults aged 25-44		0.037	19.7	0.069	2.9
Proportion of adults 60 and over		-0.036	-5.7	-0.13	-1.4
Unification split		-0.129	-4.7	-0.15	-1.0
Diagnostics					
Equation standard error		0.00639		0.008870	
DW		1.70		1.70	
R-squared		0.881		0.777	

Data Appendix

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 are only available on an annual basis and must be made quarterly accordingly. For this purpose, *household disposable income* is linked to the dynamics of quarterly seasonally adjusted compensation per employee, which is available back to 1980 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 1980-2013from 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 last observation matched to end of year figures).

Housing wealth and housing stock

Figures on *housing wealth (including land) and housing stock 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 is from the house price database of the OECD. This house price index is based on selected annual house price indices provided by the Bundesbank.

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 *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-Svennsson yield curve model calculated by the Bundesbank.

Population

Information on population is from the NSI. Annual 5-year age bands are available from 1980 onwards.

Other data

The unemployment rate and bank lending survey information is from the Bundesbank.