Consumption, Wealth and Business Cycles in Germany[1]

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Abstract

This paper studies the long-run relationship between consumption, asset wealth and income in Germany, based on data from 1980 to 2003. While earlier studies – mostly for the Anglo-Saxon economies – have generally documented that departures of these three variables from their common trend signal changes in asset prices, we find that for Germany they predict changes in income. Asset price changes are found to have virtually no effect on consumption – both in the short as well as in the long-run. We offer an explanation of this finding that emphasizes differences between the bank-based German financial system and the rather market-based Anglo-American system: stock ownership by private households is much less widespread in Germany than in the Anglo-Saxon economies and the share of publicly traded equity in household wealth is much smaller in Germany than in the U.S., the UK or Australia.

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1 Introduction

The idea that fluctuations in asset prices can have huge effects on the real economy and notably on consumption has recently obtained renewed and increased attention. In particular during the decline of international stock markets in the first years of this decade it was feared that consumers in countries where stock ownership is relatively widespread, might reduce their spending in response to an abrupt decrease in asset wealth.

Most extant empirical studies document a long-run relation between wealth and consumption, but the evidence on the effects of sudden and abrupt changes in asset prices – those most feared by policymakers – is much less clear cut.[1] One important reason why certain asset price busts may lead to pronounced adjustments in consumption whereas others do not is that the prices of financial assets may have transitory components. According to economic theory, consumption should react only to the permanent component of wealth. This could explain the long-run link between consumption and wealth. But to the extent that consumers perceive certain asset price fluctuations, e.g. the bull market of the late 1990s, as a temporary phenomenon, consumption should neither react to a build-up nor to a subsequent correction in stock prices.

If temporary fluctuations of wealth leave consumption unaffected then it should be possible to identify them with fluctuations in the consumption-wealth ratio. This fundamental insight underlies a recent strand of empirical research initiated by Lettau and Ludvigson (2001, 2004) that has demonstrated very convincingly that an empirical characterization of the consumption-wealth ratio predicts capital gains, and in particular excess returns in the stock market.

The results obtained by Lettau and Ludvigson for the United States have been corroborated for other economies (Fernandez-Corugedo et al. (2003) for the UK and Tan and Voss (2003) as well as Fisher and Voss (2004) for Australia), but all of these studies are based on data from Anglo-Saxon countries. To the best of our knowledge, there has, to date, not been any comparable evidence for economies in continental Europe. One reason for this could be that asset wealth data are not readily available for most continental European economies. In this paper, we compile a unique new data set of German household wealth that explicitly accounts for real estate. This allows us to examine the wealth effect on consumption, based on German data, from 1980 to 2003.

[1] The wealth effect on consumption is a classic theme of empirical macroeconomics dating back at least to the work of Modigliani (1971). We do not attempt to survey the literature here.

Our results – besides being of interest in their own right – provide important differential evidence vis-à-vis those studies that have concentrated on the Anglo-Saxon economies. Germany's financial system is one of the main representatives of the continental European type of financial system where private stock ownership is much less widespread than in the Anglo-Saxon countries and households generally hold large shares of their wealth in the form of relatively illiquid assets. The evidence we present here suggests that these differences find their reflection in a very different transmission mechanism between financial markets and the real economy and in particular in a very different role of asset price fluctuations for consumption.

In keeping with Lettau and Ludvigson, we can characterize the consumption-wealth ratio as a cointegrating relationship between consumption, asset wealth and income – the *cay* residual. But while earlier studies find the consumption-wealth ratio to predict fluctuations in asset wealth and in particular in stock prices, we find that the German *cay* mainly predicts temporary fluctuations in income – *cay* signals business cycles rather than stock market cycles. The dynamic analysis we conduct shows virtually no evidence of an effect from asset prices on German consumption, irrespective of whether these asset price changes are permanent or transitory. In German data, shocks to consumption ultimately reflect permanent shocks to income, in line with quite basic permanent income models.

We note that German asset prices and in particular stock markets *do* have transitory, predictable components; we find the U.S. consumption-wealth ratio to be a very good predictor of excess returns on the German stock market. However, stock price fluctuations hardly affect German household wealth, because households' direct ownership of stocks in Germany is very limited. This explains why fluctuations in the German consumption-wealth ratio do not help identify these transitory components.

The remainder of the paper is structured as follows: section two discusses recent evidence on stock market predictability and the particular role that the consumption wealth ratio plays in this literature. We build on Lettau and Ludvigson (2001, 2004) to derive the empirical approximation of the consumption-wealth ratio in terms of a cointegrating relationship between consumption, asset wealth and income. Section three offers a preview of our main results and suggests an interpretation. In section four we discuss our data set and our econometric implementation. Section five discusses and concludes.

2 The consumption wealth ratio and stock market predictability

A growing body of literature documents that asset prices, notably stocks, are predictable over the business cycle. While early analysts tended to interpret this finding as evidence of informational inefficiency or of herding and other forms of irrational behaviour, it is now widely acknowledged that predictability does not amount to a rejection of the efficient market paradigm. Rather, stock market predictability largely reflects time variation in risk and risk premia. There is now a range of rational-agent models that can explain why stock markets may be predictable. The most prominent of these are models with habit-formation mechanisms (Campbell and Cochrane (1999)), non-insurable background risk (Constantinides and Duffie (1996) and Heaton and Lucas (2000)) or limited stock market participation (Guo (2001), Vissing-Jørgensen (2002), Polkovnichenko (2004)).

Predictability in stock markets just means that stock returns have mean-reverting and therefore transitory components. The spread of the use of cointegration techniques over the last ten to fifteen years has hugely improved the possibilities for theory-based decompositions of financial time series into stationary (transitory) and integrated (permanent) components. In this way, a host of 'usual suspects' have been rehabilitated as successful predictors of stock returns: stock prices as well as dividends and earnings all are typically integrated variables, but the dividend-price ratio (Cochrane (1994)) as well as the price-earnings ratio and the dividend earnings ratio (Lamont (1998)) all define stationary (cointegrating) relations that have been found to have considerable predictive power for stock returns. Until relatively recently, however, stock markets seemed predictable almost exclusively from such financial variables, whereas real macroeconomic variables were found to have considerably less or no direct relation to stock market fluctuations[2].

One real macroeconomic variable that – according to all leading theoretical explanations – should be key in understanding the predictability of the equity premium and therefore for stock market returns as a whole is the consumption-wealth ratio. Models with habit-formation as well as models in which labour or entrepreneurial income form a source of non-diversifiable idiosyncratic risk (background risk) all generate time-variation in expected returns: if background risk is high, the average stock owner will require high expected returns to hold the economy's equity portfolio willingly, suggesting that stock prices and therefore wealth will have to be temporarily low. Similarly, habit-formation consumers become extremely risk averse

[2] For a discussion see Cochrane (2001).

when they have to reduce consumption in recessions. Therefore, the average stock-owning consumer will require high expected returns and again this will be reflected in temporarily low prices. Since consumption will only react to permanent fluctuations in wealth, this suggests that in both cases the consumption-wealth ratio should signal transitory fluctuations in stock market wealth.

Against this backdrop, the papers by Lettau and Ludvigson (2001, 2004) constitute a major breakthrough since they are the first to present conclusive evidence that the consumption-wealth ratio does indeed predict stock returns in post-war data from the United States. We employ their empirical framework in this paper.

The starting point of our analysis is to decompose total household wealth, W_t, into financial assets – claims to physical capital that we denote with A_t – and human capital, H_t:

$$W_t = A_t + H_t$$

Along a balanced growth path, the respective shares of financial and human wealth in total wealth should be constant. We denote the long run means of A_t/W_t and H_t/W_t with γ and $1-\gamma$ respectively. Re-arranging and taking natural logarithms (denoted with lower case letters), we obtain

$$\log(1 - \frac{A_t}{W_t}) = h_t - w_t$$

We expand this expression around γ to obtain

$$w_t = \kappa + \gamma a_t + (1-\gamma)h_t \tag{1}$$

where κ is a linearization constant.

Human capital is unobservable and so is therefore total wealth. We can still use (1) to obtain an empirical approximation of the log-consumption-wealth ratio, $\ln(C_t/W_t) = c_t - w_t$ by interpreting H_t as the present or permanent value of labour income. This allows us to use log labour income as a proxy for h_t. Denoting (log) labour income with y_t, we then obtain an observable approximation of the consumption wealth ratio that we denote with cay:

$$cay_t = c_t - \gamma a_t - (1-\gamma)y_t \approx c_t - w_t \tag{2}$$

This is the long-run relation that defines our main point of reference in this paper. In the appendix we derive this relation more formally and we show that:

$$cay_t = \mathbf{E}_t \left\{ \sum_{j=1}^{\infty} \rho^j \left[r_{t+j} - \Delta c_{t+j} \right] \right\} + (1-\gamma)\, z_t \tag{3}$$

Here r_t is the return on total wealth, which can be further disaggregated into the returns on asset holdings, r_t^a , and the returns on human wealth, r_t^h. $\rho = 1 - \exp(\overline{c - w})$ is one minus the long run consumption-wealth ratio, i.e. the steady state ratio of invested wealth in total wealth, z_t is a stationary variable with mean zero that captures transitory dynamics in income, and $\mathbf{E}_t$ denotes the expectations operator. To the extent that consumption growth and the return on total wealth are both stationary, the present value on the right hand side will be a stationary variable and so will be *cay*. Therefore, if c, a and y are individually integrated of order one, the three variables should be cointegrated. The presence of cointegration has far-reaching consequences: at least one of the three variable must adjust to restore *cay* to its long-run mean. The consumption-wealth ratio must therefore help to predict c, a or y, or even have predictive power for all three of them: equation (3) states that *cay* either reflects changes in expected future consumption or changes in the returns to wealth (i.e. in the returns to financial or human capital).

The punchline of the Lettau and Ludvigson results is that, in U.S. data, *cay* mainly predicts adjustment in asset wealth, whereas consumption and labour income come very close to pure random-walk behaviour – wealth is the one variable in the *cay*-relationship with a sizeable transitory component. This predictability in asset wealth is largely driven by the predictability of excess returns on the stock market - *cay* predicts time-variation in risk premia. Analogous results have been reported by Tan and Voss and Fernandez-Corugedo et al. for Australia and the UK respectively.

In this paper, we will report that income is the main variable to help adjust *cay* to its long-run mean in German data and that the consumption-wealth ratio predicts the German stock market only very poorly. Before discussing our empirical implementation and our data in more detail, we provide an informal preview on our results in the following section. We also suggest an interpretation that is based on the different structures of financial markets in Germany and the Anglo-Saxon economies.

3 First empirical results and a suggested interpretation

3.1 Properties of the consumption wealth ratio for Germany

The solid line in figure 1 is our estimate of *cay*, the consumption wealth ratio for Germany. The estimated relation is

$$cay_t = c_t - 0.31a_t - 0.74y_t \tag{4}$$

As can be gleaned from figure 1, this is clearly a mean-reverting relationship and our formal cointegration tests below support this conclusion. The dashed line in figure 1 is the detrended (log) consumption-income ratio, $c-y$, for Germany. Pure eye-balling reveals that $c - y$ is highly correlated with *cay*, suggesting that fluctuations in financial asset wealth do indeed seem to contribute little to fluctuations in the consumption-wealth ratio.

An alternative way to see that *cay* predicts changes in labour income rather than asset prices or consumption in German data is to run regressions of the form

$$x_{t+k} - x_t = \delta_k cay_t + u_t^k \tag{5}$$

where x measures, in turn, consumption, asset prices and income. Again, we report detailed results on such long-horizon regressions below. Figure 2 plots the R^2 of this regression as a function of the differencing horizon, k. Panel a) pertains to the German data set. For comparison, panel b) reports the corresponding results for the U.S. Comparing the two graphs clearly illustrates our point:

Consumption is almost unpredictable from the consumption-wealth ratio. The R^2 almost never exceeds 0.05. This is uniformly true in both the German and the U.S. data sets and our results in this respect provide a corroboration based on German data of those reported by Lettau and Ludvigson for the United States. This finding is important in its own right since it is predicted by virtually all versions of the permanent income hypothesis: fluctuations in the consumption wealth ratio should originate in either income or asset wealth. This is because fluctuations in $c - w$ are transitory and therefore consumption should not help to restore $c - w$ (or *cay* for that matter) to its mean.

Figure 2 also reveals the major difference between the roles that asset prices and labour income play in the U.S. and Germany in bringing the consumption-wealth ratio back to its long-run mean: in US data *cay* mainly predicts asset price changes, and the explanatory power is highest at horizons

of 3-4 years. In German data, *cay* predicts income changes and it does so best at business cycle frequencies, i.e. at horizons of 1-2 years.

What can explain these different adjustment mechanisms in Germany and in the U.S. (or – as the results in Tan and Voss and Fernandez-Corugedo et al. (2003) suggest: the Anglo-Saxon economies more generally)? The explanation we offer is based on the differences in the structure of the financial systems and in particular on the fact that stock ownership in Germany (and most continental European economies) is very concentrated relative to what we observe in the U.S. or in the UK and Australia. Stock market wealth only plays a minor role in the portfolio of the average German household. Therefore fluctuations in labour income are a relatively much more important lever in explaining fluctuations in *cay*.

3.2 Stock markets and household wealth: some comparative evidence

Germany's financial system is often characterized as bank-dominated while in Anglo-Saxon countries such as the US capital markets play a much bigger role for firms' financing decisions (see e.g. Allen and Gale (2000)). As a result, the German markets for both equity and corporate bonds are relatively small and the role of these two asset types in the net wealth position of the German private sector is minor.

In table 1, we present a range of statistics that illustrate the different roles of public equity markets for the US and the German economies at large and for household wealth in particular. As a first measure of the importance of public equity finance for the economy as a whole, we inspect market capitalization relative to GDP in panel I. In the case of Germany, the market value of equity as a percentage of GDP amounted to less than 40% in 1989 and stood at about 45% in 2003, showing the comparatively low growth dynamics in the value of equity outstanding. By contrast, the ratio of the market value of equity to GDP was at 55% in the US in 1989, but increased by a factor of 2.5 to more than 131% at the end of 2003. German stock market capitalization (relative to GDP) falls far behind the US market, both in terms of levels and in terms of growth.

[Table 1 about here]

Panel II provides an impression of the role of stocks for the net wealth positions of German and American households. In 2003, share holdings accounted for 3% in the German private sector net wealth position. This was

just under the boom years' peak of 4% and only slightly higher than the 2% that were recorded in 1985. By contrast, the share of equities in the average American household's net wealth position amounted to 33% in the second quarter of 2004. This was 6 percentage points more than in 1985.

Moreover, as is apparent from panel III of table 1, equity ownership in Germany is not as widespread as in the USA. The percentage of Germans holding shares has remained stable at low levels in the years from 1981 to 2003. In 2000, when equity indices peaked, a maximum of about 9% of the German population owned shares. This number declined to 7.8% in 2003 which was only slightly higher than in 1981 (6.4%). At the same time the proportion of American households owning shares increased from 19% in 1983 to about 50% in 2002.

The fact that pension systems are so fundamentally different in the two countries is also likely to help explain why the share of equity in household portfolios is so much lower in Germany than in the United States. In Germany, both the public as well as most employer-sponsored retirement schemes are financed on a "pay as you go" (PAYG) basis. Conversely, private mutual funds and pension funds play a much more important role in the Anglo-Saxon economies. In particular the U.S. saw considerable growth in the number of tax-deferrable defined contribution plans such as the 401 (k) throughout the entire 1980s and 90s (Poterba, Venti and Wise (1994, 1998)).

As a consequence of the minor role that equity holdings play in Germany, real estate wealth dominates the net wealth position of the German private sector. About two thirds of net asset wealth come under real estate wealth. In the US, by contrast, real housing wealth accounts for only about a third of total net wealth.

It would therefore seem conceivable that temporary fluctuations in *cay* capture temporary fluctuations in housing wealth. But while residential real estate prices in the US are characterized by long and pronounced swings over our sample period (1980-2003), prices in Germany have remained relatively flat.[3] Here too, differences in the financial system, in particular in the profiles of mortgage finance system, may play a major role: e.g., mortgage equity extraction is not used in Germany (as opposed to the US) and according to the BIS study by Tsatsaronis and Zhu (2004), banks' lending behaviour is more conservative and requires home buyers to provide relatively high levels of collateral for their mortgages. Against this backdrop, it is not surprising that Germany has not seen any pronounced cycles in the residential real estate market and that, therefore, fluctuations of the *cay* relation can hardly be attributed to real estate wealth.

[3] For a survey of recent research on housing prices see Tsatsaronis and Zhu (2004).

These facts clearly support the notion that fluctuations in income must be a relatively much more important lever – in fact the only remaining – in explaining fluctuations in the German consumption-wealth ratio. But it would seem that our results suggest that stock market prices do not have a transitory component in German data, even though there are compelling theoretical reasons to believe that stock markets in general should have transitory components that reflect time-varying risk premia. We make the following remarks: first, we *do* find that the *cay* residual is statistically significant in predicting excess returns on the German stock market. But in terms of economic significance, the predictive power of *cay* for asset prices and in particular for equity returns in Germany is negligible relative to what is found in the U.S., UK or Australian data sets. Secondly, this finding is in no way tantamount to saying that stock markets in Germany could not have sizeable transitory components. What we say is that the consumption-wealth ratio of the average German household does not help to identify these transitory components. We report some evidence below that suggests that the U.S. consumption-wealth ratio has considerable forecasting power for German stock returns.

Our finding that household disposable income – largely derived from labour – constitutes the transitory component of the consumption-wealth ratio in German data may seem at odds with the general notion that German labour markets are very rigid and that wages may display only very sluggish adjustment. But note that it is the sum of all household labour incomes that enters the intertemporal budget constraint from which the *cay*-relationship is derived. This sum is equally determined by temporary fluctuations in the unemployment rate and in hours worked, so that sizeable temporary fluctuations in labour income do not *a priori* contradict the view that the German labour market is rigid. Indeed, we report below that *cay* has considerable predictive power for fluctuations in the unemployment rate and other business cycle variables.

4 Empirical Implementation

Our empirical analysis proceeds as follows: we start by briefly presenting our data (section 4.1.). We then ascertain the cointegration properties of the data and we estimate the cointegrating relationship *cay* (section 4.2). Afterwards, we characterize the joint dynamics of consumption, asset wealth and income by means of a cointegrated vector autoregression (VECM) (section 4.3). This provides us with a basis for a decomposition of these three variables into permanent and transitory components. Finally, we further investigate the

forecasting properties of *cay* for a range of asset prices by means of long-horizon regressions in section 4.4. In section 4.5. we report on robustness and stability tests. Section 5 further discusses the results of the empirical analysis: first we extend the long-horizon regressions based on *cay* to a range of business cycle indicators. Secondly, we build on our VECM analysis to study the wealth effect on consumption based on a structural identification of shocks.

4.1 Data

Our data spans the period 1980Q1 to 2003Q2. The details concerning the construction of our data set are available in a separate appendix at the end of the paper. Here we discuss some conceptional issues.

The level of consumption that is relevant for our purposes does not directly correspond to recorded consumption expenditure or its components. Rather, true consumption is unobservable because, besides expenditure on non-durables and services, it also includes the consumption *services* derived from the stock of durables (rather than current durables expenditure itself). Lettau and Ludvigson, following the tradition in the literature (see e.g. Campbell and Mankiw (1989)) suggest to proxy consumption through expenditure on non-durables excluding shoes and clothing. We follow this approach in the present paper. Specifically, we obtain domestic consumption expenditure of private households by use and construct non-durables consumption as total consumption expenditure less spending on shoes, clothing, furniture and household appliances.

Note that we use disposable income rather than after tax labour income, in contrast to e.g. Lettau and Ludvigson. The difference between reported labour income and disposable income largely reflects proprietors' income which for two reasons should be part of the budget constraint of the average household: first, proprietors' income can also partly be interpreted as labour income, i.e. as a dividend to human capital. Secondly, our asset wealth data do not include a measure of proprietors' wealth (unlike the U.S. data used by Lettau and Ludvigson (2001,2004)). By including proprietors' income into our income concept, we therefore implicitly also proxy for the stock of proprietary capital, very much as we proxy for human capital through labour income.

The wealth variable used in this analysis contains both financial and housing wealth. Residential housing wealth was obtained by combining capital stock data from the German statistical office and a new price series that the Bundesbank calculates on the basis of information obtained from the Bulwien AG, which collects data on house prices in 60 German cities. For more

detail we refer the interested reader to the appendix.

4.2 Cointegration results

We start our empirical analysis with an inspection of the cointegration properties of the data. In this context, the proper choice of consumption concept is crucial and we therefore briefly discuss this issue.

Rudd and Whelan (2002) have argued that from the point of view of intertemporal budget balance, it is the intertemporal structure of *total* expenditure that matters, not the services eventually derived from these expenditures. The cointegrating relationship *cay* should therefore be based on total consumption expenditure. We respond to this potential objection by ascertaining the cointegration properties of the data using both the theoretically relevant concept (non-durables) as well as total consumption expenditure.

`[Table 2 about here]`

Table 2 reports cointegration tests for the two data sets (total/non-durables consumption, asset wealth and income). We take account of the structural break induced by German reunification by including a step dummy into the cointegrating space. The inclusion of deterministic drift terms can make standard critical values invalid. We therefore simulated the critical values for the likelihood ratio test (the trace statistics) using the program DisCo, developed by Søren Johansen and Bent Nielsen (1993) that is available from Bent Nielsen's web page.[4] On both data sets, the test strongly rejects the null of no cointegration at the 5 percent level, signalling the presence of one cointegrating relation in both data sets.[5]

Table 3 presents estimates of the cointegrating vector. These are obtained in two different ways: once based on Johansen's FIML-procedure and once based on Stock and Watson's (1993) dynamic OLS cointegrating regressions. Again we report results for total consumption expenditure and for non-durables.

`[Table 3 about here]`

[4] http://www.nuff.ox.ac.uk/users/nielsen/disco.html

[5] As an additional test, we re-estimated the model for the the period before (1980Q1-1990Q3) and after (1995Q1-2003Q4) German unification, (excluding its immediate aftermath). In spite of the low power of cointegration tests in such short samples, both the the maximum Eigenvalue as well as the trace tests strongly rejected the null of no cointegration in both subperiods.

As is apparent, the estimated cointegrating vector is robust to the choice of estimation method or consumption concept. According to equation (2), the coefficients on asset wealth and income should reflect the share of financial and human capital in total wealth. Since asset wealth is the discounted sum of all profits, γ should approximately reflect the economy's capital share. We estimate a value of around 0.3 throughout, quite in keeping with the results by Lettau Ludvigson and other researchers for other countries and close to the values generally reported for Germany. The sum of coefficients when total consumption expenditure is used is just below unity, the result predicted by equation (2). The sum of coefficients is slightly higher than unity when we use non-durables consumption. Hoffmann (2004) reports a similar finding for the U.S. and suggests an interpretation: when only non-durables consumption is used, the right hand side of the intertemporal budget constraint (wealth and the present value of labour income) should exceed the left hand side (the present value of non-durables consumption) by the steady state share of the stock of durables in wealth. Therefore, when we normalize the coefficient on (non-durables) consumption to unity, the sum of coefficients on wealth and income should be somewhat in excess of unity.

We sum up this section as confirming that the cointegrating relationship predicted by the intertemporal budget constraint of the average household is borne out strongly by the data. As our results show, we can identify this long-run relationship for both total and non-durables consumption. We have argued, however, that non-durables consumption is closer to the concept of consumption that is relevant on theoretical grounds. All further results in this paper will therefore be based on non-durables consumption. We refer to the cointegrating residual as *cay*, according to equation (4) above and – based on the cointegrating vector estimated from the Johansen procedure – we define

$$cay = c_t - 0.31a_t - 0.74y_t - 0.05stepDWU_t$$

where the step dummy $stepDWU_t$ controls for German unifcation.

4.3 VECM estimates

The presence of cointegration implies that the joint dynamics of consumption, asset wealth and income can be represented by a vector error correction model (VECM) so that (neglecting constant terms)

$$\mathbf{\Gamma}(\mathbf{L})\mathbf{\Delta}\mathbf{x}_t = \boldsymbol{\alpha}\boldsymbol{\beta}'\mathbf{x}_{t-1} + \boldsymbol{\varepsilon}_t$$

where $\mathbf{x}_t = \begin{bmatrix} c_t & a_t & y_t \end{bmatrix}'$, $\boldsymbol{\beta}' = \begin{bmatrix} 1 & -\gamma & -(1-\gamma) \end{bmatrix}$ is the cointegrating vec-

tor so that $cay_{t-1} = \boldsymbol{\beta}'\mathbf{x}_{t-1}$, $\boldsymbol{\alpha}$ is a vector of adjustment coefficients, $\boldsymbol{\Gamma}(\mathbf{L})$ is a $3 \times 3-$matrix polynomial in the lag operator $\mathbf{L}$ and $\boldsymbol{\varepsilon}_t$ is white noise.

[Table 4 about here]

In the estimation of the cointegrated VAR we included two lagged differences of $\mathbf{x}_t$ but we note that none of our results is sensitive to the choice of lag length.

Table 4 presents coefficient estimates of the VECM. The most important feature are the estimated coefficients on cay_{t-1} i.e. the error-correction loadings $\boldsymbol{\alpha}$. First, the coefficient α_1 in the consumption equation is insignificant, suggesting that consumption does not (at least not directly) contribute to the error-correction mechanism. The same is true for the asset wealth equation, whereas the coefficient on *cay* in the income equation is sizeable and highly significant: this result is in stark contrast with those reported by Lettau and Ludvigson for the U.S. and by other authors for the UK and Australia. It suggests that deviations of labour income, wealth and consumption from their common trends are corrected by adjustments in labor income rather than through adjustments in wealth. On other hand, our results are in line with those reported in earlier studies in as far as consumption does not contribute to the error-correction mechanism. This, indeed, suggests that consumption has no or (taking account of the lagged differences in the consumption equation) only a small transitory component, broadly in line with the permanent-income hypothesis.

We now identify the permanent and transitory components of consumption, asset wealth and labour income more formally. We do this in two ways: first, we build on work by Granger and Gonzalo (1995), Proietti (1997) and Johansen (1995). These authors have demonstrated that the permanent and transitory components of a cointegrated system can be represented as linear combination of the levels of $\mathbf{x}_t$. Expressing the permanent and transitory components as a linear combination of $\mathbf{x}_t$ offers the convenience that permanent and transitory components are straightforward to compute. Here we use a generalization of the permanent-transitory decomposition by Granger and Gonzalo (1995) as suggested by Proietti (1997). The Proietti decomposition is

$$\mathbf{x}_t = \mathbf{x}_t^P + \mathbf{x}_t^T = \mathbf{C}(\mathbf{1})\boldsymbol{\Gamma}(\mathbf{1})\mathbf{x}_t + (\mathbf{I} - \mathbf{C}(\mathbf{1})\boldsymbol{\Gamma}(\mathbf{1}))\mathbf{x}_t \tag{6}$$

where $\mathbf{x}_t^P$ is the trend of $\mathbf{x}_t$ and $\mathbf{x}_t^T$ its cycle. $\mathbf{C}(\mathbf{1})$ is the long-run response of the moving average representation of Δx and can be shown to have the

form

$$\mathbf{C}(\mathbf{1}) = \boldsymbol{\beta}_{\perp} \left[\boldsymbol{\alpha}'_{\perp} \, \boldsymbol{\Gamma}(\mathbf{1})\boldsymbol{\beta}'_{\perp}\right]^{-1} \boldsymbol{\alpha}'_{\perp} \tag{7}$$

and $\boldsymbol{\alpha}_{\perp}$ and $\boldsymbol{\beta}_{\perp}$ are the orthogonal complements of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ respectively.

In figure (2) we plot our data and the trend components of $\mathbf{x}_t$ as identified from (6). The graphs confirm our earlier conjecture that consumption and asset wealth are almost identical to their respective permanent levels, whereas labour income displays significant departures from trend.

The second way in which we examine the cyclical properties of consumption, wealth and labour income is through a direct identification of the permanent and transitory shocks to $\mathbf{x}_t$. Based on this approach we can obtain variance decompositions and impulse responses to study the dynamic properties of the system.[6]

Note that it follows from (7) above that the Beveridge-Nelson decomposition for $\mathbf{x}_t$ has the form

$$\mathbf{x}_t = \mathbf{A}\boldsymbol{\alpha}'_{\perp} \sum_{l=0}^{t} \boldsymbol{\varepsilon}_l + \mathbf{C}^*(\mathbf{L})\boldsymbol{\varepsilon}_t$$

where $\mathbf{A} = \boldsymbol{\beta}_{\perp} \left[\boldsymbol{\alpha}'_{\perp} \, \boldsymbol{\Gamma}(\mathbf{1})\boldsymbol{\beta}'_{\perp}\right]^{-1}$ and $\mathbf{C}^*(\mathbf{L})$ is a lag polynomial of infinite order.[7] Hence, the permanent shocks to $\mathbf{x}_t$ are given by

$$\boldsymbol{\pi}_t = \boldsymbol{\alpha}'_{\perp} \, \boldsymbol{\varepsilon}_t$$

Requiring permanent and transitory shocks to be orthogonal to each other, we obtain for the transitory shocks (see Johansen (1995))

$$\boldsymbol{\tau}_t = \boldsymbol{\alpha}'\boldsymbol{\Omega}^{-1}\boldsymbol{\varepsilon}_t$$

where $\boldsymbol{\Omega}$ is the covariance matrix of the reduced-form shocks $\boldsymbol{\varepsilon}_t$.

Note that in our case the dimension of $\mathbf{x}_t$ is three and we have one cointegrating relationship, implying that there are two permanent shocks feeding the two common trends in the system. These permanent shocks are not uniquely determined, since for any choice $\boldsymbol{\alpha}^{0\prime}_{\perp}$, any invertible linear combination $\boldsymbol{\pi}_t = \mathbf{S}\boldsymbol{\alpha}^{0\prime}_{\perp} \, \varepsilon_t$ will also qualify as a vector of permanent shocks. Still, as shown e.g. in Hoffmann (2001) and in the appendix to Becker and Hoffmann (2003), the relative variance contribution of permanent and transitory shocks is invariant to any particular choice of $\mathbf{S}$ and $\boldsymbol{\alpha}^{0}_{\perp}$.

[6] We report results from an impulse response analysis in section 5.2. below, in the context of our discussion of the wealth effect.

[7] Specifically, $\mathbf{C}^*(\mathbf{L}) = [\mathbf{C}(\mathbf{L}) - \mathbf{C}(\mathbf{1})] / (1 - \mathbf{L})$, where $\mathbf{C}(\mathbf{L})$ is the moving average representation of $\boldsymbol{\Delta}\mathbf{x}_t$, i.e. $\Delta\mathbf{x}_t = \mathbf{C}(\mathbf{L})\boldsymbol{\varepsilon}_t$.

[Table 5 about here]

Table (5) gives the variance contribution of transitory shocks to the forecast error in consumption, asset wealth and labour income. Again it is apparent that the only variable for which transitory shocks play some role is labour income: at the one quarter horizon, more than 70 percent of the forecast error variance of labour income are explained by transitory shocks and the impact of transitory shocks on labour income only decays slowly: at the two year horizon, transitory shocks still account for 16 percent of the variance.

Note also that consumption is the variable for which transitory shocks matter the least at all horizons. At the same time there *does* seem to be a small transitory component in asset wealth: it is not anywhere as important as it is for income, but transitory shocks *do* account for a small share of variation in asset prices. The contribution peaks at the 6 months horizon with 13 percent and decays only slowly afterwards. But in comparison with the results reported by Lettau and Ludvigson for the U.S., the transitory component in asset wealth that can be identified from the German consumption-wealth ratio appears rather small. It appears that income is the driving force behind deviations of consumption, asset wealth and income from their common trends.

We turn to documenting this point in more detail in the next subsection, where we provide results from long-horizon regressions of excess returns on our estimated *cay* and other explanatory variables, including the *cay* identified by Lettau and Ludvigson for the United States.

4.4 Long-Horizon Regressions

In this section, we provide detailed results for long-horizon regressions of the form (5):

$$x_{t+k} - x_t = \delta_k cay_t + u_t^k$$

In particular, we present further evidence that *cay* contains almost the same information as does the consumption income ratio in that it mainly predicts changes in income and not changes in asset prices. We also document that equity premia in the German stock market are better explained by the U.S. consumption wealth ratio than by its German counterpart.

Table 6 provides a first set of results. Here, we regress the components of the *cay* relation – consumption, asset wealth and income – on *cay*. To make

these regressions meaningful, we have removed the effect of German unification using the unification dummy and the associated coefficients estimated from the VECM.

[Table 6 about here]

Panel I shows long horizon regressions of consumption growth on *cay*. As is apparent, the *cay* residual has no predictive power for future consumption growth. In line with the permanent income hypothesis, household consumption behaviour is not influenced by short-run deviations of actual wealth from its long-run equilibrium value. Panel II of table 6 reports long-horizon regressions of the growth of total asset wealth, a, on *cay*. We find that the consumption-wealth ratio significantly predicts asset wealth at horizons from 6 months to 5 years. The associated coefficient is significant at horizons beyond two quarters and the associated $\overline{R}^2$ peaks around 28 percent at the 4-5 year horizon. Panel III of table 6 presents our results for income growth, Δy_t. The $\overline{R}^2$ attains values up to 0.32 at the two year horizon and the coefficients are highly significant at horizons below five years.

These results, on the one hand, seem to corroborate two important findings from our VECM-analysis: consumption is almost unpredictable and income has important cyclical components. But, on the other hand, they would seem to contradict our earlier finding that income is the only and major predictable component in the *cay* relationship and that asset prices are not predictable from *cay*.

But we note that predictability in asset wealth can arise even if asset *prices* are not predicted by *cay*: if income has an important transitory component but consumption reacts mainly to permanent shocks, then savings – income less consumption – will be predictable. Cumulated private savings are, however, an important component of asset wealth and therefore, if savings are predictable so will be wealth.

Our results underpin this interpretation along several dimensions: first, the predictive power of *cay* for income is concentrated at short horizons and the business cycle frequency. The $\overline{R}^2$ of the regression for asset wealth rises more slowly to peak only *after* that of the income regression, as should be the case if asset wealth is predictable mainly because savings are. Secondly closer inspection of the VECM results in table (4) reveals only one significant coefficient in the asset wealth equation – the coefficient on lagged income. Again,

this supports our point that predictability in asset wealth is ultimately due to the predictability in income. Third, in panel IV, we provide regressions for a comprehensive measure of asset prices that we construct as asset wealth purged of cumulated savings (as measured by $Y_t - C_t$). We denote this asset price measure with p_t.[8] At all horizons, this measure is a lot less predictable from *cay* than is a_t and the estimated coefficients are not consistently significant. Running the same regression based on a p_t constructed from the Lettau-Ludvigson data set for the U.S. reveals an R^2 of up to 0.45 and coefficients that are robustly significant up to horizons of five years. Hence, in German data, most of the predictability in asset wealth is ultimately due to predictability of savings and income over long horizons. Asset *prices* are barely predictable from the German consumption-wealth ratio.

Table 7 provides further evidence on this point. Panel I gives the results for the growth of real estate wealth, panel II for *excess* returns on the DAX and panel III for net returns on the DAX. The results corroborate the observation that asset prices play no role in bringing back the consumption-wealth ratio to its long-run value. The $\overline{R}^2$ of the changes in real estate wealth never exceeds 0.02 and the associated coefficients are never significant. Interestingly, the regression of DAX excess returns on *cay* is (marginally) significant at almost all horizons. The $\overline{R}^2$ for the excess return equation attains a maximum value of only 0.08 at the 5 year horizon, that for the net return regression equally peaks at 5 years with $\overline{R}^2 = 0.10$. This compares very poorly with the results reported by Lettau and Ludvigson (2004), who report $\overline{R}^2$ values for the net stock market return equation of up to 0.52 at business cycle frequencies and where the associated coefficients are robustly significant at all horizons.

`[Table 7 about here]`

It is important to emphasize that we are not saying that there is no transitory component in German asset prices. It is certainly true that German real estate prices have evolved very smoothly, i.e. without obvious temporary

[8] The law of motion for asset wealth can be written as $A_{t+1} = (1 + r_{t+1})(A_t + Y_t - C_t)$. Dividing through with A_t, taking logarithms and solving backwards it is straightforward to show that $a_{t+1} = \sum_{l=1}^{t+1} r_{t+l} + a_0 + \sum_{l=0}^{t} \log(1 + (Y_l - C_l)/A_l)$. The asset price measure we construct is $p_t = a_t - \sum_{l=0}^{t} \log(1 + (Y_l - C_l)/A_l)$. Under the null that asset returns are unpredictable, $r_{t+k} = r + v_{t+k}$, where r is a constant and v_{t+k} is *i.i.d.*. Then $\mathbf{E}_t(p_{t+k} - p_t) = kr$, i.e. p_t follows a random walk with drift and should therefore not be predictable from *cay* or other variables.

swings. But this is certainly not the case for the prices of financial assets, in particular for stocks. We believe that the reasons why we do not identify sizeable transitory components in the German stock market are those discussed in section 3.1.: firstly, stocks virtually do not matter in the German private sector's wealth position. Secondly, their ownership is even more concentrated than in the U.S. Therefore it is not possible to isolate the transitory component of the German stock market by analyzing the private sector's wealth position alone.

This point is borne out strongly by the results in table 8: here, we also include the U.S. consumption-wealth ratio as constructed by Lettau and Ludvigson (2004) into the long-horizon regression for excess returns: both the German and the U.S. *cay* are strongly significant at horizons between three and five years and $\overline{R}^2$ rises from 0.03 to reach 0.27 at a horizon of 12 quarters. The U.S. *cay* has considerable predictive power for excess returns in the German stock market. This suggests that there is considerable business-cycle variation in the German equity premium, but this variation displays an important international component.[9]

[Table 8 about here]

The results of our long-horizon regressions confirm a salient feature of our earlier, VECM-based findings: *cay* mainly predicts fluctuations in income, not in asset prices. We turn to a further discussion of this point in our concluding section. Before, we briefly report on a battery of exercises that we undertook to check the stability and robustness of our results.

4.5 Stability and robustness issues

Stability of the cointegrating relationship: We subscribe to the view put forward in L&L that to estimate long-run relationships, one has to use a long time series, so that instability in the cointegrating vector in short samples may have little to say. But note that our cointegrating vector *is* actually very stable, in particular it is robust to our treatment of German unification or to the inclusion or exclusion of the internet bubble from the sample.

Data quality and interpolation: our results could partly have to do with the fact that our wealth data had to be constructed from the ground up and had in parts to be interpolated. We make the following remarks: first,

[9] This ties in with recent results by Nitschka (2004), who documents that the U.S. *cay* has considerable predictive power for the stock markets of the other G7 economies, including Germany.

we would expect that interpolation should lead to more predictability in asset wealth rather than less. Secondly, we did the following exercises: (i) run our analysis with only the CDAX variable (rather than the total wealth variable). (ii) run the system in four variables (stock market and non-stock market wealth separately) and, (iii) on annual (i.e. non interpolated) data. (iv) re-run our long-horizon regression for the subsample Q1:1992 to Q1:2004, using the re-estimated *cay* residual for this time span. Though rather short, this period offers us the advantage that non-interpolated quarterly data are available. v) run the system with different consumption variables (i.e. excluding transportations and telecommunication). vi) run the system with labour income instead of disposable income.

None of these exercises substantially affects our conclusions: income is the key variable driving the mean reversion on *cay*.

5 Discussion and Conclusion

5.1 Business cycles rather than stock market cycles

In one important respect, our results differ markedly from those reported in the papers by Lettau and Ludvigson for the U.S. and Fernandez-Corugedo et al. and Voss et al. for the UK and Australia: temporary stock market fluctuations have almost no impact on the budget constraint of the average German household, because stocks account for only a minor share of German household net worth. Conversely, the consumption wealth ratio has considerable predictive power for income at business cycle frequencies: in Germany, *cay* predicts business cycles, not stock market cycles or the prices of other assets.

This result is somewhat reminiscent of Cochrane's (1994) finding that the consumption-income (GNP) ratio predicts cyclical fluctuations in U.S. GNP. Recall figure (2) that plots the *cay* residual against the detrended consumption-income ratio, denoted with *cy*. The correlation between the two time series is 0.8. This would seem to suggest that, in German data, the *cay* and *cy* contain the same information. To the extent that their fluctuations signal changes in disposable income, and therefore in real economic activity, one might therefore expect that – in analogy to the findings in Cochrane (1994) – *cay* and *cy* should have predictive power for measures of the business cycle at large.

In table 9 we demonstrate that this is indeed the case. The table provides results from predictive regressions of a set of business cycle indicators on *cy* and the difference between the consumption-wealth and the consumption

income ratio, $cay - cy$. As is apparent from all four sets of regressions, the coefficient on $cay - cy$ is hardly ever significant, suggesting that it is mainly the variation in cy that drives our findings.

[Table 9 about here]

While panel I just corroborates our earlier finding that income has an important transitory component, the results in panels II to IV show that $c(a)y$ has considerable forecasting power for other business cycle variables as well: while fluctuations in GDP (panel II) are not quite as predictable as income, we still attain an adjusted R^2 of 15 to 30 percent at business cycle frequencies. The consumption-income ratio is also a successful predictor of the unemployment rate (panel III); again it is mainly cy that has predictive power and the regression accounts for 15 to 40 percent of the variability in unemployment at horizons between 2 and 4 years. Finally, cy also successfully predicts inflation in the deflator of private consumption expenditure with a measure of fit of 0.23 at horizons as low as two quarters.

5.2 The wealth effect on consumption

One point of departure for this paper was to quantify the magnitude of a potential wealth effect on consumption in German data. Our analysis has highlighted that this question is somewhat ill-posed: if there are permanent and transitory shocks to wealth, then according to the theory, consumption should not react to transitory shocks at all. As we have seen, theory is a very good guide in this case – consumption is largely driven by permanent shocks.

To the extent that shocks to wealth are permanent, however, the effect on consumption can be gauged from the parameters of the cay relationship and from knowledge of the value of the ratio between consumption and asset wealth. To see this, note that the marginal propensity to consume out of wealth, ω_t, is defined as

$$C_t = \omega_t W_t = \omega_t (A_t + H_t) = \omega_t A_t + \omega_t \mu_t Y_t$$

where $\omega_t \mu_t$ defines the marginal propensity to consume out of income. From the above it is clear that the marginal propensity to consume out of total wealth just equals the marginal propensity to consume out of asset wealth, so that $\omega_t = \partial C_t / \partial A_t$. From the cay relationship we know that the long-run elasticity of consumption with respect to asset wealth is just equal to the share of asset wealth in total wealth, ,the capital share γ, so that

$$\frac{\partial C_t}{\partial A_t}\frac{A_t}{C_t} = \gamma$$

implying that

$$\omega_t = \gamma \frac{C_t}{A_t}$$

The annualized mean of C_t/A_t over our sample period is 0.1478, implying that the mean of ω_t is 0.044: a one Euro increase in asset wealth leads to a $4-5$ Euro cent increase in consumption spending per year. This number is in line with Ludvigson and Steindel (1999) who report a mean of ω_t for the U.S. of $4-5$ percent.

In our data set, asset wealth is predominantly permanent, whereas temporary fluctuations in income are the main driver of cyclical fluctuations in total wealth. Therefore, our estimate of 0.044 may capture the marginal propensity to consume out of asset wealth quite well, but is likely to be highly misleading with respect to the marginal propensity to consume out of total wealth, or, for that matter, out of income.

A fully dynamic analysis of the interactions between consumption, asset wealth and income may be a more reliable guide to the wealth effect. In figure (4) we plot impulse responses of c, a and y. These impulse responses are based on the decomposition of permanent and transitory shocks outlined in subsection 4.3. The transitory shock is readily identified from $\tau_t = \boldsymbol{\alpha}'\boldsymbol{\varepsilon}_t$. Since the adjustment coefficients on consumption (α_1) and wealth (α_2) are insignificant according to our estimates in table 4, we restrict $\boldsymbol{\alpha}' = \begin{bmatrix} 0, & 0, & \alpha_3 \end{bmatrix}'$. A possible choice for $\boldsymbol{\alpha}'_\perp$ is therefore given by

$$\boldsymbol{\alpha}'_\perp = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

so that the vector of permanent shocks is $\boldsymbol{\pi}_t = \boldsymbol{\alpha}'_\perp \boldsymbol{\varepsilon}_t = [\varepsilon_{ct}, \varepsilon_{at}]'$. This allows us to interpret the two permanent shocks as a shock to consumption (or total wealth) and a shock to asset wealth.[10]

The response to the transitory shock is very much in line with our earlier findings: consumption and also asset wealth almost do not react, whereas the response of income is very marked and persistent.

[10] Note that the permanent shocks $\boldsymbol{\pi}_t$ constructed in this way are not necessarily mutually orthogonal. Their covariance is $\boldsymbol{\alpha}'_\perp \boldsymbol{\Omega} \boldsymbol{\alpha}_\perp = \boldsymbol{\Omega}_{11}$, where $\boldsymbol{\Omega}_{11}$ is the 2×2-matrix in the upper left corner of $\boldsymbol{\Omega}$.To orthogonalize the entries in $\boldsymbol{\pi}_t$, we also do a Choleski-decomposition of $\boldsymbol{\alpha}'_\perp \boldsymbol{\Omega} \boldsymbol{\alpha}_\perp$.This does, however, not affect our results. The impulse responses and variance decompositions we report in this subsection are based on the orthogonalized permanent shocks.

After a permanent consumption shock, consumption reaches its new level immediately, whereas both asset wealth, but in particular income, reach their new permanent levels only gradually, after about 4-6 quarters. In accordance with economic theory, consumption 'overshoots' both asset wealth and income in the short run to adjust to its new permanent level immediately.

The second permanent shock is the shock to asset wealth. We interpret this shock as a temporary shock to asset returns. To underpin this interpretation, the respective panel in figure (4) also plots the impulse response of Δp, our comprehensive measure of asset price changes constructed in the previous section. The response of Δp is hump-shaped but transitory. The shock affects asset wealth and income asymmetrically, driving up asset wealth and driving down income. At the same time, it leaves consumption almost unaffected. Note that the *temporary* return shock will still have a one-off *permanent* effect on asset prices and therefore on asset wealth. It also drives down income permanently.[11]

To what extent are c, a and y driven by the two permanent shocks? Variance decompositions based on an orthogonalized version of the identification outlined above (see previous footnote) suggest that the asset wealth shock almost does not contribute to the variation in consumption and income, whereas the consumption shock explains virtually all consumption variability at all horizons. It also explains most income variability in the long-run. The consumption shock can therefore also be interpreted as a permanent income shock. This indicates that there is only a very limited direct effect of asset wealth on consumption in German data – a result that should caution against an over-interpretation of any estimate of the wealth effect that is based on a simple marginal propensity to consume.

[11] It may appear surprising that the return shock also leads to a permanent decline in income. But note that if human (and in our case: proprietary) capital is non-tradeable, then – as argued in Fisher and Voss (2004) – the discount factor to be applied to future income is just r^a, the return on financial wealth. In this case, the *cay*-relationship simplifies to the following representation:

$$cay = E_t \sum_{j=1}^{\infty} \rho^j \left[\gamma r^a_{t+j} + (1-\gamma)\,\Delta y_{t+j} - \Delta c_{t+j}\right]$$

As *cay* is stationary, it is ultimately not affected by a permanent shock on assets, which is equivalent to a temporary return shock. Therefore, a positive temporary return shock must be offset by a temporary decrease in either consumption or income growth. Recall that consumption is unpredictable and does not react to the shock. Consequently, this alternative representation for *cay* implies that it must be income growth that falls temporarily, implying that the level of income is reduced permanently.

5.3 Summary and Conclusion

This paper has studied the link between consumption and wealth in Germany during the period 1980-2003. Very much as earlier studies for other countries, we can identify an empirical approximation of the consumption-wealth ratio as a cointegrating relationship between consumption, asset wealth and income – the *cay* residual. In keeping with most versions of the permanent income hypothesis, we find that consumption mainly reacts to permanent innovations in asset wealth and income. But whereas earlier studies for the U.S., Australia and the UK have documented that this cointegrating relationship predicts changes in asset prices, in particular risk premia in the stock market, we find that *cay* mainly predicts income changes in German data. Our explanation for this phenomenon is that stock market wealth accounts for a much smaller share of household net worth in Germany than in the Anglo Saxon economies so that temporary fluctuations in stock markets have only very limited impact on German private household net worth. We have interpreted this observation in the light of well-documented structural differences in the financial and pension systems of continental Europe and the Anglo-Saxon economies.

Since we find the consumption-wealth ratio to predict income rather than stock market fluctuations, one may expect *cay* to have forecasting power for many macroeconomic variables over the business cycle. Using a range of macroeconomic indicators for Germany, we have documented that this is indeed the case. Conversely, we find that temporary components in the German stock market can be identified with cyclical variation in the U.S. consumption-wealth ratio: variation in the German equity premium over the business cycle seems largely driven by international forces.

Our framework also allowed us to obtain an empirical measure of the wealth effect on consumption. Our estimates are in line with those reported for other countries: a one Euro increase in asset wealth leads to an increase in consumption spending by around 4 to 5 Euro cent. Such estimates can however be misleading if wealth has considerable transitory components. As our results have demonstrated, consumption reacts predominantly to permanent shocks. While German household asset wealth is indeed largely permanent, transitory shocks account for the bulk of variation in income at business cycle frequencies. Furthermore, permanent shocks to income rather than wealth seem to be the predominant driving force behind German private consumption.

Technical Appendix: log-linearization of the budget constraint

Aggregate household wealth in period t, W_t, private consumption, C_t, and the net return on aggregate wealth, $R_{t+1,}$ determine aggregate wealth in period t+1:

$$W_{t+1} = (1 + R_{t+1})(W_t - C_t). \tag{8}$$

Defining $r \equiv \log(1 + R)$, dividing by W_t, taking logarithms and using lowercase letters to denote log variables, one gets:

$$\Delta w_{t+1} = r_{t+1} + \log(1 - \exp(c_t - w_t)).$$

Taking a first-order Taylor expansion, one obtains the following expression:

$$\Delta w_{t+1} = k + r_{t+1} + (1 - 1/\rho)(c_t - w_t), \tag{9}$$

where ρ is the steady-state ratio of invested wealth in total wealth, $(W - C)/W$ and k is a constant that is dropped in the following. The growth rate of aggregate wealth therefore depends on the rate of return and a fraction of the consumption wealth ratio.

Combining the identity $\Delta w_{t+1} = \Delta c_{t+1} + (c_t - w_t) - (c_{t+1} - w_{t+1})$ with 9, one gets:

$$c_t - w_t = \rho(r_{t+1} - \Delta c_{t+1}) + \rho(c_{t+1} - w_{t+1}) + \rho k. \tag{10}$$

Solving forward, imposing that $\lim_{j\to\infty} \rho^j (c_{t+j} - w_{t+j}) = 0$ and omitting the linearization constant, the log consumption wealth ratio can be expressed in the following way:

$$c_t - w_t = \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}). \tag{11}$$

Equation 11 also holds ex ante:

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}). \tag{12}$$

The logarithm of total household wealth can be approximated by a weighted average of the logarithm of its two components asset holdings, A, and human wealth, H,:

$$w_t \approx \gamma a_t + (1 - \gamma) h_t, \tag{13}$$

where γ is the average share of asset holdings in total wealth. Equally, the return on aggregate wealth is approximated by the a weighted average of the returns of asset holdings and human wealth, r_a and r_h respectively:

$$r_t \approx \gamma r_t^a + (1-\gamma)\, r_t^h \tag{14}$$

Substituting 13 and 14 into 12, one obtains:

$$c_t - \gamma a_t - (1-\gamma)\, h_t = E_t \sum_{j=1}^{\infty} \rho^j \left[\left(\gamma r_{t+j}^a + (1-\gamma)\, r_{t+j}^h \right) - \Delta c_{t+j} \right]. \tag{15}$$

As human capital is not observable, the nonstationary component of human wealth is proxied by labour income, Y, which implies that the log of human capital can be approximated by a constant, μ, log labour income and a stationary variable with mean zero, z:

$$h_t = \mu + y_t + z_t. \tag{16}$$

A combination of 15 and 16 shows that if the return on wealth is stationary and consumption is integrated of order one, there exists a cointegrating relationship between consumption, asset wealth and labour income:

$$c_t - \gamma a_t - (1-\gamma)\, y_t = E_t \sum_{j=1}^{\infty} \rho^j \left[\left(\gamma r_{t+j}^a + (1-\gamma)\, r_{t+j}^h \right) - \Delta c_{t+j} \right] + (1-\gamma)\, z_t. \tag{17}$$

Data Appendix

Consumption and income Quarterly consumption and income data is available from the German national accounts.

Seasonally and working-day adjusted real disposable income of private households was obtained by taking the sum of seasonally and working-day adjusted consumption and seasonally adjusted savings, thus assuming that savings do not contain a calendar effect. As for the time before 1991 only annual disposable income is available, quarterly data was obtained using a cubic spline. All pre-1991 data is for West Germany only.

Besides net wages and salaries and net monetary transfers received disposable household income consists of net transfers from abroad and net other household income. Besides proprietary income, 'net other income' also includes other forms of capital income such as corporate dividend and interest payments. It would be desirable to disentangle these income components further. For the relatively long time period we require for our analysis, 'other household income' is, however, only available as an aggregate .

We also note that income data before 1980 are partly based on different SNA-definitions, and therefore the results reported in this paper are based on a sample ranging from 1980Q1 to 2003Q2.

Financial wealth Annual data for net financial wealth of the private sector according to ESA95 is available from the financial accounts (Deutsche Bundesbank (2004)) from 1991 onwards. Internally available quarterly data for net financial wealth from 1991 onwards was used for the construction of our asset wealth variable. For the period before 1991 only annual West German data according to ESA79 can be obtained. The stock of shares and fixed-interest securities contained in this net financial wealth are at cumulated issue prices and nominal values respectively. Thus changes of wealth due to the variation of market prices are not adequately captured. However, stocks of shares and fixed-interest securities held by the private sector are available separately at current market prices. In order to picture the quarterly profile of net financial wealth at market values as adequately as possible,shares and fixed-interest security holdings at cumulated issue prices and nominal values were subtracted from net financial wealth. Quarterly data for the remaining variable, which is characterized by relatively little variation, was obtained by using a cubic spline. The series for shares at current market prices was then used to obtain quarterly values by assuming that its quarterly profile corresponds to the development of the stock market

performance index CDAX. For fixed-interest securities the bond market index REX was applied to generate a quarterly profile. Both series were then added to the rest of net financial wealth in order to obtain quarterly data of net financial wealth of the private sector at market values for the time prior to 1991.

Housing wealth Residential housing wealth was obtained by combining capital stock data from the German statistical office and a new price series that the Bundesbank calculates on the basis of information obtained from the Bulwien AG, which collects data on house prices in 60 German cities. These are weighted with population shares in order to construct house price indices.[12] The index used here is for the typical object of newly built apartments and terraced houses of good quality. For the time before 1995 the index was calculated on the basis of information for West Germany only. As the price data is annual, a quarterly profile was also obtained by applying a cubic spline. Capital stock data was constructed from annual data on gross fixed assets of residential housing (dwellings) at 1995 prices that is only available for all sectors combined and thus slightly overestimates the assets held by the private households. The quarterly profile was obtained by using the corresponding seasonally adjusted residential investment series from the national accounts. The implied annual capital consumption was calculated and assumed to follow a smooth quarterly path. Combining this with the quarterly investment data from the national accounts, a quarterly capital stock series could be generated. The series was extended backwards into the period before 1991 using growth rates obtained from West German data on fixed assets of residential housing at 1991 prices that is only available according to a slightly different statistical concept from the "dwellings" of the German data. Again, a quarterly profile of this data was obtained by applying a cubic spline.

[12] See Deutsche Bundesbank 2003a, b for more detailed information.

6 Literature

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7 Tables and Figures

Table 1: The role of stock markets in the U.S. and Germany

Panel I: Market capitalization [1)]

	1989	1995	2003
Germany	39.90%	23.20%	45.20%
USA	55.10%	95.20%	131.40%

Panel II: Composition of private sector wealth

	Germany [8)] in billion Euro			USA [9)] in billion US-Dollar		
	1985	1995	2003	1985	1995	2004Q2
Net worth of private sector [2),3)]	3242.6	5638.0	7431.9	14145.7	27555.7	45907.1
in percent						
Net financial assets [4)]	0.30	0.26	0.31	0.54	0.60	0.55
of which equities [5)]	0.02	0.04	0.03	0.27	0.32	0.33
Tangible assets	0.69	0.72	0.67	0.46	0.40	0.45
Real estate [6)]	0.65	0.68	0.64	0.37	0.31	0.37
Consumer durable goods [7)]	0.06	0.06	0.05	0.09	0.09	0.08

Panel III: Stock ownership by private households [11)]

	1981	1990	2000	2003
Germany [9)]	6.4%	6.2%	8.9%	7.8%
	1983	**1996**	**1999**	**2002**
USA [10)]	19.0%	43.2%	48.2%	49.5%

NOTES: [1)] Source: DAI Factbook, Chapter 5, 2003, [2)] including nonprofit organization, [3)] including durable consumer goods, [4)] financial assets: credit market instruments + security [5)] Corporate equities, mutual fund shares, equity in noncorporate business, excluding pension funds, [6)] including real estate of nonprofit organizations, [7)] for the US: including equipment and software owned by nonprofit organizations, for Germany: including shoes, clothes, transport and telecommunication, calculated from flow data on basis of the perpetual inventory method, implied quarterly deduction rate 10%, [8)] German data: financial accounts (Deutsche Bundesbank (2004)), [9)] percentage of population over 14 with share holdings , [10)] percentage of households. [11)] Source: Equity Ownership in America,ICI and SEA, 2002 and DAI Factbook.

Table 2: Likelihood ratio (trace) tests for cointegration

# of cointegrating relations	consumption concept		critical values	
	non-durables	Total	95%	99%
$h = 0$ vs. $h > 0 (h = 1)$	**37.63**	**46.19**	34.72	40.39
$h = 1$ vs. $h > 1 (h = 2)$	13.39	6.90	18.87	23.38

NOTES: Critical values are simulated by DisCo. The number of drift functions with unrestricted parameters u (i.e. the drift functions in the short run part of our VECM) equals two in our specification (a constant and a dynamic dummy for the observation in 1990Q4). Let n be the number of variables and h the number of cointegrating relations. Since the number of unrestricted drift functions u (in our case: $u = 2$) cannot exceed the number of common trends $(n - h)$, the last hypothesis we are able to test with the trace statistics is $h = 1$ vs $h > 1$. Formally: $u \leq (\min(p - h, 3))$. For a discussion see Saikkonen, P. and Lütkepohl, H. (2000).

Table 3: Estimated cointegrating vectors

	Non-Durables Consumption		Total Consumption	
	Johansen	Dynamic OLS	Johansen	Dynamic OLS
β_c	1	1	1	1
β_a	-0.3124	-0.3127	-0.2211	- 0.2328
β_y	-0.7393	- 0.7248	-0.7493	- 0.7504
β_{dum}	-0.0490	-0.0505	-0.04	-0.04

NOTES: β_x where $x = c, a, y$ in turn , denotes the coefficient on consumption, asset wealth and income respetively . β_{dum} is the coefficient on the German unification step dummy $\mathbf{1}_{[1990Q4:2003Q4]}$.

Table 4: Estimated VECM

	Equation		
	Δc_t	Δa_t	Δy_t
Δc_{t-1}	-0.2075	-0.1251	-0.1450
	(-1.4899)	(-1.2425)	(-1.2220)
Δa_{t-1}	-0.0567	0.0105	-0.0893
	(-0.9065)	(0.2329)	(-1.6750)
Δy_{t-1}	0.1782	**0.1753**	0.1584
	(1.4711)	(2.0011)	(1.53511)
Δc_{t-2}	0.0353	0.0380	-0.1062
	(0.2709)	(0.4039)	(-0.9571)
Δa_{t-2}	**0.1300**	0.0449	**0.1703**
	(2.1649)	(1.0337)	(3.3284)
Δy_{t-2}	**-0.2417**	-0.0736	0.0769
	(-2.1580)	(-0.9091)	(0.8056)
cay_{t-1}	0.0337	0.1118	**0.3944**
	(0.3231)	(1.4801)	(4.4322)
	deterministic terms		
dummy (Q4:90)	**-0.0906**	**-0.2315**	**-0.0772**
	(-9.3652)	(-33.1007)	(-9.3720)
constant	**0.0050**	**0.0053**	**0.0032**
	(4.8145)	(7.1379)	(3.6259)
R^2	0.55	0.93	0.61

NOTES: t-values in parentheses. dummy (Q4:90) is an impulse dummy. $cay_t = c_t - 0.31a_t - 0.74y_t - 0.05$ StepDWU where StepDWU=$\mathbf{1}_{[1990Q4:2003Q4]}$. is the step dummy correcting for the effect of unification.

Table 5: Variance decompositions

	Variance share of transitory component							
	Horizon k in quarters							
	1	2	4	8	12	16	20	24
$c_{t+k} - \mathbf{E}_t(c_{t+k})$	0.0038	0.0564	0.0469	0.0425	0.0404	0.0392	0.0385	0.0380
	[0.00-0.14]	[0.014-0.20]	[0.01-0.18]	[0.01-0.15]	[0.01-0.14]	[0.01 -0.14]	[0.01-0.14]	[0.01-0.13]
$a_{t+k} - \mathbf{E}_t(a_{t+k})$	0.0800	0.1296	0.1023	0.0779	0.0690	0.0642	0.0613	0.0594
	[0.00-0.34]	[0.02-0.27]	[0.02-0.23]	[0.02-0.17]	[0.02-0.15]	[0.02-0.14]	[0.02-0.14]	[0.02-0.14]
$y_{t+k} - \mathbf{E}_t(y_{t+k})$	0.7173	0.5669	0.3675	0.1694	0.1162	0.0917	0.0772	0.0677
	[0.31-0.92]	[0.24-0.76]	[0.13-0.54]	[0.07-0.26]	[0.05-0.19]	[0.04-0.17]	[0.03- 0.15]	[0.03-0.15]

NOTES: numbers in parentheses give the 90%-confidence intervals obtained from a bootstrap with 250 replications

Table 6

Univariate long-horizon regressions of c, a and y **on** cay

$$\sum_{l=1}^{k} \Delta x_{t+l} = \delta_k cay_t + \mu_k + v_{kt}$$

	Horizon k in quarters						
	1	2	4	8	12	16	20
Panel I: consumption – $\Delta x_t = \Delta c_t$							
δ_k	-0.08	0.02	-0.01	0.34	0.19	0.06	0.03
t-stat	(-0.86)	(0.21)	(-0.03)	(1.74)	(0.64)	(0.14)	(0.05)
$\overline{R^2}$	[-0.00]	[-0.01]	[-0.01]	[-0.02]	[-0.01]	[0.01]	[0.01]
Panel II: financial wealth – $\Delta x_t = \Delta a_t$							
δ_k	0.07	**0.24**	**0.31**	**0.59**	**0.95**	**0.86**	**0.76**
t-stat	(1.20)	(2.62)	(2.08)	(4.56)	(7.21)	(5.90)	(9.66)
$\overline{R^2}$	[0.0021]	[0.05]	[0.05]	[0.11]	[0.26]	[0.28]	[0.27]
Panel III: income – $\Delta x_t = \Delta y_t$							
δ_k	**0.31**	**0.63**	**0.91**	**1.49**	**1.62**	**1.32**	1.13
t-stat	(4.93)	(6.65)	(4.44)	(5.29)	(3.61)	(2.43)	(1.75)
$\overline{R^2}$	[0.13]	[0.26]	[0.29]	[0.32]	[0.27]	[0.14]	[0.08]
Panel IV: asset prices – $\Delta x_t = \Delta p_t$							
δ_k	0.08	0.26	0.31	**0.56**	**0.80**	0.70	0.51
t-stat	(1.26)	(2.53)	(1.71)	(2.74)	(2.44)	(1.54)	(1.35)
$\overline{R^2}$	[0.0068]	[0.0598]	[0.0473]	[0.0762]	[0.1239]	[0.0780]	[0.0315]

NOTES: Panel I-IV: OLS regressions. $t-$statistics are based on heteroskedasticity and autocorrelation consistent standard errors based on Newey and West (1987), using a window width of $k+1$. Panel IV only: Our asset price measure is constructed as asset wealth net of cumulated savings: $p_t = a_t - \sum_{l=1}^{t} \log(1 + (Y_l - C_l)/A_l)$.

Table 7

Univariate long-horizon regressions on cay: components of asset wealth

$$\sum_{l=1}^{k} \Delta x_{t+l} = \delta_k cay_t + \mu_k + v_{kt}$$

	Horizon k in quarters						
	1	2	4	8	12	16	20
Panel I: real estate wealth – $\Delta x_t = \Delta a_t^{\text{real estate}}$							
δ_k	0.09	0.19	0.36	0.38	0.38	0.43	0.33
t-stat	(0.77)	(0.77)	(0.75)	(0.47)	(0.41)	(0.44)	(0.31)
$\overline{R^2}$	[0.01]	[0.02]	[0.00]	[-0.01]	[-0.01]	[-0.01]	[-0.01]
Panel II: excess returns on the stock market (DAX) – $\Delta x_t = r_t^{dax} - r_t^f$							
δ_k	**2.81**	**4.27**	4.25	0.18	-4.91	**-8.42**	**-11.3**
t-stat	(2.25)	(2.73)	(1.99)	(0.04)	(-1.32)	(-2.44)	(-2.59)
$\overline{R^2}$	[0.03]	[0.04]	[0.02]	[-0.01]	[0.00]	[0.04]	[0.08]
Panel III: net stock market returns – $\Delta x_t = r_t^{dax}$							
δ_k	**1.70**	2.59	4.06	0.26	-4.44	**-9.18**	**-11.86**
t-stat	(2.07)	(1.93)	(1.94)	(0.07)	(-1.57)	(-2.94)	(-3.15)
$\overline{R^2}$	[0.02]	[0.02]	[0.03]	[-0.01]	[0.01]	[0.06]	[0.10]

NOTES: OLS regressions. $t-$statistics are based on heteroskedasticity and autocorrelation consistent standard errors based on Newey and West (1987), using a window width of $k+1$.. The risk free rate, r_f, is a 3-months money market rate and $r^{dax} = \Delta \log(DAX_t)$ the quarterly return on the DAX.

Table 8

LH regressions of DAX excess returns on U.S. *cay*

$$\sum_{l=1}^{k} \Delta x_{t+l} = \delta_{1k} cay_t^{GER} + \delta_{2k} cay_t^{US} + \mu_k + v_{kt}$$

	Horizon k in quarters						
	1	2	4	8	12	16	20
Panel I: excess returns on the DAX - $\Delta x_t = r_t^{dax} - r_t^f$							
δ_{1k}	1.56	2.35	3.32	-1.29	**-7.66**	**-11.48**	**15.74**
t-stat	(1.98)	(1.81)	(1.65)	(-0.35)	(-2.84)	(-3.71)	(-3.88)
δ_{2k}	1.13	1.92	4.27	8.33	**14.64**	**15.54**	18.15
t-stat	(1.43)	(1.38)	(1.46)	(1.74)	(2.83)	(2.12)	(1.85)
$\overline{R^2}$	[0.03]	[0.04]	[0.08]	[0.10]	[0.27]	[0.25]	[0.26]

NOTES: see table 7.

Table 9

Regressions of business cycle indicators on cy and $cay - cy$.

$$\sum_{l=1}^{k} \Delta x_{t+l} = \delta_{1k} cy_t + \delta_{2k} \left[cay_t - cy_t \right] + \mu_k + v_{kt}$$

	Horizon k in quarters						
	1	2	4	8	12	16	20
Panel I: income – $\Delta x_t = \Delta y_t$							
δ_{1k}	**0.31**	**0.58**	**0.88**	**1.41**	**1.67**	**1.47**	**1.26**
	(4.63)	(5.21)	(4.01)	(5.10)	(4.81)	(4.12)	(3.91)
δ_{2k}	0.15	0.26	0.28	0.17	-0.16	-1.26	-2.43
	(1.09)	(1.23)	(0.80)	(0.32)	(-0.27)	(-2.52)	(-4.81)
$\overline{R^2}$	[0.13]	[0.24]	[0.32]	[0.42]	[0.45]	[0.49]	[0.60]
Panel II: gdp growth – $\Delta x_t = \Delta gdp_t$							
δ_{1k}	0.11	**0.34**	**0.56**	**0.98**	**1.14**	1.04	0.93
	(1.44)	(2.94)	(2.36)	(2.64)	(2.06)	(1.85)	(1.38)
δ_{2k}	0.06	0.21	0.30	0.22	-0.04	-1.21	-2.34
	(0.42)	(0.83)	(0.68)	(0.36)	(-0.04)	(-1.33)	(-1.91)
$\overline{R^2}$	[-0.01]	[0.06]	[0.09]	[0.15]	[0.15]	[0.22]	[0.30]
Panel III: unemployment rate – $\Delta x_t = \Delta U_t$							
δ_{1k}	**-0.08**	**-0.15**	**-0.31**	**-0.44**	-0.44	**-0.43**	**-0.47**
	(-3.61)	(-3.34)	(-3.73)	(-2.23)	(-1.95)	(-2.13)	(-2.31)
δ_{2k}	-0.03	-0.05	-0.08	0.01	0.25	0.68	1.08
	(-0.41)	(-0.38)	(-0.30)	(0.03)	(0.47)	(1.32)	(1.91)
$\overline{R^2}$	[0.08]	[0.11]	[0.16]	[0.14]	[0.14]	[0.25]	[0.41]
Panel IV: private consumption deflator – $\Delta x_t = \Delta pce_t$							
δ_{1k}	**-0.14**	**-0.34**	**-0.49**	**-0.86**	**-1.04**	**-0.98**	-0.73
	(-2.07)	(-2.85)	(-2.10)	(-2.83)	(-2.75)	(-2.31)	(-1.95)
δ_{2k}	-0.00	-0.03	0.13	0.35	0.87	1.53	2.20
	(-0.03)	(-0.14)	(0.35)	(0.51)	(1.05)	(1.85)	(3.07)
$\overline{R^2}$	[0.10]	[0.23]	[0.21]	[0.27]	[0.35]	[0.38]	[0.40]

NOTES: cy is the residual of a regression of $c_t - y_t$ on a constant and a linear trend. Further notes see table 7.

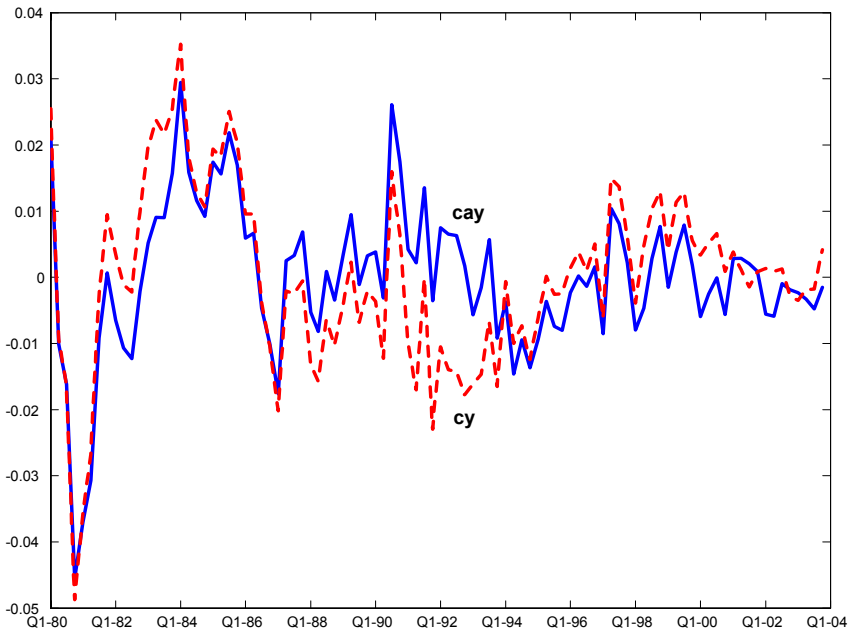
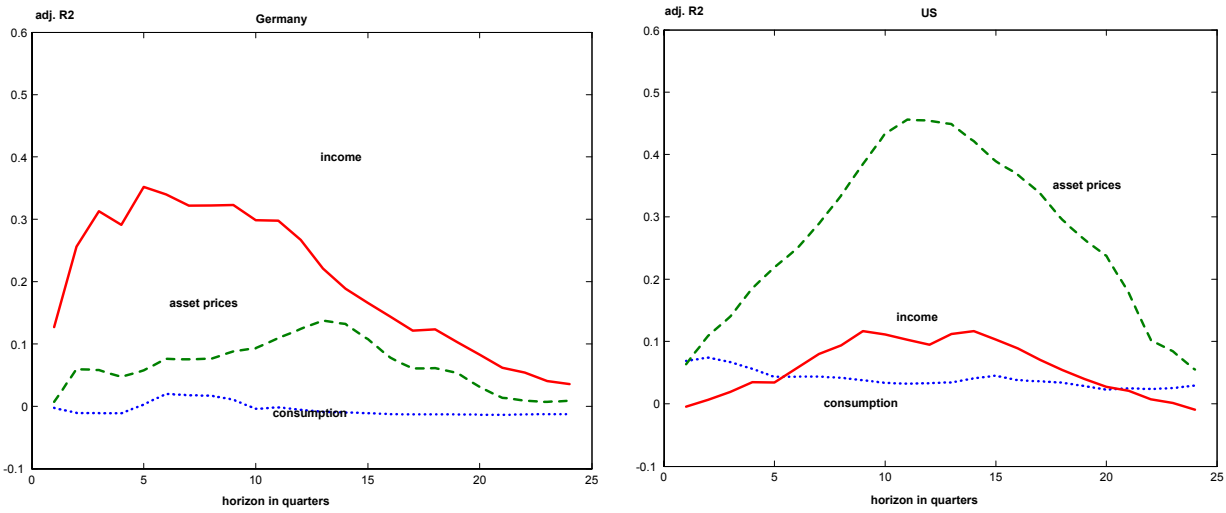


Figure 1: Consumption-wealth ratio (cay) and detrended consumption income ratio (cy) for Germany



Panel a): Germany Panel b): United States

Figure 2: Explanatory power of cay – adj. R^2 as a function of the forecast horizon

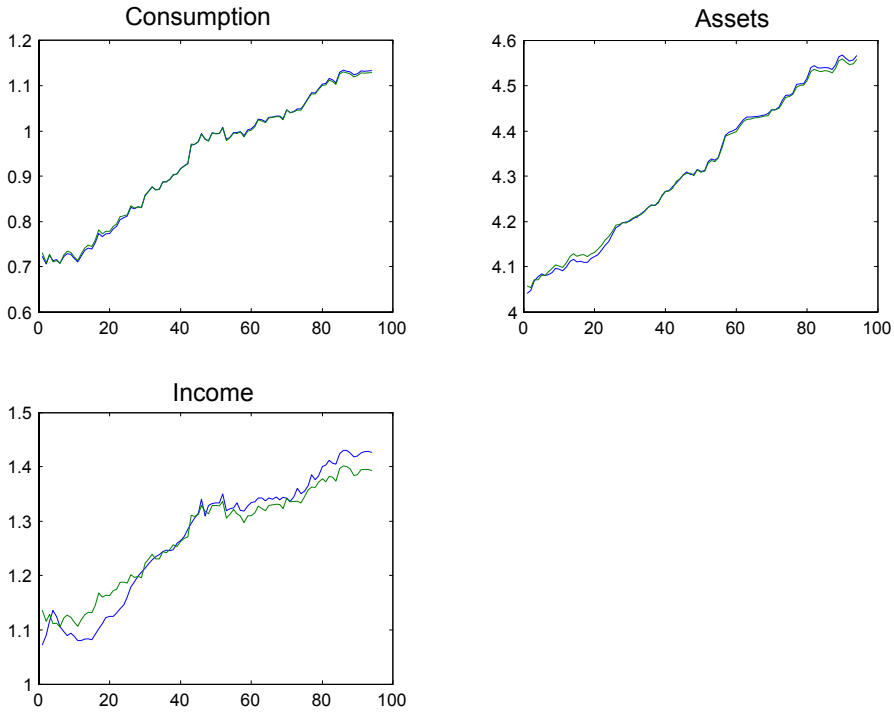


Figure 3: the data vs. their trend components(German unification dummied out)

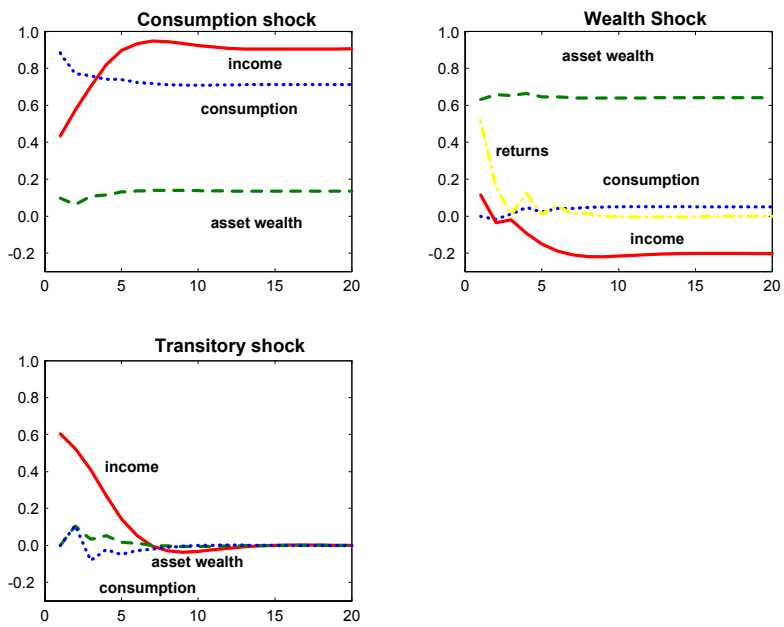


Figure 4: Impulse responses of the VECM