E C O N O M I C S B U L L E T I N

Does Consumption−Wealth Ratio Signal Stock Returns? − VECM Results for Germany

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Abstract

This paper studies the signalling effect of the consumption−wealth ratio (cay) on German stock returns via vector error correction models (VECMs). The effect of cay on U.S. stock returns has been recently confirmed by Lettau and Ludvigson with a two−stage method. In this paper, performance of the VECMs and the two−stage method are compared in both German and U.S. data. It is found that the VECMs are more suitable to study the effect of cay on stock returns than the two−stage method. Using the Conditional−Subset VECM, cay signals real stock returns and excess returns in both data sets significantly. The estimated coefficient on cay for stock returns turns out to be two times greater in U.S. data than in German data. When the two−stage method is used, cay has no significant effect on German stock returns. Besides, it is also found that cay signals German wealth growth and U.S. income growth significantly.

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1. Introduction

Since the 1990s, there is evidence that stock returns could be signalled by macroeconomic variables, such as the investment-capital ratio (Cochrane 1991) and the consumption-wealth ratio (Lettau and Ludvigson 2001). Using U.S. quarterly data from 1952 to 1998, Lettau and Ludvigson find that consumption, asset holdings, and labor income are cointegrated. The deviations from the common trend, the consumption-wealth ratio, is a strong signal of stock returns, but not of consumption growth. This evidence is interpreted by the forward-looking behaviour of investors. When the future stock returns are expected to increase (decrease), the investor who want to smooth the consumption path will increase (decrease) the consumption above (under) its trend with the current wealth and labor income. A two-stage method has been used by Lettau and Ludvigson. In the first stage, the dynamic least square (DLS) approach is adopted to estimate the regression of consumption on wealth and labor income. Using the estimated coefficients, the estimated trend deviation, $\widehat{cay}$, can be obtained. In the second stage, the signalling effect of $\widehat{cay}$ on stock returns is investigated via the ordinary least squares (OLS) regression or the vector autoregressive (VAR) model.

This paper studies the role of cay as a signal of German stock returns in the vector error correction models (VECMs). Not only the signalling effect of cay on stock returns (r) but also the cointegration relation among consumption (c), wealth (a) and labor income (y) can be investigated via VECMs in one stage. The maximum likelihood (ML) estimator from the VECMs is based on full information over all equations explaining c, a, y, and r. In contrast, the DLS approach contains only limited information in a single equation for c conditional on a and y. Thus, the ML estimator from the VECMs is likely more efficient than the estimator from the two-stage method. To compare the performance of the two-stage method with the one of the VECMs, both Germany and U.S. data sets have been investigated. U.S. quarterly data from 1952.4 to 1998.3 are those from Lettau and Ludvigson (2001). German quarterly data are from 1971.1 to 2002.4. Using the Conditional-Subset VECM, cay signals both real stock returns and excess return over a Treasury bill rate in both German and U.S. data sets significantly. When the two-stage method is used, the effect of cay on stock returns is not confirmed in German data. Moreover, via the Conditional-Subset VECM, cay has significant impact on German wealth growth and U.S. income growth. These empirical results cannot be explained by the theory of the consumption-wealth ratio.

The rest of the paper is organized as follows. Part 2 presents the macroeconomic model of the consumption-wealth ratio. Part 3 describes the VECMs used in this paper and the two-stage method used by Lettau and Ludvigson. Part 4 shows the performance of cay in the German data with the two-stage method. Part 5 investigates the signalling effect of cay on stock returns in both data sets with the VECMs. Part 6 concludes.

2. The Consumption-Wealth Ratio

The consumption-wealth ratio is firstly considered by Campbell and Mankiw (1989) to determine the current level of consumption by wealth (or income) and asset returns.

The log consumption-wealth ratio is shown by them as,

$$c_t - w_t = \sum_{i=1}^{\infty} \rho_w^i (r_{w,t+i} - \Delta c_{t+i}) + \rho k/(1-\rho), \tag{1}$$

where c_t denotes the logarithm of consumption in period t, w_t is the logarithm of aggregate wealth in period t, and r_w is the logarithm of the gross return on aggregate wealth. ρ and k are constant terms. Equation (1) shows that the log consumption-wealth ratio of today is associated with the future rate of return on invested wealth and future consumption growth.

Four further assumptions for the consumption-wealth ratio have been made by Lettau and Ludvigson (2001). First, they consider equation (1) to be held ex ante. Second, they assume that the wealth W_t is the sum of asset holdings A_t and human capital H_t, $W_t = A_t + H_t$. The log aggregate wealth may be represented as, $w_t \approx \omega a_t + (1-\omega)h_t$, where ω is the average ratio of asset holdings to total wealth, A/W. The lowercase letters denote log variables of the corresponding uppercase letters throughout. Third, it is assumed that the observable aggregate labor income, Y_t, can describe the unobservable human capital, H_t. Thus, $h_t = \kappa + y_t + z_t$, where κ is a constant and z_t is a mean zero stationary random variable. Finally, Lettau and Ludvigson assume that log consumption is a constant multiple of log nondurables and services,

$$c_t = \lambda c_{n,t}, \tag{2}$$

where $\lambda > 1$ and $c_{n,t}$ denotes log nondurable consumption. Based on these assumptions, the log consumption-wealth ratio may be written as,

$$\begin{aligned} c_{n,t} - \beta_a a_t - \beta_y y_t &= (1/\lambda) E_t \sum_{i=1}^{\infty} \rho_w^i \{[\omega r_{a,t+i} + (1-\omega) r_{h,t+i}] - \Delta c_{t+i}\} \\ &\quad + (1/\lambda)(1-\omega) z_t, \end{aligned} \tag{3}$$

where $\beta_a = (1/\lambda)\omega$ and $\beta_y = (1/\lambda)(1-\omega)$. $\beta_a + \beta_y$ identifies $1/\lambda$, which is smaller than 1. r_a denotes the logarithm of the gross return on the asset holdings and r_h the logarithm of the gross return on human capital. E_t is the conditional expectation on information available at time t. The constant term is omitted here because it does not play a role in the analysis. Since all the variables on the right-hand side of (3) are presumed stationary, the variables on the left-hand side, $c_{n,t}$, a_t, and y_t, might be cointegrated. The deviation from the common trend, the log consumption-wealth ratio, is obtained as, $cay_t = c_{n,t} - \beta_a a_t - \beta_y y_t$. According to this relation, cay_t can signal the expected return on future assets if the expected return on human capital, $r_{h,t+i}$, and the expected consumption growth, Δc_{t+i}, are not too volatile or these variables are strongly correlated with the expected return on asset, $r_{a,t+i}$.

3. Methodology

This section describes two different methods which can be used to investigate the performance of *cay*. Both of these methods are based on the evidence that nondurables consumption, household net worth (measure of asset holdings), and labor income each contains a unit root and there is a single cointegrating vector for these three variables.

3.1 Two-Stage Method

In the first stage, to estimate the cointegrating vector, β_a and β_y in equation (3), Lettau and Ludvigson (2001) use a dynamic least squares (DLS) technique (Stock and Watson 1993). The DLS specification takes the form,

$$c_{n,t} = \alpha + \beta_a a_t + \beta_y y_t + \sum_{i=-k}^{k} b_{a,i} \Delta a_{t-i} + \sum_{i=-k}^{k} b_{y,i} \Delta y_{t-i} + \epsilon_t, \tag{4}$$

where Δ is the first difference operator, e.g. $\Delta y_t = y_t - y_{t-1}$. Based on the standard OLS estimation of equation (4), the estimated trend deviation can be calculated as $\widehat{cay}_t = c_{n,t} - \widehat{\beta}_a a_t - \widehat{\beta}_y y_t$.

In the second stage, to investigate the performance of $\widehat{cay}_t$, Lettau and Ludvigson (2001) use an OLS regression of stock returns on lagged $\widehat{cay}_t$. Defining r_t as the logarithm of the gross return on stocks during period t, a typical OLS specification is as follows,

$$r_{t \to k} = \theta_1 \widehat{cay}_t + \phi + u_{t \to k}, \tag{5}$$

where $r_{t \to k} = r_{t+1} + r_{t+2} + \cdots + r_{t+k}$, is the continuously compounded k-period rate of return and ϕ is a constant. The coefficient θ_1 reflects the signalling effect of $\widehat{cay}_t$ on stock returns. Newey-West corrected t-statistics is used for the estimators because of the possible serial correlation in the residual $u_{t \to k}$. Another method used by Lettau and Ludvigson to investigate long-horizon stock returns is a vector autoregression (VAR) of stock returns and return indicators,

$$\begin{pmatrix} \widehat{cay}_t \\ r_t \end{pmatrix} = \begin{pmatrix} \theta_{11}, \theta_{12} \\ \theta_{21}, \theta_{22} \end{pmatrix} \begin{pmatrix} \widehat{cay}_{t-1} \\ r_{t-1} \end{pmatrix} + \Phi + \epsilon_t. \tag{6}$$

In equation (6), Φ is a vector of constant and ϵ_t is the white noise. The coefficient θ_{21} presents the signalling effect of $\widehat{cay}_t$ on the future stock returns.

3.2 Vector Error Correction Models (VECMs)

This paper adopts the vector error correction models (VECMs) to estimate the cointegrating vector of consumption, wealth, and labor income in the long-term parameter vector $\boldsymbol{\beta}$ and to investigate the signalling effect of cay_t on stock returns in the adjustment parameter vector $\boldsymbol{\alpha}$. Namely,

$$\begin{pmatrix} \Delta c_{n,t} \\ \Delta a_t \\ \Delta y_t \\ r_t \end{pmatrix} = \underbrace{\begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{pmatrix}}_{\boldsymbol{\alpha}} \underbrace{(1, \beta_2, \beta_3, 0)}_{\boldsymbol{\beta}} \begin{pmatrix} c_{n,t-1} \\ a_{t-1} \\ y_{t-1} \\ cs(r_{t-1}) \end{pmatrix} + \sum_{i=1}^{p-1} \Gamma_i \begin{pmatrix} \Delta c_{n,t-i} \\ \Delta a_{t-i} \\ \Delta y_{t-i} \\ r_{t-i} \end{pmatrix} + \Phi + \epsilon_t, \tag{7}$$

where $cs(r_t)$ is the cumulative sum of the stock returns, r_t, and Φ is the vector of constant. Parameters in equation (7) are estimated by the ML method. The last coefficient in the cointegration vector $\boldsymbol{\beta}$ has been restricted to zero, because the cumulated sum of the stock returns is not considered in the cointegration relation among consumption, wealth and labor income. β_2 and β_3 in equation (7) are the cointegration coefficients, which serve the same goal as the β_a and β_y in equation (4). α_4 in equation (7) presents the signalling effect of the trend deviation on stock returns. It has comparable role as θ_1 in equation (5) and θ_{21} in equation (6).

To reduce the number of parameters in the VECM, a conditional system can be adopted. Johansen (1992) shows, if a full VECM can be decomposed in two parts as,

$$\underbrace{\begin{pmatrix}\Delta X_{at}\\ \Delta X_{bt}\end{pmatrix}}_{\Delta X_t}=\underbrace{\begin{pmatrix}\alpha_a\\ \alpha_b\end{pmatrix}}_{\boldsymbol{\alpha}}\boldsymbol{\beta}'X_{t-1}+\sum_{i=1}^{p-1}\underbrace{\begin{pmatrix}\Gamma_{ai}\\ \Gamma_{bi}\end{pmatrix}}_{\Gamma_i}\Delta X_{t-i}+\underbrace{\begin{pmatrix}\Phi_a\\ \Phi_b\end{pmatrix}}_{\Phi}+\epsilon_t,$$

where $\alpha_b = 0$, then ΔX_{bt} is weakly exogenous for $(\boldsymbol{\beta}, \alpha_a)$. The ML estimator of $\boldsymbol{\beta}$ and α_a can be calculated from the conditional model,

$$\Delta X_{at}=\alpha_a\boldsymbol{\beta}'X_{t-1}+\sum_{i=1}^{p-1}\widetilde{\Gamma}_{ai}\Delta X_{t-i}+\widetilde{\Phi}_a+\eta\Delta X_{bt}+\widetilde{\epsilon}_t. \tag{8}$$

Another method for reducing the number of parameters in the VECM is to specify a subset procedure. The cointegrating vector $\boldsymbol{\beta}$ is first estimated, and then linear restrictions on the parameters for the lagged difference terms can be imposed in the following model,

$$\Delta X_t=\boldsymbol{\alpha}\widehat{\boldsymbol{\beta}}'X_{t-1}+\sum_{i=1}^{p-1}\Gamma_i\Delta X_{t-i}+\Phi+\epsilon_t. \tag{9}$$

The parameter in Γ_i, which has an absolute value of t-statistic smaller or equal to 1, is set to zero. The remaining parameters in (9) are estimated by generalized least squares (GLS) or estimated generalized least squares (EGLS) technique (Lütkepohl 1991). In order to have as least parameters in the system as possible to reduce estimation uncertainty, the Subset VECM is combined with the Conditional VECM in the analysis.

4. Performance of *cay* with Two-Stage Method

In this section, German data from 1971.1 to 2001.4 are used to estimate the fluctuations in the consumption-wealth ratio with a DLS method in the first stage. In the second stage, the estimated trend deviation is used to signal stock returns. The data of nondurables consumption, household net worth, and labor income are quarterly, seasonally adjusted, per capita variables in logarithm, measured in billions of 2000 euros. The quarterly data of real stock returns is calculated from the Morgan Stanley Capital International (MSCI) German stock price index and MSCI German stock return index. The log excess return is obtained by subtracting the call money rate (risk-free rate) from the log real return of the index. The Appendix provides details on data construction and the source for the data.

4.1 Unit Root and Cointegration Test of c, a and y

Although the augmented Dickey-Fuller (ADF) test could have low power for time series which are nearly integrated or fractionally integrated, the ADF test is used here to test for unit roots since the encountered features are not expected to govern the level of c, a and y. Panel A in Table 1 reports results of the ADF test for unit root. The number of lagged differences is determined according to the Akaike Information Criterion (AIC). All the values of the test statistic are greater than the corresponding 5% critical values. The null hypothesis of unit root is not rejected for all three variables. Johansen trace test rather than other residual-based tests as the one in Engle and Granger (1987) is chosen here to test for cointegration since the former approach allows to test for cointegration rank. The results of the cointegration test are reported in Panel B of Table 1. The numbers of lags are chosen according to the AIC and Schwarz criterion. Null hypothesis of rank 0 is rejected for all the cases. By contrast, null hypothesis of rank 1 is accepted for all the cases because of the smaller test statistics compared to 5% critical values. Therefore, there is strong evidence in the German quarterly data to support the null hypothesis that nondurables consumption, household net worth, and labor income each contains a unit root and they have a single cointegrating vector. The fundamental assumption of the consumption-wealth ratio is confirmed.

4.2 First Stage: Estimation of Trend Deviation cay_t

Implementing the DLS specification (4) using German data from 1971.1 to 2002.4 generates the following point estimates,

$$\widehat{c}_{n,t} = \underset{(-45.62)}{-3.83} + \underset{(28.98)}{0.92}\, a_t + \underset{(3.98)}{0.30} y_t, \tag{10}$$

where Newey-West corrected t-statistics appear in the parentheses below the coefficient estimate. The number of lead/lag lengths of the first differences is 4 according to the AIC. The estimators for the first differences are not listed, because they are not essential for the *cay* estimation. All the estimates in (10) are significant at the 5% level. However, there might be positive autocorrelation in the residuals, given the value of Durbin-Watson statistic, 0.37. This hints that the DLS specification may not be the best choice for estimating the relation between cointegrated consumption, household net worth, and labor income. Furthermore, it is worth to mention that the sum of the coefficient of household net worth (β_a) and the coefficient of income (β_y) is greater than 1. This leads to a λ, which is equal to $1/(\beta_a + \beta_y)$, being smaller than 1. Thus, according to the equation (2), the total consumption , c_t, is smaller than the nondurables and service, $c_{n,t}$. This result contradicts the general intuition and hence does not support the assumption, that the log consumption is just a constant multiple of log nondurables and services.

4.3 Second Stage: $\widehat{cay}_t$ as a Signal of Stock Returns

Based on the estimation results from the DLS specification, corresponding estimated trend deviation $\widehat{cay_t}$ can be calculated as $c_{n,t} - \widehat{\beta}_a a_t - \widehat{\beta}_y y_t$. The signalling effect of the trend deviation on one-quarter-ahead stock returns is investigated in an OLS regression. Table 2 presents the results. The real returns and the excess returns are regressed on a constant with either their own lag, or the lagged trend deviation, or both. Neither the estimated trend deviations, $\widehat{cay}_t$, nor the one lag of dependent variable has significant impact on the real return or the excess return. The statistics of adjusted R^2 are around zero.

The signalling effect of $\widehat{cay}_t$ on long-horizon stock returns is investigated with an OLS regression over horizons from 1 quarter to 6 years. Table 3 presents the results of single-equation regressions of either consumption growth or excess returns. Consumption growth is considered here, because the consumption-wealth ratio can signal either the future expected return, or consumption growth, or both, according to equation (3). The dependent variable in Panel A is the H-period consumption growth rate, $\Delta c_{n,t+1} + \cdots + \Delta c_{n,t+H}$. The dependent variable in Panel B is the H-period log excess returns on the MSCI German stock price index, $r_{t+1} - r_{f,t+1} + \cdots + r_{t+H} - r_{f,t+H}$. As can be seen in Panel B, the estimated trend deviation, $\widehat{cay}_t$, has no significant impact on stock excess returns at any horizon. According to Panel A, $\widehat{cay}_t$ has significant impact on consumption growth at long-horizons from 2 years to 4 years. These findings from German data are different from the results of Lettau and Ludvigson (2001). They find no impact of $\widehat{cay}_t$ on U.S. consumption growth.

Besides, a vector autoregressive (VAR) model is used to investigate the effect of $\widehat{cay}_t$ on long-horizon stock returns. Table 4 presents a first-order VAR with two variables: excess returns on the MSCI German index, $r_t - r_{f,t}$ and the estimated trend deviation, $\widehat{cay}_t$. As can be seen in Row 1, the coefficient of $\widehat{cay}_t$ on excess returns is not significant.

Therefore, no matter which method is used in the second stage, the estimated deviation $\widehat{cay}_t$ has no significant impact on the German stock returns.

5. Performance of *cay* with VECMs

In this section, VECMs are adopted to analyze the signalling effect of *cay* on stock returns in both German and U.S. data sets. Quarterly U.S. data from 1952.4 to 1998.3 are taken from Lettau and Ludvigson (2001). A single cointegrating vector is included, according to the Johansen trace test of cointegration for German data in Table 1 and the analysis for U.S. data in Lettau and Ludvigson (2001). A constant is included in the equation. Based on the AIC, the Schwarz criterion, and the Portmanteau test of the error terms, order 2 is chosen for German data and order 3 for U.S. data.

Table 5 shows the estimation results of the long-term parameters, $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$, in the basic VECM. As can be seen in row 1 and 2, all the estimators of the cointegrating vectors ($\boldsymbol{\beta}$) are significant at the 5% level. Household net worth has a much higher weight in the common trend of consumption, wealth, and income for Germany than for the U.S.. Compared with the DLS estimation results in equation (10), Johansen approach provides a smaller coefficient on asset wealth and a greater coefficient on income. Besides, according to the last two rows in Table 5, all the p-values of the Portmanteau test are greater than 5%. There are no significant autocorrelations in the estimated residuals.

Based on the results of the VECM, the Conditional VECM can be conducted. In the VECM for Germany, consumption growth, $\Delta c_{n,t}$, and income growth, Δy_t, get the most insignificant influence from trend deviations. The absolute values of

t-statistics for the corresponding estimates in $\boldsymbol{\alpha}$ are smaller or equal to 1.1 in Table 5. Thus, consumption and income are taken as exogenous for German data in the Conditional VECM. Based on the same argument, consumption and wealth are treated as exogenous for U.S. data. The results from the Conditional VECM are shown in Table 6. Compared with the results of the VECM in Table 5, the t-statistics of the coefficients in the long-term vectors, $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$, have increased.

Finally, Table 7 provides the estimation results of the Conditional-Subset VECM. The estimators of $\boldsymbol{\beta}$ are taken from the results of the Conditional VECM in Table 6. The Conditional-Subset VECM provides the highest t-statistics of the remaining $\boldsymbol{\alpha}$ parameters among all the analysis of VECMs. The estimated consumption-wealth ratio has a significant impact on wealth growth and (excess) returns in German data, and a significant impact on income growth and (excess) returns in U.S. data. The effect of the estimated trend deviation on German wealth growth is 0.052 and on U.S. income growth is around 0.17. The signalling effect of the estimated trend deviations on returns is about two times greater in the U.S. than in Germany. The estimated coefficient on the trend deviation for U.S. real returns (excess returns) is about 2.440 (2.293) and for German real returns (excess returns) is about 1.058 (1.140). The results for the U.S. are similar to those in Lettau and Ludvigson (2001). Moreover, the adjusted R^2 in the regression of stock returns is 0.15 in U.S. data and 0.07 in German data. Stock returns can be better signalled by $\widehat{cay}$ in the U.S. than in Germany.

6. Conclusions

In this paper, the signalling effect of the fluctuations in the consumption-wealth ratio on German stock returns has been investigated. Two different methods are used: the two-stage method and the VECMs. Using the two-stage method, significant impact of *cay* on German stock returns is not found. The DLS technique in the first stage may not be efficient to estimate the coefficients among cointegrated consumption, wealth, and labor income. Compared with the results from the VECM, the DLS approach overestimates the weight of wealth and underestimates the weight of labor income in the regression of consumption. Besides, the two-stage method may lead to the loss of information by having two separated stages to study the performance of *cay*. When the VECMs are used, there is evidence to support the view that *cay* signals real stock returns and excess returns in both German and U.S. data sets significantly. The Conditional-Subset VECM provides the most precise results. The effect of *cay* on stock returns is two times greater in U.S. data than in German data. A Model with the consumption-wealth ratio might be more suitable for U.S. stock returns than for German stock returns. Besides, the results for U.S. are similar to those via the two-stage method by Lettau and Ludvigson.

In addition, two new evidences have been found in the analysis. First, with the Conditional-Subset VECM, *cay* has impact not only on stock returns, but also on wealth growth in Germany and income growth in the U.S.. This evidence cannot be explained by the standard theory of the consumption-wealth ratio. Second, no matter which method is used, the sum of the estimated coefficients on income and wealth for German consumption is greater than 1. This result is against the assumption made by Lettau and Ludvigson (2001) that the log consumption is just a constant multiple of log nondurables and services.

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Appendix: Data Construction

The data of stock returns are log real variables from the stock market index. Quarterly U.S. data from 1952.4 to 1998.3 are taken from Lettau and Ludvigson (2001). U.S. stock returns are returns from the Standard & Poor's (S&P) Composite Index. The log excess return is obtained by subtracting the log real return on the 30-day Treasury bill (risk-free rate) from the log real return of the index. Quarterly German data of real stock returns from 1971.1 to 2002.4 is calculated from the Morgan Stanley Capital International (MSCI) German stock price index and MSCI German stock return index. The risk free rate is the German call money rate from the IMF's International Financial Statistics.

The macroeconomic data such as consumption of nondurables and services, asset holdings, and labor income are quarterly, seasonally adjusted, per capita variables in logarithm. U.S. data are measured in billions of 1992 dollars, taken from Lettau and Ludvigson (2001). German data are measured in billions of 2000 euros[1]. Data for consumption of nondurables and services and labor income are obtained from the Federal Statistical Office Germany.

The real obstacle in the data construction is to find suitable German data of asset holdings. Time series of household net worth is generally used as the measure for asset holdings. Because quarterly time series of German household net worth cannot be obtained directly, it has to be constructed based on other available time

[1]Consumer price index (2000=100) is used.

series. The following four time series are used: annual data of German household net worth from 1991 to 2001 obtained from Datastream, monthly data of deposits of resident individuals at banks (MFIs) in Germany from 1970 to 2003 obtained from the Deutsche Bundesbank[2], monthly data of share capital for the whole German market from 1960 to 2003 obtained from Datastream, annual data of non-financial assets for the whole German economy from 1960 to 1997 obtained from the Federal Statistical Office Germany.

The basic idea of construction is to regress the available short time series of net worth (1991-2001) on the other three variables, and then use the estimated coefficients and the other three variables to construct enough long quarterly time series of net worth. The net worth is regressed on deposits, share, and non-financial assets at a quarterly frequency. If the regression of net worth is at the annual frequency, there are only ten available observations for the net worth. Thus, annual data of net worth and non-financial assets, and monthly data of private deposits and share capital are transformed into quarterly data for the estimation. The annual data are expanded to quarterly data using constant growth rate. The monthly data are transformed to quarterly data using the observations of the last month of the quarter. Besides, Lettau and Ludvigson (2001) use the observation of net worth at the beginning of the period. In order to construct comparable variables, all the transformed quarterly data at the end of this period are treated as the beginning variables at the next period.

Based on the transformed German quarterly data of household net worth, deposits, shares, and non-financial assets from 1992.1 to 2002.1, the following OLS estimates is obtained,

$$\underset{}{\widehat{w}_t} = \underset{(3.42)}{2.44} + \underset{(4.13)}{0.26}d_t + \underset{(3.40)}{0.18}s_t + \underset{(2.84)}{0.38}n_t, \tag{11}$$

where w_t is the household net worth, d_t denotes the private deposits, s_t is the share capital, and n_t presents the non-financial assets. The data used for this estimation are seasonally adjusted, per capital variables in logarithm, measured in 2000 euros. t-statistics appear in parentheses below the coefficient estimates. The corresponding R^2 statistic is 0.97. A time trend is not included in the equation because of the insignificant t-statistic. Figure 1 shows that the fitted household net worth from the regression is very similar to the original series. Based on the estimators in equation (11) and quarterly data of private deposits, shares, and non-financial assets, the quarterly time series of household net worth from 1971.1 to 2002.4 are obtained.

[2]Private deposits include private transferable deposits, private time deposits, private savings deposits, and private savings certificates.

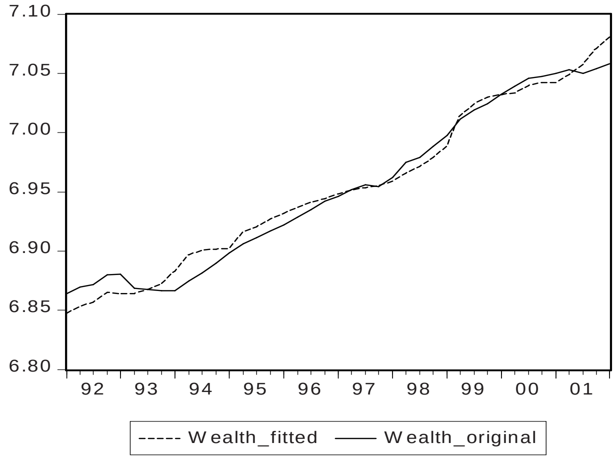

Figure 1: The original household net worth and the estimated household net worth. The sample period is 1992.1 to 2002.1. The estimated household net worth is calculated by using private deposits, shares, and non-financial assets.

Table 1: **Tests for Unit Root and Cointegration**

♯	Panel A: Augmented Dickey-Fuller Test for Unit Root				Panel B: Johansen Trace Test for Cointegration			
	Variable	Lag	Test Statistic	5% Critical Value	H_0:$r =$	Test Statistic Lag = 1	Test Statistic Lag = 2	5% Critical Value
1	$c_{n,t}$	5	-1.18	-2.86	0	152.98	65.41	34.80
2	a_t	2	-1.62	-2.86	1	13.08	12.58	19.99
3	y_t	5	-1.23	-2.86	2	3.47	2.97	9.13

This table reports the results of tests for unit root and cointegration. Panel A shows the augmented Dickey-Fuller test statistics for the variables: consumption of nondurables and services, $c_{n,t}$, household net worth, a_t, and labor income y_t. For all variables, an intercept is included. Panel B reports the results of the Johansen trace test for $c_{n,t}$, a_t, and y_t. An intercept is included in the test."Test statistic" gives the value of the Likelyhood Ratio (LR) test.

Table 2: **Quarterly Regressions of Stock Returns**

♯	Dependent Variable	Constant	lag	$\widehat{cay}_t$	$\overline{R}^2$
1	r_{t+1}	0.013	0.033		-0.01
		(1.30)	(0.44)		
2	r_{t+1}	3.304		0.861	0.01
		(1.35)		(1.34)	
3	r_{t+1}	3.261	0.010	0.850	0.00
		(1.31)	(0.13)	(1.31)	
4	$r_{t+1} - r_{f,t+1}$	0.007	0.041		-0.01
		(0.71)	(0.54)		
5	$r_{t+1} - r_{f,t+1}$	3.529		0.921	0.01
		(1.44)		(1.44)	
6	$r_{t+1} - r_{f,t+1}$	3.463	0.015	0.904	0.01
		(1.39)	(0.20)	(1.39)	

This table reports the estimates from OLS regression of stock returns on lagged trend deviation $\widehat{cay}_t$. The dependent variables are the log real return, r_{t+1}, and the log excess return, $r_{t+1} - r_{f,t+1}$. Newey-West corrected t-statistics appear in the parentheses below the coefficient estimate.

Table 3: **Long-horizon Regressions of Excess Stock Returns**

	Forecast Horizon H							
Regressors	1	2	3	4	8	12	16	24
	Panel A: Consumption Growth							
$\widehat{cay}_t$	−0.079	−0.140	−0.166	−0.223	**−0.488**	**−0.772**	**−0.838**	−0.431
	(−1.59)	(−1.69)	(−1.46)	(−1.43)	(−2.09)	(−3.13)	(−2.70)	(−0.90)
	[0.01]	[0.03]	[0.03]	[0.04]	[0.08]	[0.15]	[0.14]	[0.02]
	Panel B: Excess Stock Returns							
$\widehat{cay}_t$	0.921	1.448	2.067	1.911	0.723	−2.853	−3.827	1.149
	(1.44)	(1.06)	(1.15)	(0.93)	(0.27)	(−1.13)	(−1.14)	(0.29)
	[0.01]	[0.02]	[0.03]	[0.01]	[−0.01]	[0.01]	[0.02]	[−0.01]

This table reports the OLS estimates from long-horizon regression of stock excess returns or consumption growth on lagged trend deviation $\widehat{cay}_t$. Newey-West corrected t-statistics appear in the parentheses below the coefficient estimate and adjusted R^2 statistics appear in square brackets. Significant coefficients at the 5% level are highlighted in bold face.

Table 4: **Vector Autoregression of Excess Returns**

♯	Dependent Variable	constant	$r_t - r_{f,t}$	$\widehat{cay}_t$	$\overline{R}^2$
1	$r_{t+1} - r_{f,t+1}$	3.463	0.015	0.904	0.01
		(1.59)	(0.17)	(1.59)	
2	$\widehat{cay}_{t+1}$	**−0.587**	0.008	**0.846**	0.73
		(−3.24)	(1.11)	(17.84)	

This table reports the estimates from a first-order vector autoregression (VAR) of the excess returns and the estimated trend deviation term, $\widehat{cay}_t$. t-statistics appear in the parentheses below the coefficient estimate. Significant coefficients at the 5% level are highlighted in bold face.

Table 5: **Vector Error Correction Model**

♯			Panel A: Return				Panel B: Excess Return			
	Influence Variable		$c_{n,t-1}$	a_{t-1}	y_{t-1}	$cs(r_{t-1})$	$c_{n,t-1}$	a_{t-1}	y_{t-1}	$cs(r_{t-1} - r_{f,t-1})$
1	$\boldsymbol{\beta}$	Germany	1	**−0.842**	**−0.496**	0	1	**−0.841**	**−0.503**	0
				(−14.08)	(−3.96)			(−14.35)	(−4.08)	
2		U.S.	1	**−0.226**	**−0.669**	0	1	**−0.238**	**−0.660**	0
				(−7.80)	(−24.11)			(−7.90)	(−22.84)	
	Dependent Variable		$\Delta c_{n,t}$	Δa_t	Δy_t	r_t	$\Delta c_{n,t}$	Δa_t	Δy_t	$r_t - r_{f,t}$
3	$\boldsymbol{\alpha}$	Germany	−0.050	**0.041**	0.063	0.971	−0.051	**0.040**	0.063	**1.034**
			(−1.09)	(2.03)	(1.01)	(1.87)	(−1.13)	(2.03)	(1.01)	(2.01)
4		U.S.	−0.022	−0.085	0.115	**2.460**	−0.012	−0.061	0.118	**2.414**
			(−0.56)	(1.07)	(1.51)	(3.59)	(−0.30)	(−0.77)	(1.56)	(3.60)
5	$\overline{R}^2$	Germany	0.03	0.15	0.01	0.06	0.03	0.15	0.01	0.07
6		U.S.	0.22	0.75	0.15	0.09	0.23	0.75	0.15	0.08
	Portmanteau Test		lag 5	lag 9	lag 13	lag 17	lag 5	lag 9	lag 13	lag 17
7	P-Value	Germany	0.26	0.62	0.07	0.16	0.26	0.63	0.07	0.17
8		U.S.	0.63	9.61	0.90	0.80	0.64	0.69	0.93	0.84

This table reports the estimates from the vector error correction model of consumption, wealth, income, and stock returns. Johansen approach is used. The dependent variables in panel A are difference in consumption of nondurables and services ($\Delta c_{n,t}$), difference in wealth (Δa_t), difference in income (Δy_t), and log real return (r_t), while in panel B the return variable is log excess return ($r_t - r_{f,t}$). cs denotes the cumulative sum of the corresponding variable. t-statistics appear in the parentheses below the coefficient estimate. A constant is included. Significant coefficients at the 5% level are highlighted in bold face.

Table 6: **Conditional Vector Error Correction Model**

♯			Panel A: Return				Panel B: Excess Return			
	Influence Variable		$c_{n,t-1}$	a_{t-1}	y_{t-1}	$cs(r_{t-1})$	$c_{n,t-1}$	a_{t-1}	y_{t-1}	$cs(r_{t-1} - r_{f,t-1})$
1	$\boldsymbol{\beta}$	Germany	1	**−0.832**	**−0.550**	0	1	**−0.831**	**−0.557**	0
				(−46.10)	(−23.86)			(−26.98)	(−24.14)	
2		U.S.	1	**−0.236**	**−0.658**	0	1	**−0.244**	**−0.653**	0
				(−14.35)	(−41.25)			(−14.57)	(−36.97)	
	Dependent Variable		$\Delta c_{n,t}$	Δa_t	Δy_t	r_t	$\Delta c_{n,t}$	Δa_t	Δy_t	$r_t - r_{f,t}$
3	$\boldsymbol{\alpha}$	Germany		**0.043**		0.870		**0.043**		**0.940**
				(2.52)		(1.90)		(2.53)		(2.08)
4		U.S.			**0.135**	**2.676**			0.128	**2.554**
					(2.02)	(4.09)			(1.95)	(4.01)
5	$\overline{R}^2$	Germany		0.17		0.04		0.17		0.05
6		U.S.			0.32	0.14			0.32	0.13
	Portmanteau Test		lag 5	lag 5	lag 13	lag 17	lag 5	lag 9	lag 13	lag 17
7	P-Value	Germany	0.59	0.96	0.68	0.66	0.60	0.97	0.66	0.66
8		U.S.	0.90	0.93	0.99	0.96	0.88	0.91	0.99	0.95

This table reports the estimates from the conditional vector error correction model of consumption, wealth, income, and returns. Johansen approach is used. The dependent variables in panel A are difference in consumption of nondurables and services($\Delta c_{n,t}$), difference in wealth (Δa_t), difference in income (Δy_t), and log real return (r_t), while in panel B the return variable is log excess return ($r_t - r_{f,t}$). cs denotes the cumulative sum of the corresponding variable. t-statistics appear in the parentheses below the coefficient estimate. A constant is included. Significant coefficients at the 5% level are highlighted in bold face.

Table 7: **Conditional-Subset Vector Error Correction Model**

♯			Panel A: Return				Panel B: Excess Return			
	Dependent Variable		$\Delta c_{n,t}$	Δa_t	Δy_t	r_t	$\Delta c_{n,t}$	Δa_t	Δy_t	$r_t - r_{f,t}$
1	$\boldsymbol{\alpha}$	Germany		**0.052**		**1.058**		**0.052**		**1.140**
				(3.37)		(2.20)		(3.37)		(2.37)
2		U.S.			**0.171**	**2.440**			**0.166**	**2.293**
					(2.93)	(4.53)			(2.85)	(4.52)
3	$\overline{R}^2$	Germany		0.20		0.07		0.20		0.07
4		U.S.			0.34	0.15			0.34	0.15
	Portmanteau Test		lag 5	lag 5	lag 13	lag 17	lag 5	lag 9	lag 13	lag 17
5	P-Value	Germany	0.37	0.86	0.56	0.66	0.36	0.86	0.54	0.66
6		U.S.	0.54	0.82	0.98	0.88	0.86	0.91	0.99	0.95

This table reports the estimates from the conditional-subset vector error correction model of consumption, wealth, income, and returns. The dependent variables in panel A are difference in consumption of nondurables and services ($\Delta c_{n,t}$), difference in wealth (Δa_t), difference in income (Δy_t), and log real return (r_t), while in panel B the return variable is log excess return ($r_t - r_{f,t}$). t-statistics appear in the parentheses below the coefficient estimate. A constant is included. Significant coefficients at the 5% level are highlighted in bold face.