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HOUSEHOLDS' PORTFOLIO STRUCTURE IN GERMANY

ANALYSIS OF FINANCIAL ACCOUNTS DATA 1959-2009

by Fred Ramb
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by Fred Ramb [2]

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2 *Sadly recently deceased researcher at Deutsche Bundesbank.*

3 *Corresponding author: Deutsche Bundesbank, Wilhelm-Epstein-Str. 14, D-60431 Frankfurt am Main, Germany; phone: +49 69 9566 2305, e-mail: michael.scharnagl@bundesbank.de*

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Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Internet
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

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CONTENTS

Abstract:

Based on a Financial Almost Ideal Demand System (FAIDS), this paper investigates the wealth structure of German households. The long-run wealth elasticities and interest-rate elasticities were calculated using a unique new quarterly financial accounts macro-data set which covers the period from 1959 to 2009 and contains a portfolio of eight different financial assets. Descriptive analysis shows that all financial assets were characterized by substantial volatility of their weight in the portfolio of households. We found that portfolio shifts in the long run are determined significantly by changes in interest rates. The estimated model provides evidence that currency (and transferable deposits) is mainly a substitute for other assets and time deposits are typically a complement. Wealth elasticity is for most assets around unity.

Keywords: Financial wealth, portfolio structure, household

JEL classification: E21, G11, C32

Non-technical summary

This paper analyzes within a FAIDS framework the long-term portfolio structure of households in Germany. The results shed some light on the relationship between financial assets and interest rates.

The analysis uses a recently compiled new data set which is based on quarterly financial accounts data according to ESA 1995 for the time period 1959 to 2009. For this period flow-of-funds data for Germany were subject to structural breaks due to a different set of definitions in ESA 1979 (prior to 1991) and ESA 1995. ESA 1995 includes self-employed persons in the household sector. Other differences are the consideration of assets abroad, maturities of assets and definitions of assets. Using the comprehensive data sets of the Deutsche Bundesbank, the household portfolio data (stocks and flows) were recalculated back to the fourth quarter of 1959.

The number of assets in the portfolio of the household sector is restricted to eight, taking into account the trade-off between economically plausible inputs and econometric considerations. These assets are currency and transferable deposits, time deposits, deposits with building and loan associations, savings deposits, debt securities, shares, mutual funds shares and insurance and pension entitlements.

During the last 50 years, descriptive analysis shows that nearly all financial assets were characterized by substantial volatility of their weight in households' portfolio. Whereas shares lost their popularity, debt securities and mutual funds seem to be en vogue. In addition, the attractiveness of savings deposits decreased substantially. These results could have been driven by the introduction of new products and by a more interest rate sensitive behavior of households.

The FAIDS is a modification of the almost ideal demand system approach developed by Deaton and Muellbauer (1980). It is a system of demand equations that permits exact aggregation over households and is easier to estimate than alternatives. It also allows for testing theoretical restrictions that must hold if one assumes that the behavior of a representative agent conforms to basic axioms of rational choice.

The long-run coefficients are estimated by applying the seemingly unrelated regression approach to the system of Bewley transformed equations for portfolio weights. This methodology takes correlations between residuals into account. Although these weights are bounded by construction, standard tests give evidence for a unit root in these variables.

Our results of the estimated models confirm the importance of interest rates in determining portfolio shifts. The own-rate elasticity is positive for all assets except time deposits. This specific result could be driven by the strong correlation between the interest rates for time deposits and savings deposits. Cross-rates indicate whether two assets are substitutes or complements. The following combinations of assets (among others) can be regarded as complements: time deposits and deposits with building and loan associations, time deposits and shares and time deposits and mutual funds. Currency (and transferable deposits) as well as mutual funds react negatively to changes in interest rates of other financial assets.

Wealth elasticity for mutual funds, pension and insurance entitlements, time deposits and debt securities is greater than one, for the other assets it is smaller than one.

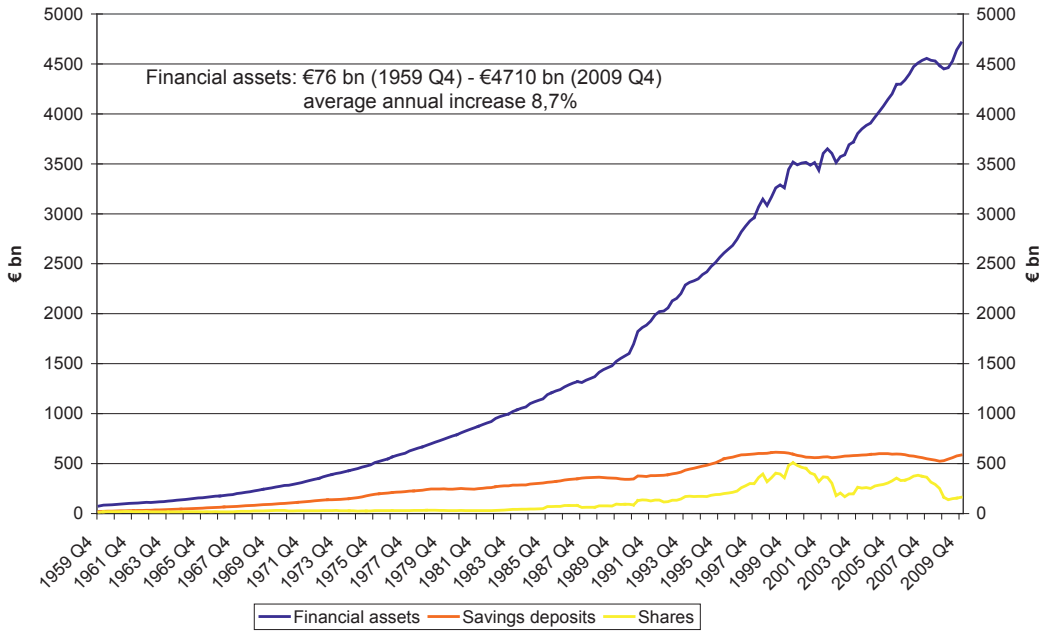
Our results provide some evidence of a positive relationship between an increasing share of older people and shares and mutual funds. Furthermore, we found that time deposits and debt securities are positively correlated and savings deposits and shares are negatively correlated with the share of employed persons (in the working population). This means employed people could have a preference for comparatively low-risk assets.

1 Introduction

Households are one of the most fundamental and diverse behavioral units in the economy. Households consume, save, invest, borrow and lend. Since the great articles by Brainard and Tobin (1968) and Tobin (1969) there has been an ongoing discussion in the economic literature about households' portfolio structure. Whereas theoretical models are well elaborated, the empirical evidence is quite limited. As has been pointed out, for example, by the European Central Bank (2003) there is no direct evidence for the quantification of portfolio shifts. In particular during the financial crisis, this topic has again become more relevant. There is a need for deeper understanding of how households decide on their financial assets structure. This paper provides some evidence for Germany and contributes to a solution for the lack of empirical evidence.

In Germany, financial wealth of households increased from €76 billion in 1959 to €4,710 billion in 2009 (see Figure 1). This corresponds to an average annual increase of around 9%. However, financial assets developed differently. Whereas, for example, shares were characterized by a volatile development, savings deposits followed a rising trend. These differences led to variations in the portfolio structure.

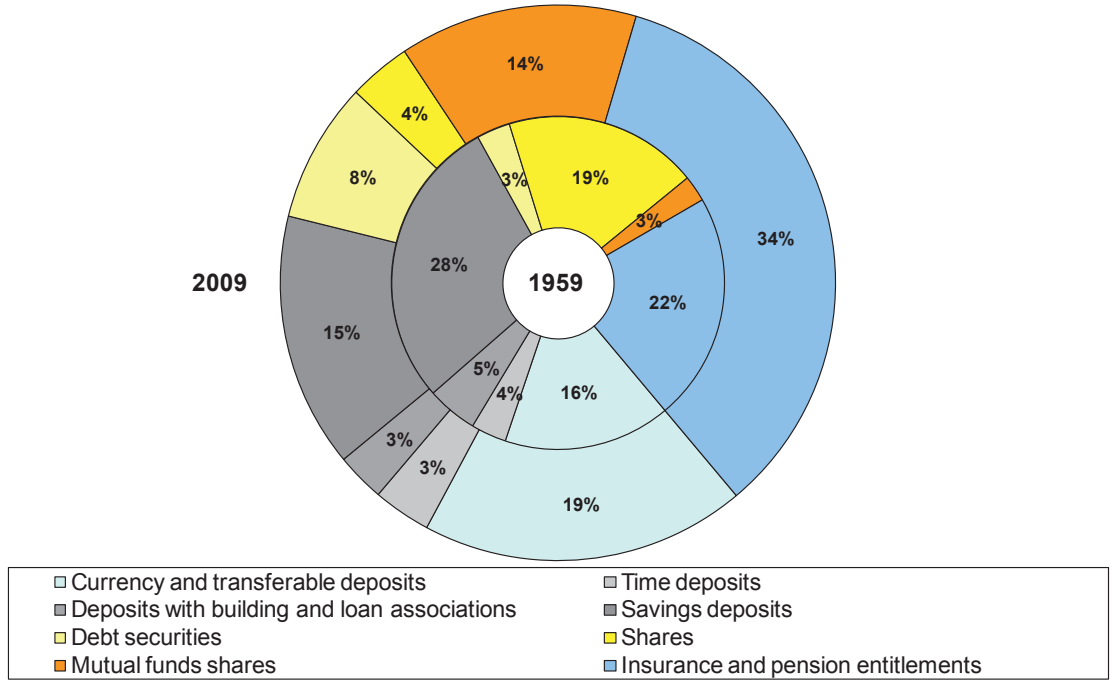
Figure 1. Development of households' financial assets between 1959 and 2009



As shown in Figure 2, the portfolio structure changed substantially over the last five decades. On the one hand the relevance of shares decreased from 19% in 1959 to 4% in 2009. On the other hand the percentage of mutual funds increased from 3% to 14% during this time period. The percentage of insurance and pension entitlements also increased significantly, from 22% to 34%.

The most recent drop and the decline at the beginning of this decade in demand for shares could be partly explained by the bursting of the dotcom bubble and the financial crisis. Moreover, the attractiveness of mutual funds and insurance and pension entitlements is in line with the increasing need for old-age pensions. Nevertheless, this behavior had not been econometrically analyzed for such a long period. By applying the method suggested by Blake (2004) we estimated a Financial Almost Ideal Demand System. Section 2 describes the theoretical framework, derives the estimated model and presents a selective survey of the empirical literature, while section 3 provides a detailed description of the data set and some descriptive results. Section 4 discusses the econometric results and section 5 summarizes the main findings.

Figure 2. German households' portfolio structure in 1959 and 2009



2 Theoretical background and empirical evidence

The papers by Brainard and Tobin (1968) and Tobin (1969) were the starting point for the theoretical discussion and for the empirical analysis of households' portfolio models. Since then, a considerable number of papers have used this approach for empirical models[1] and some articles have enhanced the methodology.[2] Whereas most of these papers made their contributions during the 1970s and at the beginning of the 1980s, the Almost Ideal Demand System (AIDS) by Deaton and Muellbauer (1980) inspired the debate. Unlike the model by Brainard and Tobin, households' behavior is based on demand equations. At the beginning of the 1990s, some authors identified the usefulness of this approach for the analysis of portfolio decisions.[3]

[1] See section 2.2 for a discussion of the main empirical results.
[2] Two of the most important enhancements are the papers by Purvis (1978) and Smith (1978).
[3] See, for example, Barr and Cuthbertson (1991a, 1991b and 1994) and Dinenis and Scott (1993).

2.1 Theoretical model

Based on the approach by Blake (2004), we use the so-called Financial Almost Ideal Demand System (FAIDS) to analyze the short-term as well as the long-run relationship between assets, interest rates and some additional macro variables. [4]

In doing so, we assume a representative agent which maximizes a time-separable utility function[5][6]

$$\max \bar{U}\left(\theta_{1t}W_t,\ldots,\theta_{Nt}W_t\right) \tag{1}$$

subject to the budget constraint

$$\bar{W}_{t+1} = \sum_{i=1}^{N}\left(1+\bar{r}_{it}\right)\theta_{it}W_t \tag{2}$$

where

$U\left(.\right)$ = utility function
W_t = real wealth at time t
θ_{it} = weight of the ith asset category in the portfolio at time t
r_{it} = real return on the ith asset category at time t
N = number of asset categories in the portfolio

Following Deaton and Muellbauer (1980) and minimizing the associated cost function optimal long-run portfolio weights can be derived.[7] For asset i it is given by

$$\theta_{it}^{*} = a_i^{*} + b_i^{*}\ln W_t + b_i^{*}\ln\left(1+\bar{r}_{Wt}\right) + \sum_{j=1}^{N} c_{ij}^{*}\ln\left(1+\bar{r}_{jt}\right) + \sum_{j=1}^{M} h_{ij}^{*}Z_{jt} \tag{3}$$

where $\bar{r}_{Wt}$ is a measure of the expected total return on the portfolio. Equation (3) includes a vector of additional variables Z_{jt} like life cycle variables that may influence the optimal weights.

[4] For a more detailed description of the derivation see Blake (2004).
[5] The assumptions of a time-separable utility function and time-invariant moments of the distribution function generating asset returns are needed to derive a tractable FAIDS model (Dinenis and Scott, 1993).
[6] Expected values are represented by bars over variables.
[7] Barr and Cuthbertson (1991) and Dinenis and Scott (1993) provide the derivation of equation (3).

Based on some additional assumptions, the expected return is equal to the value-weighted average expected return assets in the portfolio.

$$\ln\left(1+\overline{r}_{Wt}\right)=a_0^*+\sum_j^N a_j^*\ln\left(1+\overline{r}_{jt}\right)+\frac{1}{2}\sum_{i=1}^N\sum_{j=1}^N c_{ij}^*\ln\left(1+\overline{r}_{it}\right)\ln\left(1+\overline{r}_{jt}\right) \tag{4}$$

Demand theory provides some model restrictions for the FAIDS. Adding up of the equations requires

$$\sum_{i=1}^N a_i^*=1,\qquad \sum_{i=1}^N c_{ij}^*=0,\qquad \sum_{i=1}^N b_i^*=0,\qquad \sum_{i=1}^N h_{ij}^*=0 \tag{5}$$

which is implemented by ignoring the *N*th equation when estimating the model and calculating the corresponding parameters from (5). The homogeneity restriction is given by

$$\sum_{j=1}^N c_{ij}^*=0 \tag{6}$$

and the symmetry restriction by

$$c_{ij}^*=c_{ji}^* \tag{7}$$

Blake (2004) calculates elasticities of demand with respect to wealth, interest rates and additional variables based on estimated coefficients of equation (3). The wealth elasticity of demand for asset *i* is given by

$$\eta_{iWt}=\frac{b_i^*}{\theta_{it}}+1 \tag{8}$$

The uncompensated interest rate elasticity of demand is given by

$$e_{ijt}=\frac{c_{ij}^*}{\theta_{it}}+\delta_{ij} \tag{9}$$

δ_{ij} denotes the Kronecker delta. For equation (9) two additional assumptions are needed. First, there is no interest rate effect on the beginning of period wealth W_t and second, there is independence of expected real yields on different assets.

Elasticities for the additional regressors are given by

$$\begin{aligned}\xi_{ijt} &= \frac{h_{ij}^{*}}{\theta_{it}} z_{jt} \qquad \text{for variables in levels} \\ &= \frac{h_{ij}^{*}}{\theta_{it}} \qquad \text{for log variables}\end{aligned} \tag{10}$$

Based on equation (3) and allowing for dynamic adjustment, both a short-run equation (11) and an equation to estimate the long-run elasticities (12)[8] can be derived. It is possible to identify whether assets are complements or substitutes.

$$\begin{aligned}\theta_{it} = a_i &+ \sum_{j=1}^{N-1} \lambda_j \theta_{jt-1} + \sum_{s=0}^{K} b_{is} \ln\left(W_{t-s}\left(1+r_{W_{t-s}}\right)\right) \\ &+ \sum_{s=0}^{K}\sum_{j=1}^{N-1} c_{ijs} \ln\left(1+r_{jt-s}\right) + \sum_{s=0}^{K}\sum_{j=1}^{M} h_{ijs} Z_{jt-s} + u_{it}\end{aligned} \tag{11}$$

$$\begin{aligned}\theta_{it} = a_i^{*} &+ \sum_{j=1}^{N-1} \lambda_j^{*} \Delta\theta_{jt-1} + b_j^{*} \ln\left(W_t\left(1+r_{Wt}\right)\right) \\ &+ \sum_{j=1}^{N-1} c_{ij}^{*} \ln\left(1+r_{jt}\right) + \sum_{j=1}^{M} h_{ij}^{*} Z_{jt} + \sum_{s=0}^{K} b_{is}^{*} \Delta \ln\left(W_t\left(1+r_{Wt-s}\right)\right) \\ &+ \sum_{s=0}^{K}\sum_{j=1}^{N-1} c_{ijs}^{*} \Delta \ln\left(1+r_{jt-s}\right) + \sum_{s=0}^{K}\sum_{j=1}^{M} h_{ijs}^{*} \Delta Z_{jt-s} + u_{it}^{*}\end{aligned} \tag{12}$$

Assuming rational expectation formation for the representative agents leads to contemporaneous returns instead of expected future returns and orthogonal expectation errors being part of the residuals. The current values of portfolio weights, asset returns and total wealth in equation (12) are jointly endogenous and Z_{jt} are weakly exogenous. In addition, economic theory suggests no contemporaneous simultaneity between the portfolio weights. Homogeneity (6) and symmetry (7) imply long-run restrictions on the parameters.

2.2 Empirical evidence

Regarding the empirical evidence on the portfolio behavior of households by using macroeconomic data, one can identify three strands.[9] First, the literature within

[8] Where Δ denotes the difference operator $\left(1-L\right)$ and L denotes the lag operator.

the Brainard and Tobin framework, second, analyses based on the Almost Ideal Demand Systems, and third, empirical results on ad-hoc specifications.[10]

Kopcke (1977) used the Brainard and Tobin approach to analyze financial assets portfolios of US households for the time period 1959 to 1970. Using Bayesian techniques, a substantial interest sensitivity of households' portfolio positions was identified. For Canada, Poloz (1986) extended the standard model of financial assets equations on real expenditure equations and liability equations. As a result, for the time period between 1968 and 1983 the response to interest rate shocks was not in line with the theoretical predictions. A lack of data quality could be one reason for these results. Fase (1979) used a system of four equations to investigate the demand for financial assets in the Netherlands for the period 1963 to 1975. The complementarity between time deposits and savings deposits was one of the main results of the study.

The starting point of our analysis was the paper by Blake (2004). The extended AIDS (the FAIDS) was applied to investigate the household portfolio structure for the post-war period 1948 to 1994 in the United Kingdom. The analyzed portfolio included financial assets as well as housing and human capital. Wealth effects were more important for determining trend shifts in asset allocation than relative returns. In addition, some demographic variables were identified for portfolio shifts towards pension and human capital accumulation. For US households, Collins and Anderson (1998) analyzed own-rate elasticities and cross-rate elasticities. For the years 1990 to 1993, a period which was in the U.S. affected by financial changes, they found a substantial rise in the own-price elasticity of money and significant cross-rate elasticity for money and mutual funds. The analysis by Allen and Smidkova (1998) also investigated the behavior during a period of transition. The household portfolio in the Czech Republic between 1992 and 1995 was affected by the introduction of coupons. As a result, the reaction of Czech households was quite conservative (cautious) with regard to such new financial assets. Al-Zu'bi (2006) and Moore et al. (2005) used the AIDS framework for the analysis of the portfolio in Sub-Saharan African countries

[9] There is a fourth strand which provides empirical evidence based on micro data. Due to comparison reasons, this literature is not mentioned here. An overview is given, for example, by the conference volume of Guiso et al. (2002).
[10] The overview of the empirical literature is not exhaustive. Only the most important papers were selected to illustrate the variety of results.

(1981-2004) and India (1951-1994). Both analyses provided deeper understanding of the long-run relationship of financial assets of households in developing countries. In a recent study, Avouyi-Dovi et al. (2011) applied the FAIDS to French data for the period 1978 to 2009 to identify substitution effects. Dynamic simulations indicated a good fit of their model.

The third group of articles is more heterogeneous than the first two. An international comparison based on an error-correction model was provided by Davis (1986). For the period from 1966 to 1984, the US, Japanese, UK and German households and company sectors were compared regarding their assets and liability structure. The analysis showed that the underlying determinants of asset and debt were similar across the countries. In the article by Frankel (1985), a maximum likelihood estimation technique was used to test within a demand system the hypothesis whether bonds and equities are substitutes. The conclusion was that substitution effects were close to zero. Hendershott and Lemmon (1975) examined US households using flow-of-funds data from 1957 to 1971. They estimated a model with financial assets and liabilities within a general-equilibrium framework. The results were in line with other studies which concluded that portfolio structure depends largely on income and interest rates. Piazzesi and Schneider (2007) developed a model for both asset prices and quantities based on a portfolio approach for the US household sector using flow-of-funds data from 1952 to 2002. They concentrated on three types of assets: corporate equity, residential real estate and bonds. Real estate positions were primarily explained by changes in supply and income, equity positions by expectations on returns.

In summing up most of the empirical results found, irrespective of the methods and model, a nexus of portfolio structure and interest rates. With respect to the effects of additional explanatory variables, the results are quite mixed and largely depend on the methods and model used.

3 Data sources and descriptive analysis

This paper is the first to use a new unique data set compiled by the financial accounts section of the Deutsche Bundesbank. The main objective of this data set is to provide a coherent flow-of-funds framework according to ESA 1995 including

quarterly data going back to 1959. In addition, we used the interest rate statistics and the capital market statistics of the Deutsche Bundesbank, yield data supplied by the Institute for Banking (Humboldt University Berlin), interest yield data provided by the Federal Financial Supervisory Authority (BaFin) and some quarterly and annual data from the Federal Statistical Office (Destatis).

3.1 Data sources

The main data source is the newly compiled quarterly flow-of-funds dataset for households according to ESA 1995. After the introduction of ESA 1995, the Deutsche Bundesbank decided in 1999 to recalculate the existing data set (which was mainly according to ESA 1979) back to 1991.[11] Due to the reason that, for some empirical models, long time series are necessary, efforts to calculate coherent data sets were forced. Using the comprehensive data sets of the Deutsche Bundesbank, the household portfolio data (flows and stocks) were recalculated back to the fourth quarter of 1959.

The main differences between ESA 1979 and ESA 1995 are the scope of the household sector (ESA 1995 includes self-employed persons), consideration of assets abroad, maturities of assets and definition of assets. For flows there are quarterly series going back to the 50s, for stocks there are annual series for the same period. Prior to 1991, quarterly series for stocks were generated by updating the levels with flows. This kind of information exists also for components of asset categories, allowing a consistent mapping of both types of definitions.

Time series for the interest rates were mainly calculated on the basis of the Bundesbank interest rate statistics. Because consistent time series are not available, we used data from the new interest rate statistics which are available from 2003 onwards[12] and applied autoregressive estimation techniques to predict data back to 1959. Yield data for shares and debt securities are provided by the Institute for Banking (Humboldt University Berlin).[13] Within a coherent framework this database offers information on nominal after-tax yields for equities listed in the DAX and CDAX as well as debt

[11] One important reason for taking 1991 as the starting point for ESA 1995 was German reunification, which led to breaks in all macroeconomic time series. The use of 1991 avoided another break in time series data. For details about the financial accounts data sets, see Deutsche Bundesbank (1994). Data sets from 1991 onwards are described in Deutsche Bundesbank (2008). For a historical survey of the flow-of-funds data in Germany, see Stöss (2009).
[12] The sampling and methodology are described in Deutsche Bundesbank (2004).
[13] A detailed description is given by Stehle et al. (1996, 1998) and Maier and Stehle (1999).

securities listed in the REX. Given its responsibility for insurance companies, the Federal Financial Supervisory Authority (BaFin) collects balance sheet and profit and loss statements from insurers. Based on this information, BaFin calculated average yield data for life insurance policies.[14]

Some control variables are needed for the estimation of the econometric model described in Section 2.1. These are mainly based on national accounts data and population statistics of the Federal Statistical Office (Destatis).

3.2 Descriptive statistics

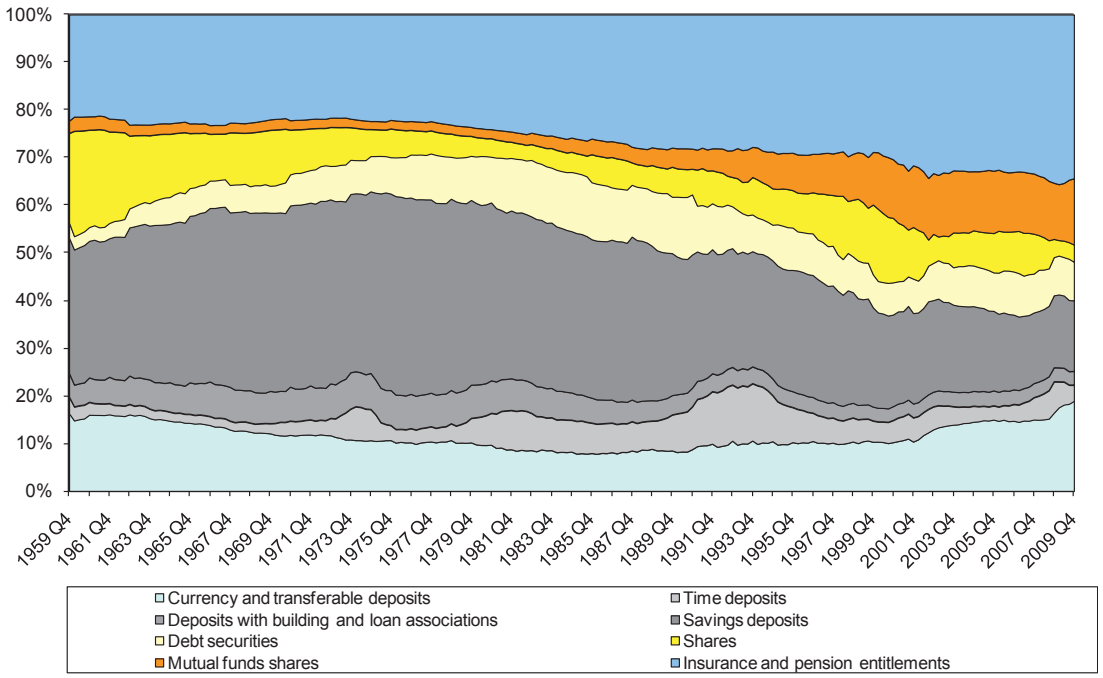
For the estimation of equation (12), we decided to include eight different financial assets. The decision with regard to the number of assets taken into account is a trade-off between economically plausible inputs and statistical (econometric) restrictions. In theory, for the modeling of the household portfolio decision, as many assets as possible should be taken into account. But on the other hand, within our model structure the number of estimated coefficients increases exponentially with the number of financial assets.[15] For statistical reasons, the number of coefficients is restricted by the length of the time series.

The decision with regard to the financial assets was driven by the specific portfolio structure in Germany during the last 50 years. The portfolio includes currency and transferable deposits, time deposits, deposits with building and loan associations, savings deposits, debt securities,[16] shares, mutual fund shares as well as insurance and pension entitlements.[17] Figure 3 shows the distribution between 1959 Q4 and 2009 Q4.

In the last five decades the portfolio structure of German households was marked by a great deal of variation. Both general trends and exogenous factors influenced the development. For instance, exogenous factors which determined all assets were the reunification in 1991, the burst of the dotcom bubble in 2001 and the most recent financial crisis. Other factors will be discussed separately for all asset categories.

[14] See, for example, Bundesanstalt für Finanzdienstleistungsaufsicht (2009).
[15] For example, for 3 assets the number of coefficients is 12 and 4 assets leads to 20 coefficients.
[16] Including money market funds. We included money market funds due to the fact that the interest rate is similar to that for debt securities.
[17] Other equities and other accounts receivable are excluded from this analysis due to a lack of interest rate information.

Figure 3. Households' portfolio structure in Germany between 1959 and 2009



Sources: Deutsche Bundesbank, own calculations.

The long-term development of currency and transferable deposits is quite smooth. Starting with a share of around 16% in 1959, one could observe a continuous decrease up to the mid-1980s, touching bottom in 1986 Q1. From then the share increased steadily, rising sharply when the financial market turbulences began at the end of 2008. Moreover, one important factor which determined the effect in the mid-1980s was the introduction of interest rates for transferable deposits.

The magnitude of time deposits is less relevant than currency and transferable deposits. In addition, it was characterized by two peaks – in 1974 and between 1991 and 1995. The first was mainly an outcome of temporary tax relief for savings and the second was partly related to German reunification.

Housing deposits contributed significantly to households' portfolio up to the mid-1980s. Between 1959 and 1985 the average share was around 5%, which was somewhat driven by tax incentives. In addition, the introduction of new financial instruments could have influenced the reduction since the end of the 1980s.

The relevance of savings deposits in Germany was significantly reduced over the last 50 years. Whereas the share in the early 1960s was around 30%, their importance increased until the mid-1960s, peaking in 1976 (42%). From then on, the share decreased to 15% at the end of 2009. Households' preferences seem to have changed in favor of more liquid assets and assets with higher returns.

The share of debt securities within the portfolio increased during the 1960s and 1970s. In 1985 the share peaked at 13%. Up until German reunification the share fluctuated at around 11%. In 1990 the share again reached the 13% mark. Thereafter, a slightly downward trend could be observed. Neither the bursting of the dotcom bubble nor the financial crisis seems to have had a significant effect on the share of debt securities. Since 2000, the percentage has been stable at around 7%-9%. These results were partly confirmed by an analysis by the ECB for the euro area.[18] Based on descriptive statistics and estimation of money demand models, the results show a shift from shares to M3. The driving factors are weak stock market development and major financial market uncertainty.

Equities are characterized by two trends. In the early 1960s equities were quite popular and common. Under certain incentive schemes, employees could receive so-called "Volksaktien" from their employers.[19] The importance of shares decreased steadily up to introduction of the "new market" in Germany in 1997. During this phase the percentage accounted for by equities increased to 15% (in 2000 Q1). After the bubble burst the share dropped to 5%. It should be noted that this effect is mainly driven by reduced asset prices and only partly by the selling of shares. Following a slight recovery between 2003 and 2008, the financial crisis led to a renewed drop in equities in the portfolios. Since 2008 Q4, the share has been around 3.5%.

The importance of mutual funds increased continuously from the beginning of the observation period. Whereas the share in 1959 was only 3%, today the proportion is around 14%. This reflects on the one hand the introduction of new financial products, and on the other hand the need for risk diversification.

[18] See European Central Bank (2003).
[19] For example VEBA, Thyssen and Volkswagen.

For insurance and pension entitlements the argument of risk diversification as well as the need for additional old-age provisions[20] could explain the increasing relevance in households' portfolios. In addition, these products are typically marked by tax promotion. The share rose from 22% in 1959 to 34% in 2009.

4 Multivariate results

In a first step, the time series are tested for a unit root using standard test procedures (augmented Dickey-Fuller test and Elliott, Rothenberg and Stock test). There is evidence for a unit root in the portfolio weights, the wealth variable and the exogenous variables. The evidence for the real returns is mixed. Even in cases of the rejection of the null hypothesis of a unit root, the specific time series shows a high persistence. Therefore, in the estimation of the long-run relationships all variables are treated as I(1) variables.

The estimation is based on equation (12) using up to four lags of the first differences of the right-hand side variables (s = 4). As there may be correlations between the residuals of the seven equations, the equations are estimated using the seemingly unrelated regression approach. The instrument set contains the current and lagged values of the weakly exogenous regressors and the lagged values of the endogenous regressors. Equation (12) represents the so-called Bewley transform of the dynamic relationship and allows for the direct estimation of the long-run elasticities and their corresponding t-statistics.

Table 1 presents the calculated impact elasticities as well as some diagnostic test statistics for the model based on equation (12), but not taking into account homogeneity and symmetry (as imposed by equations (6) and (7)). As described in Section 3.2 we used the weights of eight portfolios and their corresponding real rates of return. We choose the equation for insurance and pension entitlements as the residual equation. By using the adding up restrictions from equation (5) we calculated the coefficients after the estimation.

Results of the estimations provide evidence on four aspects. The elasticities with respect to wealth are calculated for all assets. Whereas estimated elasticities of one

[20] For example the launching of the "Riester-Rente" (Riester pension).

($\eta_{iWt} = 1$) means that the asset category has a unit impact on wealth, estimated elasticities smaller than 1 ($\eta_{iWt} < 1$) could be interpreted as wealth-inferior assets and estimated elasticities greater that 1 ($\eta_{iWt} > 1$) as wealth-luxury assets. Using equation (9), own-rate elasticities and cross-rate elasticities were calculated. Based on neoclassical demand theory, the own-rate elasticity should be positive for all asset categories. With respect to cross-rate elasticities it is noted that positive elasticities denote complements and negative elasticities denote substitutes. Elasticities given by the additional variables should provide some indications of the effect of two macro variables, namely the share of persons over 60 years old of the total population and the share of employed persons of all persons aged between 15 and 65 years. For both variables the signs of the calculated elasticities are not predetermined.

Given this, our results for the model in Table 1 indicate that mutual funds and pensions (and insurance entitlements) have unit impact elasticity with respect to wealth. Currency and transferable deposits, deposits with building and loan associations and shares are wealth-inferior assets, whereas time deposits and debt securities are wealth-luxury assets. All asset categories have positive own-rate elasticity, with the exception of time deposits. This implausible result could be driven by the strong correlation between the interest rate for time deposits and savings deposits. Turning to cross-rate elasticities, the following combinations of assets are long-run complements: currency (and transferable deposits) and mutual funds, time deposits and deposits with building and loan associations, time deposits and shares, time deposits and mutual funds as well as savings deposits and debt securities. Long-run substitutes frequently belong to currency (and transferable deposits)[21] and mutual funds.[22] In addition, deposits with building and loan associations and shares seem to be substitutes. However, the sign differences between all other asset pairs led to the rejection of the symmetry for the entire model.

Looking at the whole picture, it seems that the portfolio weight of shares reacts more distinctly to changes in interest rates than any other financial asset. By contrast, mutual funds are the most inelastic asset category. Another interesting result is that

[21] Deposits with building and loan associations, savings deposits and debt securities are substitutes for currency (and transferable deposits).
[22] Savings deposits, debt securities and shares are substitutes for mutual funds.

currency (and transferable deposits) reacts negatively to changes in interest rates of other financial assets. By contrast, the shares of time deposits and pensions (and insurance entitlements) are positively correlated with changes of the interest rates of other financial assets.

Calculated elasticities for the share of persons over 60 years show a mixed picture. Whereas time deposits and debt securities have negative elasticities, savings deposits, shares, mutual funds and pensions (and insurance entitlements) show a strong positive correlation. The elasticities for the share of employed persons are mainly diametral to those for persons over 60. There are two exceptions: currency (and transferable deposits) and deposits with building and loan associations.[23]

Whilst for Table 1 we calculated elasticities without any parameter restrictions (homogeneity and symmetry), for Table 2 we estimated the model under the symmetry restriction from equation (7). This theoretical restriction could shed some light into the assumed demand theory. In general, most of the results remained the same. Estimated elasticity with respect to wealth deviates only in the case of shares, which become closer to zero. With respect to the own-rate elasticities, unfortunately the implausible result of a negative sign for time deposits is verified. In addition, the elasticity for debt securities switched the sign, and is therefore also not in line with the theoretical prediction. For most of the cross-rate elasticities where Table 1 suggests complementarity or substitution, the model under the symmetry restrictions provided the same evidence. Only in the case of the pairs currency (and transferable deposits) and debt securities as well as savings deposits and debt securities were the results not confirmed under the theoretical model.

Concerning the additional variables, the parameter restricted model also confirms most of the results. Differences in the sense of changing signs arise for debt securities and shares for the share of employed persons. As pointed out in the discussion of the results given in Table 1, this indicates the strong reaction of both financial assets.

[23] We tried to include other additional variables such as disposable income, savings rate and some other variables related to the population (e.g. share of retired persons). Whereas other population-related variables did not change the main results, use of the first two variables led to implausible elasticities.

Table 1. Portfolio composition using all parameters: impact elasticities (homogeneity and symmetry not imposed)

	Currency & tr. dep.	Time deposits	Deposits with building and loan associations	Savings deposits	Debt sec.	Shares	Mutual funds	Pensions
Wealth	0.85 (9.82)	3.05 (7.75)	0.53 (3.27)	0.84 (1.35)	1.26 (4.16)	-0.75 (9.09)	1.06 (2.36)	1.09
i - Currency	7.28 (7.38)	-12.73 (0.89)	-29.55 (3.82)	-18.92 (3.05)	-1.88 (0.57)	62.55 (6.04)	2.42 (1.84)	1.23
i - Time deposits	7.51 (5.83)	-26.21 (1.25)	23.79 (2.03)	-3.00 (0.32)	-13.19 (2.62)	14.00 (0.89)	3.95 (1.99)	2.08
i - Deposits with building and loan associations	-8.59 (5.41)	7.61 (0.28)	11.14 (0.70)	6.61 (0.57)	-4.37 (0.71)	-34.11 (1.77)	6.15 (2.51)	2.48
i - Savings deposits	-3.07 (2.13)	7.27 (0.30)	-19.27 (1.47)	4.47 (0.33)	5.15 (0.92)	39.82 (2.27)	-6.08 (2.74)	1.92
i - Debt sec.	-4.27 (4.11)	38.67 (2.22)	4.72 (0.50)	6.51 (0.86)	23.89 (5.65)	-96.31 (7.63)	-6.95 (4.35)	2.93
i - Shares	-0.17 (3.03)	0.86 (0.93)	-0.07 (0.15)	-0.25 (0.63)	0.30 (1.42)	0.82 (0.27)	-0.00 (0.02)	0.07
i - Mutual funds	0.55 (4.54)	1.93 (0.95)	-2.05 (1.87)	-1.68 (1.91)	-0.06 (0.13)	-0.62 (0.42)	1.33 (1.76)	0.35
Over 60	0.37 (3.11)	-19.92 (9.94)	0.37 (5.88)	2.46 (2.83)	-3.01 (6.47)	6.86 (4.73)	1.79 (9.74)	0.57
Employed	0.24 (1.57)	10.46 (4.11)	0.24 (3.37)	-3.85 (3.49)	1.49 (2.52)	-3.04 (1.65)	0.08 (0.34)	0.82
Chi^2 test	1273.205 or F(21,*)= 60.628							
LR test	549.249							

Method: SUR estimation of equation (12), t-values in parentheses.

Table 2. Portfolio composition using all parameters: impact elasticities (homogeneity not imposed and symmetry imposed)

	Currency & tr. dep.	Time deposits	Deposits with building and loan associations	Savings deposits	Debt sec.	Shares	Mutual funds	Pensions
Wealth	0.93 (5.41)	3.02 (9.18)	0.57 (3.67)	0.70 (3.27)	1.15 (2.91)	-0.23 (7.94)	1.08 (4.05)	1.07
i - Currency	2.81 (11.36)	-9.36 (4.97)	-16.87 (15.92)	-2.19 (5.03)	3.78 (6.99)	-0.37 (1.83)	0.76 (6.96)	1.09
i - Time deposits	-1.67 (4.98)	-9.21 (1.09)	5.11 (2.04)	2.44 (1.47)	1.79 (0.79)	1.93 (3.35)	-0.60 (2.21)	0.05
i - Deposits with building and loan associations	-2.52 (15.92)	4.29 (2.04)	15.40 (8.16)	-2.95 (4.67)	3.23 (6.48)	-0.10 (0.42)	-0.29 (2.77)	0.42
i - Savings deposits	-1.72 (5.03)	10.75 (1.47)	-15.46 (4.67)	4.71 (1.56)	-1.08 (0.76)	-2.56 (2.55)	-0.86 (2.15)	0.44
i - Debt sec.	1.63 (6.99)	4.35 (0.79)	9.32 (6.49)	-0.60 (0.76)	-0.28 (0.63)	1.27 (4.03)	-0.53 (3.63)	1.45
i - Shares	-0.07 (1.83)	2.08 (3.35)	-0.13 (0.41)	-0.63 (2.54)	0.57 (4.03)	1.21 (0.58)	-0.16 (2.99)	0.02
i - Mutual funds	0.56 (6.97)	-2.47 (2.21)	-1.42 (2.77)	-0.80 (2.15)	-0.90 (3.63)	-0.61 (2.99)	1.71 (7.40)	0.39
Over 60	0.36 (3.38)	-17.73 (10.25)	0.36 (3.65)	0.46 (0.63)	-3.10 (7.73)	10.39 (8.87)	2.13 (13.61)	0.16
Employed	1.33 (14.03)	6.93 (3.99)	1.33 (5.22)	-5.55 (8.41)	-0.98 (2.36)	4.80 (4.57)	0.94 (6.82)	0.69
Chi^2 test								

Method SUR estimation of equation (12), t-values in parentheses.

5 Conclusion

This paper is the first to analyze within a FAIDS framework the long-term portfolio structure of households in Germany. By using a more recently compiled new data set which is based on quarterly financial accounts data for the time period 1959-2009, the results provide some deeper understanding of the relationship between financial assets and interest rates.

During the last 50 years, descriptive analysis shows – with the exception of insurance and pension entitlements – that all financial assets were characterized by substantial volatility of their weight in households' portfolio. Whereas shares lost their popularity, debt securities and mutual funds seem to be en vogue. In addition, the attractiveness of savings deposits decreased substantially. Both results could have been driven by the introduction of new products (especially in the case of mutual funds and debt securities) and by a more interest rate sensitive behavior of households.

While the bursting of the dotcom bubble mainly affected the weight of shares, the most recent financial crisis led to greater adjustments of the portfolio. The preference for more liquid assets increased to the disadvantage of riskier assets. Altogether, households seem to be more sensitive to changes in interest rates and external shocks. Results of the estimated models confirm the importance of interest rates as a determinant for portfolio shifts.

Regarding the wealth elasticities of different financial assets we found evidence that currency (and transferable deposits), deposits with building and loan associations, savings deposits and shares are wealth-inferior assets. By contrast, time deposits and debt securities are wealth-luxury financial assets. With respect to the own-rate elasticities we found, with the exception of time deposits, positively significant elasticities for all categories. The analysis of the cross-rate elasticities shows that currency (and transferable deposits) is mainly a substitute for other assets and time deposits are typically a complement within the portfolio. In addition, the calculated elasticities provide evidence for the sensitivity of the weight of shares. Given that due to the high price volatility of shares the income effects are comparatively high, this result is perhaps not surprising. Moreover, the financial market uncertainty could play an important role in this behavior. In addition, this result confirms the analysis by the

ECB for the euro area. By contrast, sensitivity for mutual funds is quite low. This is due to the fact that these assets are characterized by regular savings schemes, and transaction costs are relatively high.

Unlike the results for the wealth elasticities and interest rate elasticities, the evidence regarding the demographic variables is quite limited. Our results provide some hints of a positive relationship between an increasing share of older people and shares and mutual funds. These results are confirmed by the outcome of the latest Einkommens- und Verbrauchsstichprobe (income and expenditure survey, EVS) (2008)[24] for Germany. According to these results, the portfolio of older people contains a significantly higher percentage of shares than that of younger people. Furthermore, we found that time deposits and debt securities are positively correlated and savings deposits and shares are negatively correlated with the share of employed persons (in the working population). This means employed people could have a preference for comparatively low-risk assets.[25]

It has to be kept in mind that the analysis is restricted to financial assets. In contrast to other studies, housing or human capital is not included. The sample period is with the exception of the recent financial crisis characterized by a relatively stable environment.

This paper is the starting point of a series in which the newly generated quarterly financial accounts data will be used to seek answers to several questions. The ongoing research agenda contains, among other things, projects on the nexus between policy rate and portfolio structure as well as an analysis of the effects of the recent financial crisis on households' portfolio structure.

[24] See Rupprecht (2010).
[25] For a deeper understanding of these effects, micro data sets seem to be more appropriate. For Germany the Socio-Economic Panel (SOEP), the German SAVE data set by the Mannheim Research Institute for the Economics of Ageing (MEA) as well as the Einkommens- und Verbrauchsstichprobe (income and expenditure survey, EVS) are the most suitable micro data sources. In addition, from 2011 onwards a new Bundesbank micro data set, the Household Finance and Consumption Network (HFCN), will be available.

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Annex. Data description

Name	Description	Source
Financial assets		
Currency and transferable deposits	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Time deposits	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Housing deposits	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Savings deposits	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Debt securities (including money market funds)	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Shares	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Mutual funds shares	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Insurance and pension entitlements	Quarterly data 1959 Q4 – 2009 Q4	Bundesbank quarterly financial accounts
Interest rates		
Currency and transferable deposits	Estimated on the daily money market interest rate	Bundesbank interest rate statistics
Time deposits	Households' deposits with an agreed maturity of up to 2 years	Bundesbank interest rate statistics
Housing deposits	Households' deposits with an agreed maturity of over 2 years	Bundesbank interest rate statistics

Savings deposits	Weighted average on: Households' deposits with an agreed maturity of up to 1 year Households' deposits with an agreed maturity of over 1 year and up to 2 Households' deposits with an agreed maturity of over 2 years	Bundesbank interest rate statistics
Debt securities	Annual nominal yield data based on REX from 1960 – 2009, quarterly data are estimated	Data base from Prof. Stehle, Humboldt-University Berlin
Shares	Annual nominal yield data based on DAX and CDAX from 1960 – 2009, quarterly data are estimated	Data base from Prof. Stehle, Humboldt-University Berlin
Mutual funds shares	Weighted average on annual nominal yield data based on DAX, CDAX and REX from 1960 – 2009, quarterly data are estimated	Data base from Prof. Stehle, Humboldt-University Berlin
Insurance and pension entitlements	Annual data from 1959 – 2009, quarterly data are estimated	Bundesanstalt für Finanzdienstleistungsaufsicht (BAFIN)
Additional variables		
Over 60	Number of people 60 years and older divided by total population, annual data from 1960 – 2009	Statistisches Bundesamt (DESTATIS)
Employed persons	Number of people working divided by population 15 to 65 years old, annual data from 1960 – 2009	Statistisches Bundesamt (DESTATIS)