Heterogeneity in Asset Allocation Decisions - Empirical Evidence from Switzerland

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This version: August 2005

INCOMPLETE AND PRELIMINARY

Abstract

We analyze asset allocation decisions of different investor types and investigate how these choices change with varying macroeconomic conditions. We consider private, commercial and institutional investors and regress their relative shares of stock and bond holdings on business condition indicators. The data include monthly portfolio holdings deposited in Swiss banks over the time period from November 1998 to November 2004. Our results provide evidence for substantial investment heterogeneity between the types considered. While private and commercial investors hold relatively less equity and bonds in their portfolio with an expected downturn, institutions increase their relative stock holdings with weaker economic prospects. Furthermore, private and commercial investors base their asset allocation decision on the past behavior of institutional investors.

Key Words: Asset allocation and business fluctuations; Investment heterogeneity; Institutional investors

JEL Classification: E44 ; G11 ; E32 ; C32

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We would like to thank the Swiss National Bank (SNB) for data provision and Harris Dellas for valuable comments. Financial support from WWZ Forum is gratefully acknowledged.

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We analyze asset allocation decisions of different investor types and investigate how these choices change with varying macroeconomic conditions. We consider private, commercial and institutional investors and regress their relative shares of stock and bond holdings on business condition indicators. The data include monthly portfolio holdings deposited in Swiss banks over the time period from November 1998 to November 2004. Our results provide evidence for substantial investment heterogeneity between the types considered. While private and commercial investors hold relatively less equity and bonds in their portfolio with an expected downturn, institutions increase their relative stock holdings with weaker economic prospects. Furthermore, private and commercial investors base their asset allocation decision on the past behavior of institutional investors.

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1. Introduction

Asset allocation is the process of distributing funds among various asset classes. Investors choose the optimal mix of investments consistent with their preferences in terms of risk aversion and expected return. Many asset-pricing models assume that assets are held by a representative agent. In reality, however, investors do not form a homogenous group, but differ from each other in several aspects. Possible sources of investor heterogeneity include investors' preferences, institution-specific characteristics,[1] regulatory issues, or varying degrees of irrational behavior.

Differences between investors are likely to be reflected in their investment behavior. This holds as well with respect to portfolio adjustments to changes in the macroeconomic environment. Macroeconomic variables such as interest rates, inflation and exchange rates as well as the corresponding expectations, which may differ between investor types, affect investment decisions through their impact on the discount rates used to capitalize future cash flows (see, e.g., Solnik, 2000).

The main purpose of our paper is to investigate how different investor types change their portfolio compositions with changing business conditions. We consider three types of investors: (1) private households, (2) commercial investors such as non-financial firms or non-profit organization, and (3) institutional investors. The latter are professionnally-managed fiduciary organizations that invest the savings of private individuals. In particular, we are interested in whether institutional investors differ from the other two types with respect to their asset allocation decisions following changes in the macroeconomic environment.

The expected asymmetry between institutions one the one hand, and private and commercial investors on the other hand is motivated by regulatory issues. Among the many reasons that may cause heterogeneity in investment behavior, we attach particular importance to the fact that the Swiss law imposes strict rules on certain institutional investors regarding their portfolio composition. Pension funds, for instance, are limited with respect to the share of equity in their portfolios. Similar strict rules apply to insurance companies. These regulations are likely to have direct as well as indirect effects on the asset allocation decisions of institutions. Consider a situation where a pension fund is close to its allowed equity limit. Let us further suppose well-performing stock markets. As a result, stocks increase in value relative to other assets, and the share of stocks in the pension fund's portfolio exceeds the limit imposed by law. While this

[1] Examples of institutional characteristics are separation of ownership and control between stakeholders and fund managers, compensation contracts or other incentives (Chevalier and Ellison 1996).

pension fund is forced to sell equity, unregulated investors with equity holdings are much less likely to get rid of their stocks under these circumstances.

Note that differences in observed portfolio structures between investor types may not only result from active buying and selling of securities following a change in (expected) business conditions. Such dissimilarities in asset holdings can as well be caused by the original portfolio composition, i.e., the choice of the portfolio's *beta*. Stock market movements have different effects on asset holdings depending on a portfolio's risk profile. Accordingly, investment heterogeneity refers to both types of behaviors.

The topic of investor heterogeneity and portfolio choice is relevant for several reasons. Even though a lot of research has been devoted to asset allocation decisions, little is known about differences between individually and professionally-managed funds and the effects on portfolio decisions (O'Connell and Teo, 2004). Further research is certainly needed in this area. The topic is also of great importance from a macroeconomic point of view. In case the two groups react differently to changing business conditions, for instance, shifts in their relative market weights are likely to imply a change in the way assets are priced (Cohen 1999). To see this, let us assume a situation where managed funds tend to buy when stock prices are falling and sell when prices have been rising. Such a behavior has a stabilizing effect on stock price movements. In case individuals eventually control a larger share of totals stock holdings, which may be one possible outcome of the currently debated Social Security Privatization in the US, destabilizing effects on stock markets could result. Finally, we provide evidence on investor heterogeneity and investment behavior for Switzerland. Even though Switzerland is considered as an important financial center, there are very few studies available on investment heterogeneity in Swiss financial markets.

Our data include monthly portfolio holdings sorted by investor type deposited in Swiss banks over the time period from November 1998 to November 2004. In accordance with the relevant literature, portfolio holdings are categorized into the main asset classes *equity instruments* (stocks) and *fixed income* (debt or bonds). Following Cohen (1999), we characterize the asset allocation decisions by computing on a monthly basis (i) the fraction of stocks and bonds held by each investor type relative to the economy-wide stock holdings, and (ii) the share of stocks held by each investor type relative to its total portfolio holdings. In order to link the asset allocation decisions to the macroeconomic environment, we regress these relative asset ratios on a set of

macroeconomic variables. Furthermore, we carry out a vector autoregression analysis in order to find out about potential temporal interaction effects between the investor groups.

Our empirical results reveal significant differences between the behavior of institutional investors on the one hand, and private and commercial investors on the other hand. In particular, private and commercial investors hold relatively less equity and bonds in their portfolio with an expected downturn, while institutions increase their relative stock and bond holdings with weaker economic prospects. Furthermore, private and commercial investors take into account past investment decisions of institutional investors, while the latter do not seem to base their portfolio choices on the past behavior of the other market players.

The new aspects of the paper are as follows. It is the first study that uses Swiss data to investigate how portfolio holdings of different investor categories are changing with business conditions. We also provide further empirical evidence on the investment behavior of institutional investors. Even though asset holdings of institutional investors now exceed directly-held individual holdings in G7 countries,[2] the bulk of empirical research has looked at the investment decisions of retail investors. Finally, we use a vector autoregression model to explore potential interactions over time between the asset allocation decisions of the different investors types considered.

The paper is structured as follows. Section 2 reviews the existing literature and states the main hypothesis. Section 3 describes the data. The results are in section 4. Section 5 includes robustness tests, and section 6 concludes. Supplementary statistics are relegated to the appendix.

2. Review of existing literature and tested hypothesis

Many asset-pricing models are based on the assumption that assets are held by a representative agent. In reality, however, different types of investors behave differently with respect to their investment behavior (Cohen 1999). Even though a series of arguments have been put forward in the investment literature why different types of investors may invest differently, it is generally not well understood what constitutes utility for an institutional investor as opposed to an individual investor. In what follows, we list main arguments on investor heterogeneity put forward in the literature and also mention possible effects on asset allocation decisions.

[2] As of 1997, the ratio of institutional to direct holdings was 1.5 across G7 households (Davis, 2000). Institutional holdings equal 100 percent of GDP in G7 countries, and 200 percent in the U.S. and U.K. (Davis and Steil, 2001).

Information

As Davis and Steil (2001) argue, institutions are generally larger organizations, with more sophisticated decision support systems and are therefore better informed than individuals. Accordingly, institutions may have better diversified portfolios or may in general behave more rationally compared to individual investors with respect to their asset allocation decisions.

Risk aversion

Based on the pioneering work by Kahnemann and Tversky (1979), numerous studies have investigated links between risk-taking, equity trading and past performance of investors (e.g., Bernatzi and Thaler, 1995; Barberis, Huang and Santos, 2001). While the bulk of the literature focuses on retail investors, only a few studies look at institutional investors. Davis and Steil (2001), for instance, find that institutional investors exhibit a lower degree of risk aversion in their investment behavior compared to households. O'Connell and Teo (2004) provide evidence for a procyclical behavior of institutional investors, which they relate to dynamic loss-aversion, narrow-framing and overconfidence. Cohen (1999) directly compares asset allocation decisions of individuals and institutions. He finds that institutions have a more constant relative risk aversion than individuals.

Time horizon of investment

According to Dennis and Strickland (2002), institutional investors have a rather short time horizons of investment. They orient themselves mainly on past market returns, which may lead to selling during a market decline. In contrast, individuals are said to make decisions based on long-term criteria, but they are exposed to psychological biases as well. An example of such a bias is the so called *disposition effect*. The disposition effect describes an investment behavior of selling past winners, but refusing to sell past losers (Odean 1998). As Shapira and Venezia (2000) outline, however, the disposition effect may not only hold for individuals, but for institutional investors as well.

Herding

Herding behavior is the term used to describe situations in which a group of individuals react coherently without there being any co-ordination between them. Institutional investors may have a preference for herding due to fear of reputation damage (Dennis and Strickland, 2002), offered compensation packages or simply investors' desire for conformity (Bikhchandani and Sharma (2001). Lakonishok et al. (2001) and Grinblatt et al. (1995), however, only find weak evidence for herding behavior of pension fund managers.

Overconfidence

Psychologists have shown that people tend to put more weight on success than on failure, i.e., they are overconfident. It is likely that such biases affect individual investors and to a lesser extent than professional traders (Gervais and Odean, 2001). As Kent et al. (1998) as well as Barber and Odean (2000) outline, overconfidence may lead to imperfect portfolio diversification, which includes inadequate responses changes in the macroeconomic environment. The adverse effects of overconfidence on investors are reasonably clear, but the effect on market prices is unresolved (Gervais and Odean, 2001).

Irrational behavior

It is commonly argued that investors do not always behave fully rational. It is not clear, however, whether individual investors or institutions are more susceptible to irrational behavior. While some claim that fund managers would irrationally herd, others assert that individuals are characterized by higher degree of irrationality (see, e.g., Lakonishok et al. 1994).

Regulations and tax treatments

Certain types of institutional investors such as insurance companies or pension funds are regulated with respect to their asset allocation decisions. The main focus of regulation of life insurance contracts is that there should be sufficient and appropriate assets to meet obligations to consumers, and that consumers should be sold appropriate financial products for their needs. Pension regulation has the broader core objective of aiming to ensure retirement income security for individuals. (Davis 2001). In Switzerland, for instance, pension funds are allowed to invest at most 50% of the capital in stocks or similar securities.[3,4] Given that pension funds are important players in the Swiss capital markets, they are expected to strongly influence the behavior of institutional investors.

It is not always clear how and to what extent the sources of investor heterogeneity affect asset allocation decisions of the investor types under consideration. Similarly, it is in general not possible to link a specific observed behavior to one or several investor characteristics as listed above. What we know, however, is that a large part of institutional investors are regulated with respect to their portfolio allocation decisions and that these restrictions do not apply to the other investor types. Given that the regulations refer to asset prices in portfolios of institutional

[3] See Verordnung über die berufliche Alters-, Hinterlassenen- und Invalidenvorsorge (BVV 2), 3. Abschnitt, Art. 55, lit. c.

investors, macroeconomic conditions have a direct impact on whether these restrictions are binding or not. Accordingly, we expect to observe divergent investment strategies with respect to fluctuations in business conditions between institutional investors on the one side, and private as well as commercial investors on the other side. We now formulate our main hypothesis as follows:

Hypothesis: Institutional investors differ from private and commercial investors with respect to the adjustments of their asset holdings to fluctuations in the macroeconomic environment.

In what follows, we test our main hypothesis with Swiss data as described in the next section.

3. Data description

3.1. Portfolio holdings

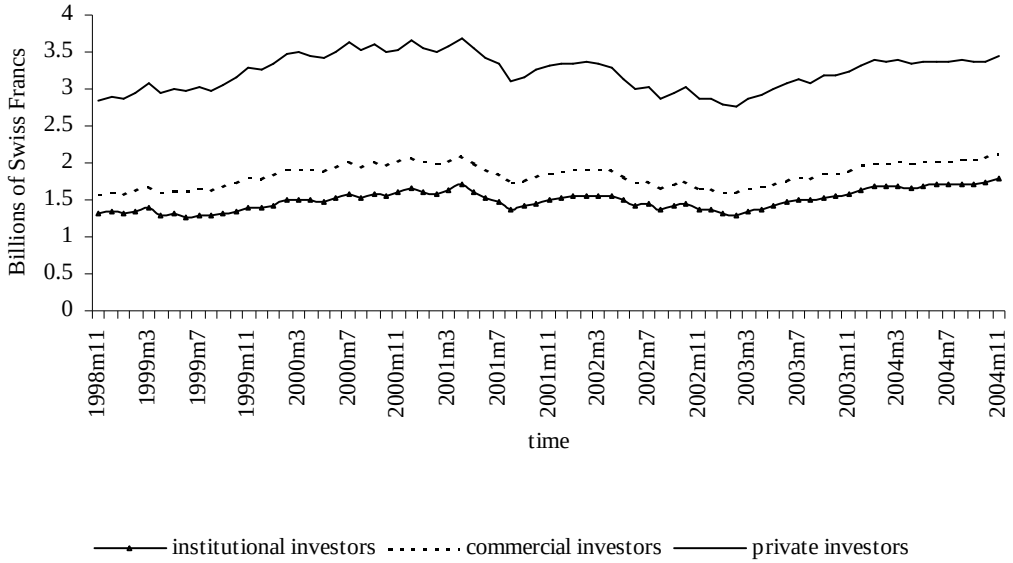
The data on portfolio holdings are taken from a survey conducted on a monthly basis by the Swiss National Bank (SNB). The statistics include the portfolio holdings deposited in 342 banks located in Switzerland and Lichtenstein. The data cover about 95% of the total value invested. Portfolio holdings are measured at market prices and are converted into Swiss francs. The data are disaggregated according to the type of depositors, the residence of depositor and issuer (domestic or foreign), the category of securities, as well as whether they are denominated in Swiss Franc, Dollar, Euro, Pound Sterling, or Japanese Yen. As to the type of depositors, private, commercial and institutional investors are considered. Private investors are individuals that are employed, self-employed, out of the labor force, retired, students or minors. Commercial investors consist of non-financial companies, governmental entities as well as non-profit organizations. Institutional investors, finally, include financial companies, banks and social security institutions. The securities are classified into the following seven categories: (1) Money market papers; (2) Commercial bonds; (3) Foreign government bonds; (4) Stocks; (5) Money market funds; (6) Other mutual funds; (7) Others.

Our sample comprises monthly end-of-period observations of asset holdings by investor types over the period from November 1998 to November 2004. Figure 1 shows the total value of deposits in Swiss banks over time. It includes deposits in all currencies considered, held by residents as well as non-residents. The total value of all deposits reached its peak in April 2001 with 3.69 Bio CHF. This figure dropped significantly during the following stock market corrections, but it returned to a value of 3.46 Bio CHF in November 2004. During the time period

[4] According to the Swiss Pensionfunds Association (Schweizerischer Pensionskassenverband ASIP), the share of stocks in the portfolios of Swiss pension funds amounted to 39.6% by the end of 2002, with 16.9% invested in

considered, the share of private investors amounted to 42.8%, whereas institutions held 46.3%, on average.

Figure 1: Total value of deposits by investor type (stacked) over time



The figure shows the total value of deposits in billions of Swiss Francs, held by private, commercial and institutional investors (stacked) over time. The values include the deposits of domestically as well as foreignly issued securities held by residents and non-residents. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

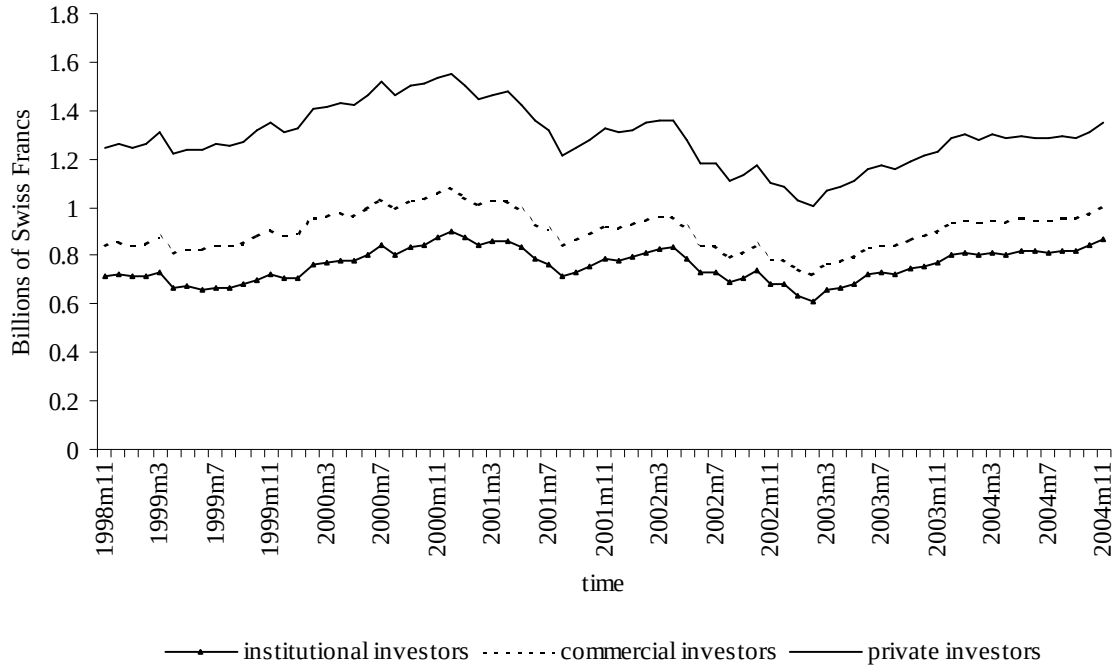
In what follows, we restrict our sample to domestically issued securities, which represent 39.9% of total holdings on average.[5] The purpose of this limitation is to reduce the amount of leakage in our data, i.e., we want to reduce trades of securities between investors that are not in our sample.[6] The series of domestically issued portfolio holdings by investor type over time are given in Figure 2. Overall, the movements of the series do not seem to differ much from the ones in Figure 1 with domestic and foreign security issues. The relative shares of total security holdings across investor types, however, are slightly different. While private investors hold 43% of all securities on average, their share drops to 30% when considering domestically issued portfolio holdings only. The share of institutional investors amounts to 46% overall, but they hold 53% of domestically issued securities on average. Commercial investors are the least important security holders, with average holdings of 11% of domestic as well as total issues.

Swiss stocks and 22.7% invested in foreign stocks.

[5] The share of domestically issued securities that is held by residents amounts to 58.5% on average.

[6] We carry out robustness tests of our main results with the complete sample.

Figure 2: Total value of deposits of domestically issued securities by investor type (stacked) over time



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The next subsection describes the relative shares of equity and fixed income in the portfolio of each investor type as well as with respect to the economy-wide holdings of domestically issued securities.

3.2. Relative stock and bond holdings by investor types

In order to know about the relative importance of the security holders with respect to total stock and bond holdings, we compute for each investor type *j* and each period *t* the fraction of his stock holdings relative to the sum of total stock holdings in the economy in period *t*, i.e.,

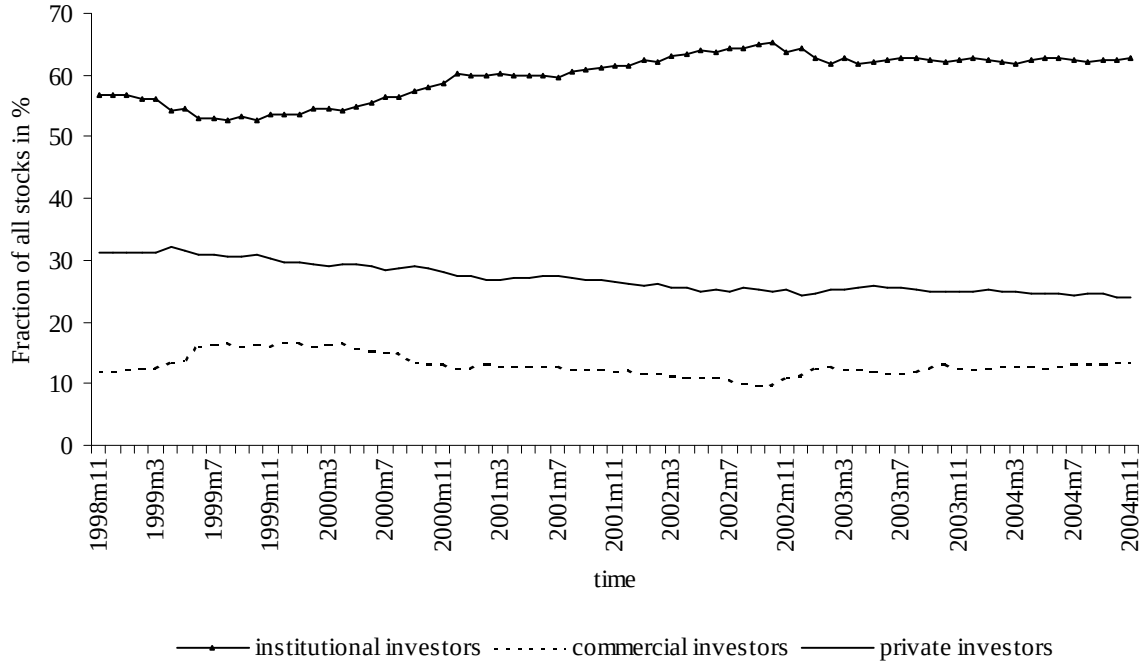
$$FRAC\_STK_{jt} = \frac{equity_{jt}}{\sum_j equity_{jt}}, \text{ with } j = PRIV, INST, COM \text{ and } t = 1,..,73 \qquad (1)$$

Similarly, we build the variable $FRAC\_BOND_{jt}$, which is the fraction of fixed income (to which we refer as bonds) held by each investor type *j* in each time period *t* relative to the total of fixed income securities held by all investors in the same period.

$$FRAC\_BOND_{jt} = \frac{fixed\ income_{jt}}{\sum_j fixed\ income_{jt}},\ \text{with } j = PRIV, INST, COM \text{ and } t = 1,..,73 \qquad (2)$$

The series are plotted in Figure 3 and Figure 4, respectively, and Table 1 shows descriptive statistics of the ratios considered.

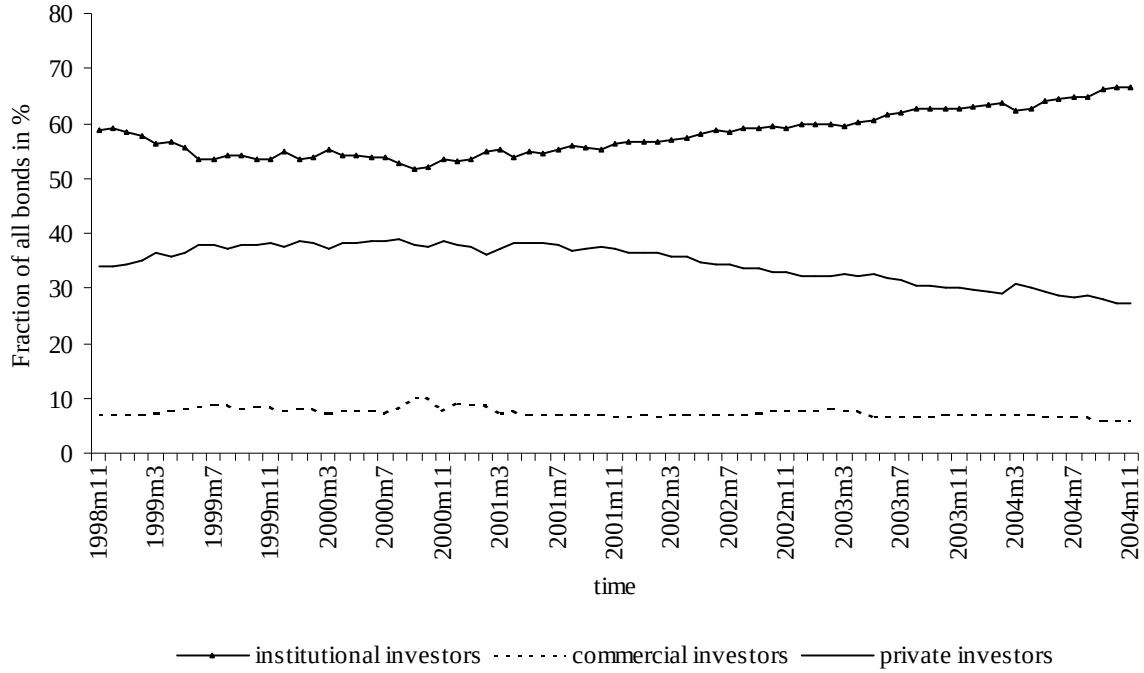
Figure 3: Fraction of stocks held by each investor type relative to economy-wide stock holdings FRAC_STK



The figure shows the fraction of stocks held by private, commercial and institutional investors relative to total stock holdings by all investors over time. The values include the deposits of domestically issued securities held by residents and non-residents. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

As we can see from Figure 3, institutional investors hold about 60% of all stocks in the economy, on average. While about 30% of all stocks are held by private investors, commercial investors are the least important equity holders. Looking at the development of the fractions over time, we observe a generally decreasing equity share of private investors. The relative share of institutions and commercial investors moves in both directions over time. Institutional investors, however, exhibit the highest variation in their relative equity holdings.

Figure 4: Fraction of bonds held by each investor type relative to economy-wide bond holdings
FRAC_BOND



The figure shows the fraction of bonds held by private, commercial and institutional investors relative total bond holdings by all investors over time. The values include the deposits of domestically issued securities held by residents and non-residents. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

The relative shares of bonds by investor type as shown in Figure 4 reveal a similar picture in terms of the relative importance of investor types. The institutions own again the largest fraction, while the commercial investors are even less significant than when equity holdings are considered. Furthermore, the relative shares of institutional and private investors seem to move in opposite directions over the time period considered, and the relative share of bonds held by commercial investors is the least volatile over time. The latter is also supported is by descriptive statistics as reported in Table 1.

Table 1: Descriptive statistics of relative stock and bond holdings by investor type

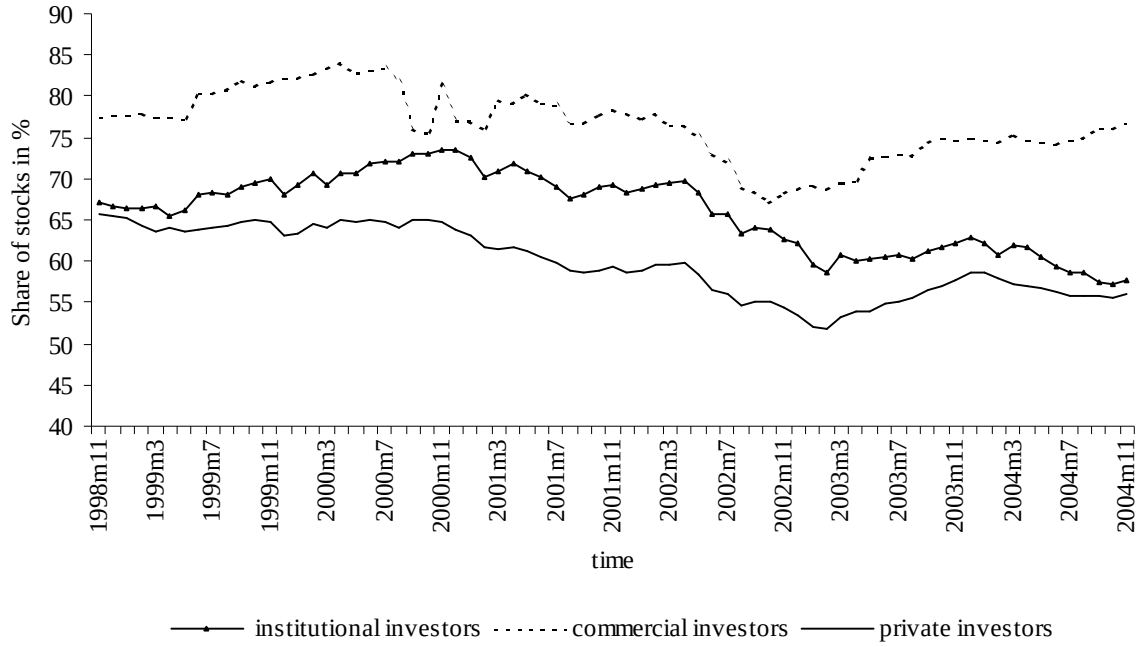
%	Mean	Std. Dev.	Min	Max
		FRAC_STK		
Private investors	27.11	2.39	23.87	32.23
Commercial investors	13.11	1.75	9.79	16.68
Institutional investors	59.78	3.71	52.68	65.15
Total	100			
		FRAC_BOND		
Private investors	34.56	3.48	27.33	38.96
Commercial investors	7.50	0.84	5.92	10.40
Institutional investors	57.94	4.03	51.80	66.69
Total	100			

The table reports descriptive statistics of the fraction of stocks and bonds held by private, commercial and institutional investors relative total stock and bond holdings by all investors over time. The values include the deposits of domestically issued securities held by residents and non-residents. The variable $FRAC\_STK_{jt}$, is defined as total value of stocks held by each investor type *j* in each time period *t* relative to the total stock holdings by all investors in period *t.* The variable $FRAC\_BOND_{jt}$, is defined as total value of bonds held by each investor type *j* in each time period *t* relative to the total bond holdings by all investors in period *t.* The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

In addition to considering the investors' stock and bond holdings relative to the economy-wide asset holdings, we are interested in the portfolio composition across investor types. The second set of ratios refers to the relative share of stocks in the portfolio of each investor type. The variable $STKSH_{jt}$ is the total value of stocks held by investor *j* in period *t* relative to the total value of assets held by investor *j* in period *t*, i.e.,

$$STKSH_{jt} = \frac{equity_{jt}}{(equity_{jt} + fixed\ income_{jt})}, \text{ with } j = PRIV, INST, COM \text{ and } t = 1,..,73 \qquad (3)$$

Figure 5: Share of stock holdings by investor type over time



The figure shows the share of stocks relative to total asset holdings of private, commercial and institutional investors over time. The values include the deposits of domestically issued securities held by residents and non-residents. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

Figure 5 shows the stock share $STKSH_{jt}$ by investor type over time, and the corresponding summary statistics can be found in Table 2. Commercial investors have the highest share of equity in their portfolio. Also, it seems that the stock share of commercial investors reaches its lowest level towards the end of 2002, whereas private and institutional investors get to their minimal value only about one quarter later. Overall, institutional investors exhibit the highest standard deviation in their stock holdings.

Table 2: Descriptive statistics of share of stocks in portfolio of each investor type

STKSH in %	Mean	Std. Dev.	Min	Max
All investors together	65.38	4.20	57.74	71.74
Private investors	59.78	4.11	51.80	65.72
Commercial investors	76.55	4.18	67.13	84.03
Institutional investors	66.05	4.68	57.33	73.54

The table reports descriptive statistics of the relative share of stock holdings in the portfolio of private, commercial and institutional investors over time. The values include the deposits of domestically issued securities held by residents and non-residents. The variable $STKSH_{jt}$ is defined as the total value of stocks held by investor *j* in period *t* relative to the total value of assets held by investor *j* in period *t*. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

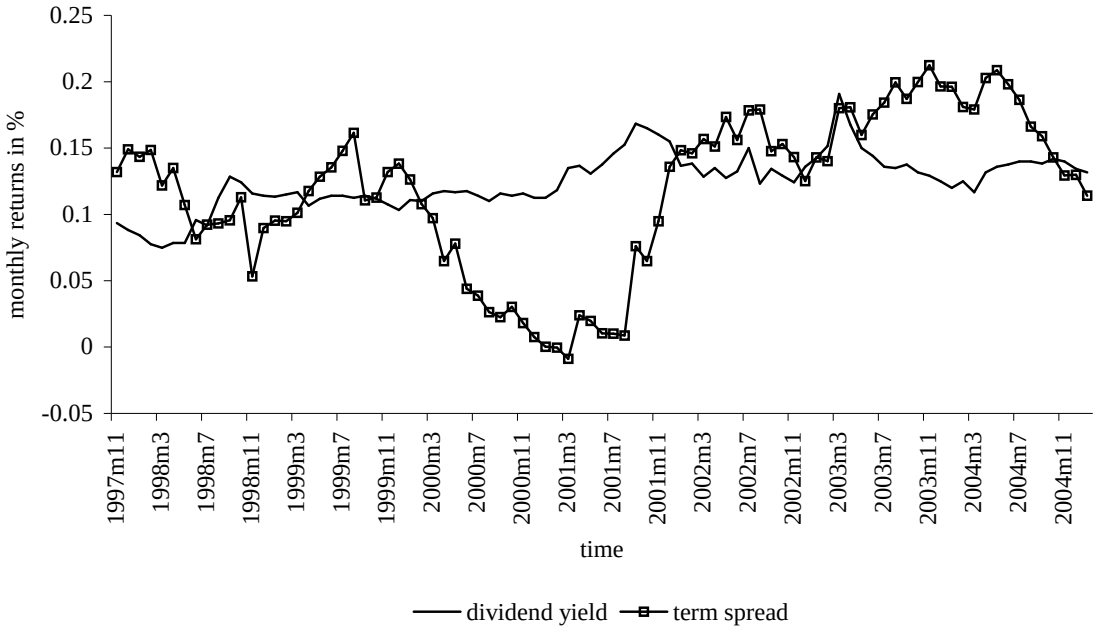
3.3. Business conditions

The choice of the variables describing the state of the macroeconomy mainly follows Cohen (1999). We use the dividend yield and the term spread as main proxies for the business conditions. Dividend yields *DIVYIELD* are commonly used to forecast stock returns. According to Fama and French (1989), the major movements of the dividend yield seem to be related to long-term business episodes that span several measured business cycles. Also, the dividend yield forecasts high returns when business conditions are weak and low return with strong conditions.

The interest rate spread or term spread *TERMY* is more closely related to shorter-term business cycle movements and is considered as a simple and powerful tool for forecasting recessions. It is generally low around measured business cycle peaks and high near troughs (Fama and French 1989). The term spread is computed by subtracting the LIBOR (the rate that banks charge one another for overnight loans) from the yield on the ten year Swiss Treasury bond.

The dividend yield and term spread over the time period considered are represented Figure 6. While differences between the two series seems to be rather small during the first and last third of the time period considered, the dividend yield is significantly higher from March 2000 to November 2001.

Figure 6: Monthly dividend yield and term spread over time



The figure shows dividend yields and term spread for Switzerland. The data are taken from the Thompson Financial Datastream database. The time period ranges from November 1998 to November 2004.

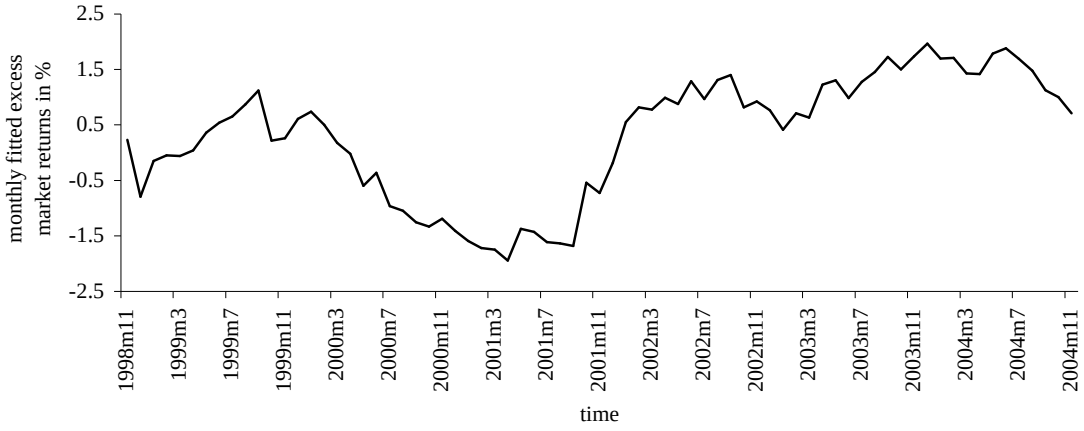
As Fama and French (1989) show, dividend yield and term spread predict excess market returns. In addition to using these two variables as business cycle proxies, we combine them in order to obtain an alternative business condition indicator. In particular, we regress excess market returns[7] EER_t on the lagged values of the dividend yield and term spread, i.e.,

$$EER_t = \beta_0 + \beta_1 DIVYIELD_{t-1} + \beta_2 TERMY_{t-1} + u_t \qquad \text{with } t = 1,..,73 \tag{4}$$

We then compute the fitted values of excess market returns $\hat{EER}_t$ and use this variable as our third business cycle indicator. The series of fitted excess market returns is given in Figure 7.

[7] The excess market returns EER_t are computed by subtracting the yield on prime thirty-day commercial papers in the previous month from the market return in the current month. The yield on commercial papers tracks returns on money market mutual funds, which are the natural alternative for an investor not wanting to invest in stock or bond funds. The market return is defined as $ER_t = \ln(I_t / I_{t-1})$, with I_t representing the market index at the end of month t.

Figure 7: Monthly fitted excess market returns $\hat{EER}_t$



The figure shows fitted values of excess market returns for Switzerland. The values are computed by regressing excess market returns on the lagged values of the dividend yield and term spread and by building the fitted values. The data are taken from the Thompson Financial Datastream database. The time period ranges from November 1998 to November 2004.

Similar to the term spread, the lowest values of fitted excess market returns are reported in the first quarter of 2001. The fitted values increase sharply by the end of 2001, and fluctuate on a higher level thereafter. Note that the macroeconomic variables are all on a monthly basis and taken from Thompson Financial Datastream. Descriptive statistics of the variables are given in Table 3.

Table 3: Descriptive statistics of macroeconomic variables

%	Mean	Std. Dev.	Min	Max
Dividend yield (*DIVYIELD*)	0.1296	0.0172	0.1033	0.1908
Term spread (*TERMY*)	0.1189	0.0638	-0.0090	0.2124
Market returns (*ER*)	0.0032	4.3335	-13.4828	10.2876
Excess market returns (*EER*)	-0.1181	0.4343	-13.5453	10.2693
Fitted excess market returns ($\hat{EER}$)	0.3181	1.1133	-0.1944	0.1967

This table shows descriptive statistics of the business cycle proxies and of (fitted) market returns. The data are taken from Thompson Financial Datastream and the Swiss Federal Statistical Office. The time period ranges from November 1998 to November 2004.

4. Methodology and results

In order to relate the asset allocation decisions to variations in the macroeconomic environment, we regress the ratios that describe the structure of portfolio holdings as outlined above on a vector of macroeconomic variables. Following Cohen (1999), we regress the relative stock and bond

holdings *FRAC_STK* and *FRAC_BOND* as well as the share of stocks in each investor's portfolio *STKSH* on current values of the dividend yield *DIVYIELD* and the term spread *TERMY*. Given that these two explanatory variables are correlated with each other, we include them separately also. In addition, we use fitted excess market returns $\hat{EER}$ as an alternative covariate. We run the regressions separately for each investor type in order to identify potential differences in investment behavior between the investor categories considered.

Given the structure of the data, the regressions exhibit autocorrelated residuals. In order to obtain consistent estimates, we use OLS with standard errors based on the Newey-West estimator. This estimator provides a heteroscedasticity and autocorrelation consistent covariance matrix. The number of lags included is three.[8] In addition, we use the bootstrap technique to compute standard error in order to check the robustness of our results (Section 5).

To see whether certain types of investors base their decisions on what some others have done, we carry out a vector autoregression analysis to get some insights about potential intertemporal interaction effects.

4.1. Fraction of stocks and bonds held by investor types relative to total stocks holdings in the economy

Let us first consider the fraction of equity held by the different types of investors, $FRAC\_STK_{jt}$, with j=*PRIV, COM, INST* and t=1,..,73. This ratio characterizes the relative importance of each investor type with respect to the economy-wide stock holdings. As outlined by equation (5), we regress for each investor type the fraction of stock holdings in period t on current values of the business condition indicators dividend yield $DIVYIELD_t$ and term spread $TERMY_t$. As mentioned earlier, high expected returns forecast weak business conditions, while stronger conditions are associated with lower expected returns.

$$FRAC\_STK_{jt} = \beta_0 + \beta_1 DIVYIELD_t + \beta_2 TERMY_t + u_{jt} \quad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{5}$$

In addition, we use the fitted excess market returns $\hat{EER}$ as alternative business indicator, i.e.,

$$FRAC\_STK_{jt} = \gamma_0 + \gamma_1 \hat{EER}_t + u_{jt} \quad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{6}$$

[8] Greene (2003) suggests the number of lags L as the smallest integer greater than or equal to $T^{1/4}$, where T is the number of periods. In our case, we have 73 periods, which leads three lags.

Note that it would be sufficient to run the regression for two out of three investor groups, given that their stock fractions $FRAC\_STK_{jt}$ sum up to one by definition.[9] In order to facilitate comparison between investor groups, however, we report the full set of results in Table 4.

Table 4: Effects of business conditions on the fraction of stock holdings of each investor type relative to total stock holdings in the economy

$FRAC\_STK_{jt}$	Private investors (5)			Commercial investors (5)			Institutional investors (5)		
	DIV-YIELD and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY
$DIVYIELD_t$	-76.40**	-86.59**	-	-47.76**	-50.35**	-	124.16**	136.94**	-
	(23.99)	(24.41)		(17.76)	(17.43)		(37.94)	(37.04)	
$TERMY_t$	-12.64*	-	-17.11**	-3.21	-	-6.00	15.85*	-	23.11**
	(5.12)		(5.25)	(3.34)		(3.65)	(7.70)		(8.07)
Constant	0.39**	0.38**	0.29**	0.20**	0.20**	0.14**	0.42**	0.42**	0.57**
	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.01)	(0.05)	(0.05)	(0.01)
F(x, y)	9.97**	12.58**	10.61**	4.45**	8.35**	2.71	9.63**	13.66**	8.20**
N		73			73			73	
$FRAC\_STK_{jt}$	Private investors (6)			Commercial investors (6)			Institutional investors (6)		
	Fitted values of excess market returns								
$\hat{EER}_t$		-0.91**			-0.24			1.15*	
		(0.31)			(0.20)			(0.46)	
Constant		0.27**			0.13**			0.59**	
		(0.01)			(0.01)			(0.01)	
F(x, y)		8.62**			1.41			6.14*	
N		73			73			73	

The table reports results from regressing the monthly share of stocks of each investor type relative to total stock holdings in the economy $FRAC\_STK_{jt}$ on current values of the dividend yield $DIVYIELD_t$ and the termspread $TERMY_t$ (upper part), as well as on the fitted value of excess market returns $\hat{EER}_t$ (lower part). The fitted values of excess market returns $\hat{EER}_t$ are computed by regressing excess market returns on lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West technique and corrected for serial correlation up to the third lag and heteroskedasticity. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and (*) respectively. The data on asset holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

The upper part of Table 4 reports the results from using dividend yield and term spread as expected return variables. It is apparent that the investment behavior of private and commercial investors significantly differs from the conduct of institutions. While private and commercial investors reduce their relative stock holdings with lower expected market returns, institutions increase their stock exposure relative to the other market participants under the same conditions. This means that private and commercial investors have relatively less equity in their portfolio when they expect a downturn of the market, while institutional investors hold relatively more

[9] As a consequence, the coefficients of the business condition proxies sum up to zero over all three investors.

equity when business prospects are weak. These results also hold when including the expected return variables *DIVYIELD* and *TERMSPREAD* separately.

Note that the effects described are economically significant. When considering the results with two covariates, for instance, an increase of the dividend yield by one standard deviation (0.017) implies a reduction of the relative stock holdings of about 1.3 % for private households, while we expect the institutions to increase their relative stock holdings by more than 2%, on average. When including one covariate only, we observe that the relative stock holdings react much stronger to changes in the dividend yield than to changes of the term spread. For commercial investors, the term spread does not even have a significant impact on their relative stock holdings. Overall, the significance of the *F* statistic in all but one specification points to a high explanatory power of the model.

The lower part of Table 4 shows the results from using the fitted excess market returns $\hat{EER}$ as our alternative business condition indicator. This indicator combines the effects of dividend yield and term spread. Consistent with the findings above, private and institutional investors react in opposite ways to changes of expected market returns. Again, private investors have lower relative stock holdings with higher expected excess market returns, on average, while the equity holdings of institutional investors are relatively higher. We do not find significant results for commercial investors, which, however, only hold about 13% of the economy-wide stock holdings on average.

Our second set of ratios considers the fraction of bonds held by each investor type relative to total bond holdings in the economy. In analogy to equity holdings, we regress the relative fraction of bonds $FRAC\_BOND_{jt}$, for $j=PRIV, COM, INST$ and t=1,..,73, on current values of dividend yield and term spread, i.e.,

$$FRAC\_BOND_{jt} = \beta_0 + \beta_1 DIVYIELD_t + \beta_2 TERMY_t + u_{jt} \quad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{7}$$

Fitted values of excess market returns are used as our alternative business cycle proxy, as given by (8).

$$FRAC\_BOND_{jt} = \gamma_0 + \gamma_1 \hat{EER}_t + u_{jt} \quad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{8}$$

The results are reported in Table 5. Overall, the results with $FRAC\_BOND_{jt}$ as dependent variable are very similar to our former findings from the relative equity holdings. The behavior of

institutional investors is opposite to the reaction of private and commercial investors. In particular, private households and commercial investors exhibit relatively higher bond holdings when the market does well and relatively less bond holdings when the market does poorly, while institutional investors have the exactly opposite behavior. The effects are strongest for private and institutional investors. But the results are also significant for commercial investors, even in the specification with the fitted excess market returns. Overall, we conclude a strong heterogeneity between institutional investors on the one hand, and private investors on the other hand in terms of their relative equity and bond holdings with changing business conditions. We interpret these findings as support for our main hypothesis.

Given our model specification, it does not come as a surprise to us that at least one investor has a positive coefficient for the business condition proxies, while the coefficients for the one or two remaining groups carry the opposite sign. The interesting dimension of this result is to know which investors move in which direction. In particular, it tells us that investors with different characteristics differ in their investment behavior as well.

Even though these findings provide additional insights, our results are limited by the available information. As mentioned earlier, we dispose of some information about potential sources of heterogeneity between investor types. Our data, however, do not allow us link a certain investment behavior to one or several specific investor characteristics. We have good reasons to believe that regulations applying to portfolio holding of certain institutional investors, such as pension funds and insurance companies, may play an important role.

In addition, let us emphasize that changes of portfolio holdings over time can result from an active trading strategy, i.e., buying and/or selling of securities by the investors, but shifts can be caused as well by stock market movements. Depending on a portfolio’s risk profile, which is a strategic decision that may well differ also between investor types, stock market movements have different effects on portfolio holdings. Investor heterogeneity may thus refer to both types of behavior.

Table 5: Effects of business conditions on the fraction of bond holdings of each investor type relative to total stock holdings in the economy

$FRAC\_BOND_{jt}$	Private investors (7)			Commercial investors (7)			Institutional investors (7)		
	DIV-YIELD and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY
$DIVYIELD_t$	-38.09	-67.57$^{(*)}$	-	-17.00$^{(*)}$	-20.94*	-	55.10$^{(*)}$	88.51*	-
	(27.30)	(37.12)		(9.34)	(9.62)		(32.77)	(42.39)	
$TERMY_t$	-36.57**	-	-38.80**	-4.89**	-	-5.88*	41.46**	-	44.68**
	(5.85)		(5.63)	(1.77)			(6.26)		(6.46)
constant	0.44**	0.43**	0.39**	0.10**	0.10**	0.08**	0.46**	0.46**	0.53**
	(0.03)	(0.05)	(0.01)	(0.01)	(0.01)	(0.003)	(0.04)	(0.05)	(0.01)
F(x, y)	23.54**	3.31$^{(*)}$	47.48**	4.98**	4.74*	6.67*	26.82**	4.36*	47.82**
N		73			73			73	
$FRAC\_BOND_{jt}$	Private investors (8)			Commercial investors (8)			Institutional investors (8)		
	Fitted values of excess market returns								
$\hat{EER}_t$		-2.25**			-0.33*			2.58**	
		(0.34)			(0.14)			(0.42)	
constant		0.35**			0.08**			0.57**	
		(0.01)			(0.002)			(0.01)	
F(x, y)		42.84**			5.39*			38.21**	
N		73			73			73	

The table reports results from regressing the monthly share of bonds of each investor type relative to total bond holdings in the economy $FRAC\_BOND_{jt}$ on current values of the dividend yield $DIVYIELD_t$ and the termspread $TERMY_t$ (upper part), as well as on the fitted value of excess market returns $\hat{EER}_t$ (lower part). The fitted values of excess market returns $\hat{EER}_t$ are computed by regressing excess market returns on lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West technique and corrected for serial correlation up to the third lag and heteroskedasticity. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and $^{(*)}$ respectively. The data on asset holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

4.2. Share of stocks in the portfolio of each investor type

Besides the investor-specific stock and bond holdings relative to economy-wide asset holdings, we are also interested in the share of equity in the portfolio of each investor type $STKSH_{jt}$, and how this ratio moves with expected business conditions. As is outlined by equations (9) and (10), we regress $STKSH_{jt}$ for $j=PRIV, COM, INST$ and t=1,..,73, on the dividend yield and the term spread as well as on the fitted values of excess market returns. The corresponding results can be found in Table 6.

$$STKSH_{jt} = \beta_0 + \beta_1 DIVYIELD_t + \beta_2 TERMY_t + u_{jt} \qquad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{9}$$

$$STKSH_{jt} = \gamma_0 + \gamma_1 \hat{EER}_t + u_{jt} \qquad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \tag{10}$$

Table 6: Effects of business conditions on the share of stock holdings in the portfolio of each investor type

$STKSH_{jt}$	Private investors (9)			Commercial investors (9)			Institutional investors (9)		
	DIV-YIELD and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY	*DIV-YIELD* and *TERMY*	*DIV-YIELD* ONLY	*TERMY* ONLY
$DIVYIELD_t$	-145.74**	-169.92**	-	-99.34**	-121.10**	-	-74.81**	-115.90*	-
	(24.16)	(32.91)		(32.63)	(39.35)		(26.75)	(48.63)	
$TERMY_t$	-29.99**	-	-38.53**	-26.99**	-	-32.80**	-50.97**	-	-55.35**
	(4.88)		(8.38)	(7.53)		(8.01)	(5.11)		(6.86)
constant	0.82**	0.82**	0.64**	0.93**	0.92**	0.81**	0.82**	0.81**	0.73**
	(0.03)	(.04)	(0.01)	(0.04)	(0.05)	(0.01)	(0.03)	(0.06)	(0.01)
F(x, y)	53.88**	26.66**	21.13**	12.43**	9.47**	16.74**	55.58**	5.65*	65.04**
N		73			73			73	
$STKSH_{jt}$	Private investors (10)			Commercial investors (10)			Institutional investors (10)		
	Fitted values of excess market returns								
$\hat{EER}_t$		-1.99**			-1.68**			-3.12**	
		(0.51)			(0.43)			(0.44)	
constant		0.61**			0.77**			0.67**	
		(0.01)			(0.01)			(0.01)	
F(x, y)		15.19**			15.32**			49.85**	
N		73			73			73	

The table reports results from regressing the monthly share of stocks relative to total asset holdings by investor type $STKSH_{jt}$ on the dividend yield $DIVYIELD_t$ and the termspread $TERMY_t$ (upper part), as well as on the fitted values of excess market returns $\hat{EER}_t$ (lower part). The fitted values of excess market returns $\hat{EER}_t$ are computed by regressing excess market returns on lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West technique and corrected for serial correlation up to the third lag and heteroskedasticity. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and (*) respectively. The data on asset holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

Looking at Table 6, we observe that the coefficients of the business conditions proxies are negative and mostly significant in all specifications and for all types of investors. This means that the share of equity in the portfolio of each investor type is decreasing with an expected downturn. As in the case with *FRAC_STK* and *FRAC_BOND*, we do not know whether this is due to changes in stock prices and/or to sales of securities.

Even though the relative share of equity in the portfolio of all three investor types seems to move in the same direction with a changing macroeconomic environment, their behavior might still be heterogeneous in case their reactions differ in strength. When looking at the results with the fitted excess market returns as covariate (lower part of Table 6), we see that institutional investors have, measured in absolute terms, the largest coefficient of $\hat{EER}_t$ and therefore the strongest reaction with respect to their relative equity share.

In order to see whether the coefficients are statistically different from each other, we carry out an interaction analysis. Let *PRIV* and *COM* be dummy variables, which are equal to one in case the investor is a private and a commercial entity, respectively, and zero else. Accordingly, the institutional investors is the base case. We then include these dummy variables as well as the interaction of them with our business condition proxies as additional covariates in the regression analyses.[10]

Without reporting the complete results, which can be found in Table A2 of the appendix, the stock share of institutions exhibits a significantly more negative reaction to changes in the business conditions indicators in comparison to stockholdings of private and commercial investors. This holds for all specifications except the one with *DIVYIELD* as single covariate. We thus conclude that the three types of investor differ in terms of their intensity with which the equity share in their portfolio is adjusted to fluctuations in the macroeconomic environment, and we see this as further support for our main hypothesis.

4.3. Disentangling the effects of buying and selling of securities from market movements of stock prices

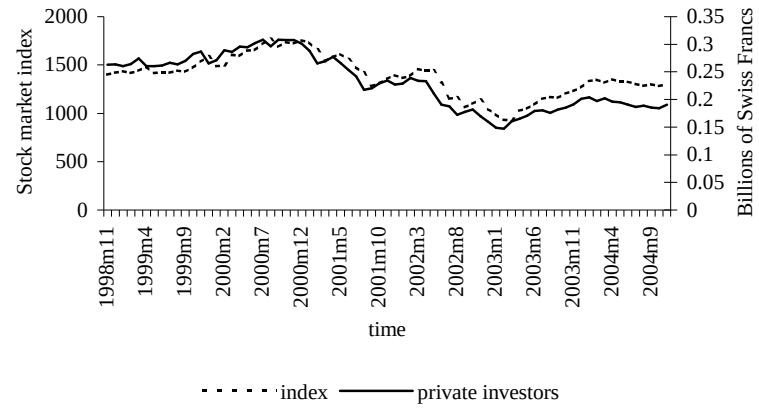
As mentioned above, changes in the relative fraction or shares of equity and bond holdings may be the result of stock market fluctuations, and/or they can be induced by purchases or sales of securities by the investors. We cannot disentangle the two effects because neither do we have investor-specific returns, nor the volumes of traded securities. However, an indirect way may reveal some information about the relative importance of those two effects. For this purpose, let us look at the absolute levels of stock holdings by investor type and consider at the same time the movement of the stock market index. The series are reported in Figure 8. Note that the absolute values of stock holdings are the product of the number of titles held times their price at a particular point in time. Variations in absolute values of equity holdings can, therefore, be either driven by changes of stock prices, which are reflected in the market index, and/or by selling and buying activities of the investors. Accordingly, the closer the equity holdings are moving with the index, the more likely is it that the investors just hold their portfolio without much trading activity. Looking at Figure 8, there seems to be some differences between private, commercial and institutional investors in terms of co-movements between their stock holdings and the market index. Equity holdings of private investors seem to follow the market index most closely. This is

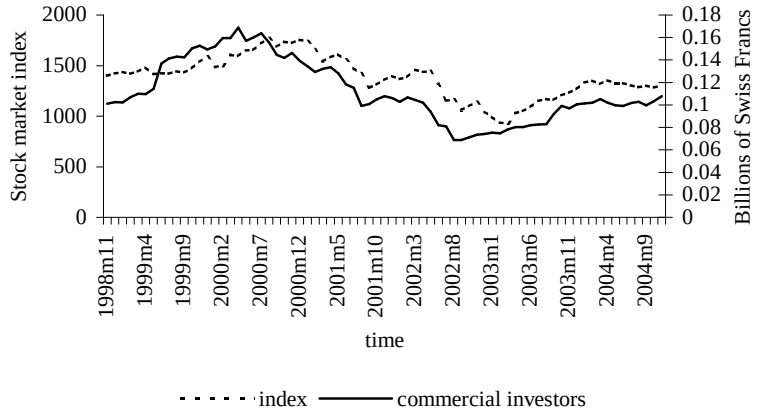
[10] Given that there are three groups, it is sufficient to run the regressions for two investor types only.

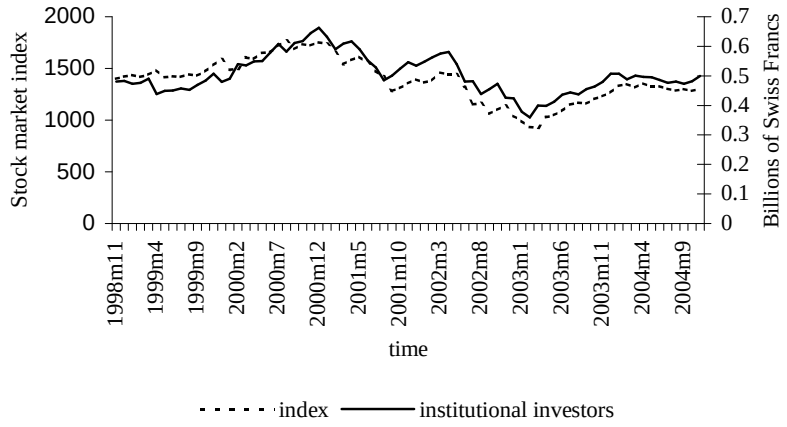
confirmed when computing the correlation coefficient between the market index and the stock holdings. While the correlation coefficient for private investors is 0.92, the corresponding values for commercial and institutional investors amount to 0.86 and 0.84, respectively.

We interpret this observation as (at least some) further evidence of heterogeneity in investment behavior between the types of investors considered. It means that private investors are more likely to follow a buy-and-hold strategy compared to commercial and institutional investors. Such an outcome may be related to the fact that asset holdings of commercial and institutional investors are professionally managed.

Figure 8: Stock holdings by investor time and stock market index movements over time







The figure shows absolute levels of equity holdings by investor type (in billions of Swiss Francs) and the market index over time. The data on equity holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB), and the index data are taken from Thompson Financial Datastream database. The time period ranges from November 1998 to November 2004.

4.4. Who follows whom in terms of portfolio adjustments?

The types of investors considered dispose of different resources to support their investment decisions. Therefore, it is possible that some investors may base their portfolio allocation choices on the past behavior of other market participants that are considered as particularly competent. Institutional investors are probably more educated, better trained, and better paid than most retail investors. Further, these investors may have internalized popular investment advice on the importance of not holding on to one's losses (O'Connell and Teo 2004). One could therefore imagine that private investors closely monitor institutional investors who are expected to dispose of better information and more investment know how than the average private investor.

In order to identify potential leader-follower effects, we measure the extent to which the investors deviate from a *let-it-ride allocation*. The latter is the allocation that would have resulted if the investors did not do anything from one period to the other. We then use a VAR analysis to see whether the deviations from the let-it-ride strategy, i.e. the difference between the current allocation and the let-it-ride allocation of the different investor types, are related to each other. As mentioned earlier, changes in portfolio holdings can be caused by active trading of securities, but also by market movements. By building the deviation from the let-it-ride strategy, we remove to a large extent the changes in asset holdings that are triggered by market movements, and we obtain a measure that reflects the action of the investor types considered.

The let-it-ride allocation is determined by multiplying for each investor type the stock and bond holdings from the former period with the expected market returns ER_t and the bond return $LGBOND_t$, respectively, of the current period.[11] In order to have a relative measure, we normalize the let-it-ride allocation of each investor type by the let-it-ride allocation of total stock holdings in the economy, i.e.,

$$\hat{STKSH}_{jt} = \frac{equity_{jt-1}(1+ER_t)}{(equity_{jt-1}(1+ER_t) + fixed\ \ income_{jt-1}(1+LGBOND_t)} \quad (11)$$
$$\text{with } j = PRIV, COM, INST;\ t = 1,..,73$$

The *deviation from the let-it-ride allocation* is then the difference between the current stock share $STKSH_{jt}$ and the let-it-ride stock share $\hat{STKSH}_{jt}$ as given by (12), and it tells us to what extent the market participants counter or accentuate the effects of market movements.

[11] Note that this definition hinges on the assumption that portfolio returns are identical across investors.

$$DEV\_STKSH_{jt} = (STKSH_{jt} - \hat{STK}\,SH_{jt}) \qquad \text{with } j = PRIV, COM, INST;\ t = 1,..,73 \qquad (12)$$

Table 7 reports the results from the VAR analysis[12] with three equations, where the deviations from a let-it-ride allocation of all three investor types are functions of all the lagged deviations. Based on the Akaike information criterion, the final prediction error as well as on Lagrange multiplier tests, the number of lags included is one. (Schröder 2002). The system of equations is estimated by ordinary least square.

Table 7: VAR analysis of the effects of past on current deviations from a let-it-ride strategy

DEV_STKSH_{jt}	Private investors	Commercial investors	Institutional investors
$DEV\_STKSH_{PRIVt-1}$	0.38(*)	0.49	0.38
	(0.22)	(0.33)	(0.28)
DEV_STKSH_{COMt-1}	-0.01	-0.10	0.04
	(0.08)	(0.12)	(0.11)
$DEV\_STKSH_{INSTt-1}$	-0.56**	-0.68**	-0.64**
	(0.17)	(0.26)	(0.22)
Log Likelihood		681.47	
N		71	

The table reports results from a VAR analysis, where the deviation from the let-it-ride of each investor type DEV_STKSH_{jt} is regressed on lagged values of the deviation from the let-it-ride of all three investor types. The deviation from the let-it-ride DEV_STKSH_{jt} is defined as the monthly share of stocks relative to total asset holdings by investor type $STKSH_{jt}$ minus the let-it-ride allocation $\hat{STKSH}_{jt}$. The let-it-ride allocation is defined as the ratio of stock holdings of each investor type from the former period multiplied by the expected market returns over stock and bond holdings of each investor type from the former period multiplied with the expected market returns and the bond return, respectively. Constant included. Standard errors are in brackets. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and (*) respectively. The data on asset holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.

The results in Table 7 and the corresponding Granger causality test statistics in Table 8 suggest that past investment decisions of institutional investors have some impact on the asset allocation decisions of private and commercial investors. The larger the deviations of institutional investors in the previous period, the smaller seem to be the current deviations from a let-it-ride strategy of private and commercial investors. In contrast, institutional investors do not seem to be affected by past deviations of private and commercial investors. Furthermore, we observe a positive effect of current deviations on future deviations for private investors, while institutional investors seem to counterbalance larger current deviations by smaller future deviations.

[12] The concept of vector autoregressions (VAR) goes back to Sims (1980). A VAR is a *n*-equation, *n*-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining (*n*-1) variables. VARs capture co-movements that cannot be detected in uni- or bivariate models and provide a systematic way to capture rich dynamics in multiple time series (Stock and Watson, 2001).

Table 8: Granger causality tests

Regressor	Dependent variable in regression		
	DEV_STKSH_{PRIV}	DEV_STKSH_{COM}	DEV_STKSH_{INST}
DEV_STKSH_{PRIV}	0.00	0.14	0.18
DEV_STKSH_{COM}	0.90	0.00	0.68
DEV_STKSH_{INST}	0.00	0.01	0.00

The table reports p-values for F-tests that lags of the variable in the row labeled *Regressor* do not enter the reduced form equation for the column variable *Dependent variable*. The results were computed from a VAR with 1 lag, and a constant term. The deviation from the let-it-ride is defined as the monthly share of stocks relative to total asset holdings by investor type $STKSH_{jt}$ minus the let-it-ride allocation $\hat{STKSH}_{jt}$. The let-it-ride allocation DEV_STKSH_{jt} is defined as the ratio of stock holdings of each investor type from the former period multiplied by the expected market returns over stock and bond holdings of each investor type from the former period multiplied with the expected market returns and the bond return, respectively. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB), and the index data are taken from Thompson Financial Datastream database. The time period ranges from November 1998 to November 2004.

We are aware of the fact that this analysis provides only a rough approximation of possible temporal interaction effects between the investor types considered. Notwithstanding, we interpret the findings as some evidence that the past behavior of institutional investors may have a certain impact on current asset allocation decisions of private and commercial investors. Such a result is not really surprising, given that institutional investors are expected to have better decision support systems than the private and maybe also commercial investors, on average.

5. Robustness tests

We carry out several robustness tests to make sure that our results are not driven by a specific sample selection, estimation method or model specification.[13] First, we include securities issued by domestic as well as foreign issuers in our analysis. As mentioned earlier, the rationale behind the inclusion of domestically issued securities only was to have as little leakage as possible in our data. The results from domestic and foreign issues confirm to a large extent our former findings, even though the effects are slightly weaker on average. The latter fact may be due to the potentially larger leakage effect due to the inclusion of foreign issuers.

A second robustness test refers to the computation of standard errors. We use a bootstrap technique that runs the regressions on artificially created data having the same autocorrelation

[13] The results of the robustness tests are available from the authors upon request.

structure as the real data. The number of repetitions is 1000. This procedure results in consistent estimates of the true regression standard errors, adjusted for the autocorrelation in the error term. The results from bootstrapping are very similar to the ones from the Newey-West procedure and confirm our former findings.

Furthermore, we allow for nonlinear effects of business conditions on relative stock and bond holdings by additionally including the square values of our business conditions indicators. Finally, we use the unemployment rate as an aggregate business condition indicator given that the dividend yield and term spread might be affected by policy decisions. Another commonly used measure is the industrial production. However, there are no monthly data available for Switzerland. The results of these additional robustness tests stand in line with our former findings and confirm the asymmetry in investment behavior between private and commercial investor on the one hand, and institutional investors on the other hand.

6. Conclusions

The purpose of this paper was to investigate how different types of investors adjust their portfolio holdings to the changing macroeconomic environment. We used data from private, commercial and institutional investors with deposits in Switzerland over the period from November 1998 to November 2004 and regressed the share of their relative stock and bond holdings on several business condition indicators. Our results provided evidence for our main hypothesis that institutional investors behave differently from the other types. In particular, institutions owned relatively more equity as well as fixed income securities with expected weaker business prospects, while private and commercial investors behaved in the opposite way.

In addition, we carried out a VAR analysis to identify potential temporal interaction effects between the investor types considered. The results provided some evidence that current portfolio holdings of private and commercial investors are affected by the past behavior of institutional investors. This may be due to the fact institutional investors, on average, are expected to have better systems to support their asset allocation decisions compared to private and commercial investors.

This paper is the first study that investigates the issue of investor heterogeneity in relation with changing business condition for Switzerland. Even though our results pointed out to some potentially interesting mechanisms, further research is needed in this area for a better understanding of the underlying decision processes. For instance, our data did not allow us to identify the exact reasons for the significant differences in investment behavior between investor

types. We speculated that investment regulations such as equity restrictions for pension funds and insurance companies, which are major institutional investors in Switzerland, may play an important role.

As another limitation imposed by our data, we were not able to identify the exact reason behind changes in portfolio holdings, i.e., we could not know whether the movements of relative stock and bond holdings with changing business conditions were the result of active portfolio management, i.e., buying and selling of securities in order to adjust to a changing macroeconomic environment, or whether these movements were the outcome of a passive investment strategy and reflected the choice of the portfolio's risk profile. A disentanglements of the different effect would require information on investor-specific market returns, which was not available.

Finally, we considered three different types of investors and implicitly assumed that investors were homogenous within each group. As King (2000) argues, however, there might be a significant amount of heterogeneity within the different types of investors with respect to preferences and thus to their investment behavior with changing business conditions, and this would hold in particular within the group of institutional investors. Accordingly, it would be desirable to consider at least institutional investors at a more disaggregated level in order to identify the different mechanisms. Some of these issues will be addressed in future work.

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Appendix

Appendix 1: Description of variables

Variable name	Description
$STKSH_{jt}$	Share of stocks in portfolio of investor *j* relative to total asset holdings by investor *j*, with *j=PRIV, COM, INST*
$FRAC\_STK_{jt}$	Fraction of stocks held by investor *j* relative to the total stock holdings by all investors
$FRAC\_BOND_{jt}$	Share of bonds (and non-equity holdings) held by investor *j* relative to the total bond holdings by all investors
$\hat{STK}\ SH_{jt}$	Let-it-ride allocation of share of stocks in portfolio of investor *j*, defined as share of stocks that would have resulted if the portfolio had not been changed from period *t* to period (*t-1*), i.e., $\hat{STK}_{jt} = \frac{equity_{jt-1}(1+ER_t)}{(equity_{jt-1}(1+ER_t) + fixed\ \ income_{jt-1}(1+LGBOND_t)}$ with $j = PRIV, COM, INST$
DEV_STKSH_{jt}	Deviation in share of stocks from let-it-ride strategy of investor *j* defined as $(STK_{jt} - \hat{STK}_{jt})$
$DIVYIELD_t$	Dividend yield
$TERMY_t$	Term spread defined as the Swiss benchmark bond ten year yield minus the Swiss three month LIBOR
ER_t	Market return defined as $\ln(I_t / I_{t-1})$, where I_t is the monthly value of the stock market index (TOTMKSW)
EER_t	Excess market return defined as the market return minus Swiss one month money market rate
$\hat{EER}_t$	Fitted excess market return defined as fitted value of regressing excess market returns on the dividend yield and the term spread, while controlling for serial correlation in the error term up to the third lag
$LGBOND_t$	Bond return defined as the Swiss benchmark bond ten year yield
PRIV, COM, INST	Dummy variables that take the value of one if the asset holder is a private, commercial or institutional investor, respectively, and zero else

Appendix 2: Effects of the business cycle on the share of stock holdings with interaction terms

	Private investors as base case			Commercial investors as base case		
$STKSH_{jt}$	*DIVYIELD* and *TERMY*	*DIVYIELD* only	*TERMY* only	*DIVYIELD* and *TERMY*	*DIVYIELD* only	*TERMY* only
PRIV	-	-	-	-0.10$^{(*)}$	-0.10	-0.16**
				(0.05)	(0.07)	(0.02)
COM	0.10$^{(*)}$	0.10	0.16**	-	-	-
	(0.05)	(0.07)	(0.02)			
INST	-0.004	-0.01	0.08**	-0.11*	-0.11	-0.08**
	(0.05)	(0.07)	(0.01)	(0.06)	(0.08)	(0.01)
$DIVYIELD_t$	-145.74**	-169.92**	-	-99.34**	-121.10**	-
	(24.16)	(32.91)		(32.63)	(39.35)	
$DIVYIELD_t$_*PRIV*	-	-	-	-46.39	-48.82	-
				(40.60)	(51.30)	
$DIVYIELD_t$_*COM*	46.39	48.82	-	-	-	-
	(40.61)	(51.30)				
$DIVYIELD_t$_*INST*	70.92*	54.02	-	24.53	5.20	-
	(36.05)	(58.72)		(42.20)	(62.56)	
$TERMY_t$	-29.99**	-	-38.53**	-26.99**	-	-32.80**
	(4.88)		(8.38)	(7.53)		(8.02)
$TERMY_t$_*PRIV*	-	-	-	-	-	-5.72
						(11.60)
$TERMY_t$_*COM*	3.01	-	5.72	-3.01	-	-
	(8.98)		(11.60)	(8.98)		
$TERMY_t$_*INST*	-20.97**	-	-16.82	-23.98**	-	-22.54*
	(7.06)		(10.83)	(9.10)		(10.55)
constant	0.822**	0.82**	0.64**	0.93**	0.92**	0.80**
	(0.03)	(0.04)	(0.01)	(0.04)	(0.05)	(0.01)
F(x, y)	92.65**	65.10	72.39	92.65**	65.10	72.39
N		219			219	

$STKSH_{jt}$	Private investors as base case	Commercial investors as base case
	Fitted values of excess market returns	
PRIV	-	-0.17**
		(0.01)
COM	0.17**	-
	(0.01)	
INST	0.07**	-0.10**
	(0.01)	(0.01)
$\hat{EER}_t$	-1.99**	-1.68**
	(0.51)	(0.43)
$\hat{EER}_t$_*PRIV*	-	-0.30
		(0.67)
$\hat{EER}_t$_*COM*	0.30	-
	(0.67)	

$\hat{EER}_t\_INST$	-1.14$^{(*)}$	-1.44*
	(0.67)	(0.62)
constant	0.60**	0.77**
	(0.01)	(0.01)
F(x, y)	69.51	69.51
N	219	219

The table reports results from regressing the monthly share of stocks relative to total asset holdings by investor type $STKSH_{jt}$ on the dividend yield $DIVYIELD_t$, the termspread $TERMY_t$, dummy variables *PRIV*, *COM* and *INST*, respectively and their interaction terms with *DIVYIELD* and *TERMY* (upper part), as well as on the fitted values of excess market returns $\hat{EER}_t$ and the dummy variables *PRIV*, *COM* and *INST*, respectively and their interaction terms with *DIVYIELD* and *TERMY* (lower part). The fitted values of excess market returns $\hat{EER}_t$ are computed by regressing excess market returns on lagged values of the dividend yield and the term spread. The dummy variables *PRIV*, *COM* and *INST* are one if the investor type is a private, commercial and institutional investor, respectively, and zero else. Standard errors are in brackets and are based on the Newey-West technique and corrected for serial correlation up to the third lag and heteroskedasticity. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and $^{(*)}$ respectively. The data on asset holdings are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank (SNB). The time period ranges from November 1998 to November 2004.