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Heterogeneity in Asset Allocation Decisions: Empirical Evidence from Switzerland

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Abstract

We analyze the asset allocation decisions of different investor groups and investigate how their investment behavior changes with macroeconomic conditions. Using a new data set that includes the monthly portfolio holdings of private, commercial, and institutional investors deposited with Swiss banks between November 1998 and November 2004, we regress their equity and bond holdings on common business cycle indicators. Against the commonly held belief, private investors do not systematically move from equities into bonds by selling equities to institutional investors and purchasing bonds from them in bad states. Moreover, based on a vector error regression framework including cointegration and error correction restrictions, we show that the behavior of commercial investors leads and private investors adopt their investment decisions only slowly over time. The investment behavior of institutional investors is not systematically affected by the actions of private and commercial investors. We provide several (non-mutually exclusive) explanations for our findings.

Key Words: Asset allocation, business cycle, investor heterogeneity, institutional investors, vector error correction.

JEL Classification: E44, G11, E32, C32.

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1. Introduction

Asset allocation refers to the process of selecting the long-term weights for the major asset classes in an investor's portfolio. On an aggregated level, the choice is between equities, bonds, and cash. Investors choose the optimal long-term mix of assets consistent with their preferences in terms of risk aversion and expected return. Standard asset-pricing models assume that assets are held by a representative agent (e.g., Lucas, 1978). More specifically, the capital asset pricing model (CAPM) specifies that investors hold identical portfolios of risky securities. Investors merely exchange risky securities to rebalance their portfolios and never trade to exploit new information. In finance practice, however, a popular advice often followed by investment professionals is that aggressive investors hold a lower ratio of bonds to equities than conservative investors. Canner et al. (1997) show that this advice is inconsistent with the two-fund separation theorem, suggesting that in a one-period valuation model investors hold the same composition of risky assets. Intertemporal asset pricing models, however, can explain heterogeneity in asset allocation decisions.

Different adjustments in the portfolio compositions of different investors and/or investor groups do not require irrational behavior. In fact, the basic assumption of investor heterogeneity can be justified on the basis of hedging demands in intertemporal asset pricing models. If the investment opportunity set is constant over time (as reflected by constant moments of the underlying asset returns) and if investors have homogeneous expectations, two-fund separation still goes through and intertemporal portfolio maximization can be treated as if investors had a single-period utility function (e.g., Fama, 1970). Except for periodic rebalancing, investors again do not shift the composition of their portfolios. However, if investor preferences and future investment opportunity sets are state-dependent or if future investment opportunity sets are partially unknown, then intertemporal hedging demand will generate transactions. As shown by Merton (1971), even with homogenous expectations changes in risk aversion induce investors to rationally adjust their portfolio compositions differently. Heterogeneity of beliefs, as assumed in Williamson's (1977) version of the capital asset pricing model, will also trigger trading between different investor groups and result in different portfolio compositions. In addition to these rational explanations, however, an increasing number of behavioral approaches and theories assuming limited rationality as well as institution-specific characteristics and regulatory restrictions provide further explanations for investor heterogeneity.

In a dynamic conditional portfolio selection setting differences between investor groups are likely to be reflected in their asset allocation decisions as well as their portfolio adjustments subsequent to changes in expected returns and/or the stage of the business cycle. Macroeconomic variables such

as interest rates, inflation rates and exchange rates will proxy for the unobservable state variables and are generally assumed to have an impact on asset allocation decisions (e.g., Solnik, 1993). Expectations about these variables in the future may differ between investor groups and affect their investment decisions through their impact on the discount rates used to capitalize future cash flows. If different investor groups react differently to changing business cycle conditions, shifts in their relative market weights will likely have an impact on asset prices. As an example, assume that managed funds tend to buy when stock prices have been falling and sell when prices have been rising. This behavior has a stabilizing effect on stock price movements. In contrast, if individuals eventually control a larger share of total equity holdings, which may be one possible outcome of the currently debated Social Security Privatization in the U.S., their presumably pro-cyclical trading behavior could have destabilizing effects on stock markets.

Although asset holdings of institutional investors nowadays exceed directly-held individual holdings in the G7 countries,¹ the bulk of the empirical research has looked at investment decisions of retail investors (e.g., Barber and Odean, 2000). The main purpose of this paper is to investigate how different investor groups shift the composition of their portfolios with changing business cycle conditions and whether one investor group leads and the others follow. We consider three types of investor groups: (1) private investors (households), (2) commercial investors (e.g., non-financial firms and non-profit organizations), and (3) institutional investors. The latter group of institutional investors comprises professionally-managed fiduciary organizations investing the savings of private individuals. In addition to intertemporal hedging behavior, one obvious reason for an asymmetry between different investor groups is motivated by regulatory issues. In fact, the Swiss law imposes strict rules on institutional investors regarding their portfolio composition. Pension funds, for instance, are allowed by the law to invest at most 50% of their funds in equities and/or equity-like securities.² Similar rules are in place for insurance companies. These rules and regulations are likely to have direct and indirect effects on the asset allocation decisions of institutional investors. As an example, consider a situation where a pension fund is close to the equity limit and the stock market performs well. Equities increase in value relative to other assets, and the share of equities in the pension fund's portfolio will exceed the limit imposed by the law. While the pension fund is forced

¹ As of 1997, the ratio of institutional to direct asset holdings was 1.5 in the G-7 countries, on average (Davis, 2000). Institutional holdings equal 100% of GDP in the G-7 countries, and 200% in the U.S. and U.K. (see Davis and Steil, 2001).

² See „Verordnung über die berufliche Alters-, Hinterlassenen- und Invalidenvorsorge“ (BVV 2), 3. Abschnitt, Art. 55. Deviations from this equity allocation limit are possible since 2000, but they require detailed explanations on behalf of the fund manager. According to the Swiss Pension Funds Association, the share of equities in the portfolios of Swiss pension funds amounted to 39.6% by the end of 2002, with 16.9% invested in Swiss stocks and 22.7% invested in foreign stocks.

to rebalance, unregulated investors will be less likely to liquidate their equity position in this state of the world, presumably following a simple buy-and-hold strategy.

Our base data include monthly portfolio holdings of different investor groups deposited with Swiss banks between November 1998 and November 2004. The portfolio holdings are categorized into two main asset classes: “equity instruments” (stocks) and “fixed income” (debt or bonds). Following Cohen (2003), we characterize asset allocation decisions by computing two ratios on a monthly basis: (i) the fraction of equities held by each investor type relative to the economy-wide equity holdings, and (ii) the fraction of equities held by each investor type relative to its total portfolio holdings. In order to link an investor group’s asset allocation decisions to the macroeconomic environment, we run regressions with these ratios as the dependent variables and a set of macroeconomic variables as the explanatory variables. One problem that inherently plagues our analysis is that differences in the observed portfolio holdings across investor types may not only result from trading following changes in the business cycle conditions. Changes in asset holdings will likely also be determined by the original portfolio composition and the choice of a portfolio’s risk profile. In fact, stock and bond market movements can have very different effects on asset holdings depending on a portfolio’s exposures. Accordingly, heterogeneity between different investor groups can be driven by both volume effects and price effects, but a lack of investor specific returns does not allow us to disentangle them. Moreover, we estimate a non-stationary vector autoregression framework including cointegration and error correction restrictions to capture the dynamic relationships between the different investor groups. The main advantage of this alternative technique is that it is based on lead-lag relationships that are unaffected by contemporaneous market movements, allowing us to analyze whether one investor group leads and others follow their decisions.

Our results can be summarized as follows. First, against the commonly held belief, private investors do not systematically move from equities into bonds by selling equities to institutional investors and purchasing bonds from them in bad states (i.e., when expected stock market returns are high). Plausible explanations are that private investors become poorer in bad states to a greater extent than institutional investors (e.g., because of their strong dependence on labor income), that their risk aversion increases in bad states, that their risk exposure makes them more sensitive to adverse market movements, and/or that they reallocate a larger portion of their equity and bond holdings into cash than institutional investors during these times.³ Second, the behavior of commercial investors seems

³ Moreover, during bad states private investors tend to change their portfolio compositions through mortgage trades in response to interest rate shifts.

to lead, and private investors adopt their investment behavior only slowly over time. In contrast, the investment behavior of institutional investors is not systematically affected by the investment decisions of private and commercial investors. These results could be explained by better information available to commercial investors and regulatory restrictions imposed on institutional investors.

The remainder of this paper is as follows. Section 2 reviews the existing literature about heterogeneity in investment behavior. Because our data set has not been used elsewhere before, section 3 contains a detailed data description. Our empirical results are discussed in section 4. Finally, section 5 concludes and provides an outlook for further research.

2. Review of existing literature

Standard asset pricing models are based on the assumption that assets are held by a representative agent (e.g., Lucas, 1978). In reality, however, one might conjecture that different types of investors behave differently with respect to their asset allocation decisions. This is best reflected in intertemporal portfolio selection models (e.g., Merton, 1971), where the hedging behavior of investors based on different state-dependent risk aversion functions provides a rationale for heterogeneous investment decisions. In an empirical setup, conditional models of portfolio selection (e.g., Solnik, 1993) provide another basis to explain a different reaction of investors based on their respective instrument variables describing the state of the world. These models are nevertheless not able to explain what determines utility for an institutional investor as opposed to an individual investor. This section summarizes the main results from the recent research on investor heterogeneity and also discusses the potential impact on asset allocation decisions.

Information: Davis and Steil (2001) argue that institutional investors are generally larger organizations that use more sophisticated decision support systems, implying that they are better informed than individual investors. Accordingly, institutional investors hold better diversified portfolios and generally behave more “rational” than individual investors with respect to their asset allocation decisions.

Risk aversion: Based on the seminal work by Kahnemann and Tversky (1979), several empirical studies investigated the relationship between risk-taking, equity trading and past performance (e.g., Bernatzi and Thaler, 1995; Barberis, Huang, and Santos, 2001). While the bulk of the literature focuses on retail investors, a few recent studies also look at institutional investors. For example, Davis and Steil (2001) suggest that institutional investors exhibit a lower degree of risk aversion than private investors. O’Connell and Teo (2004) provide evidence for pro-cyclical risk taking behavior of

institutional investors, which they relate to dynamic loss-aversion, narrow-framing, and overconfidence. Cohen (2003) directly compares asset allocation decisions of individuals and institutions. He interprets his results as indicating that institutional investors have a more constant relative risk aversion than individual investors.

Time horizon of investment: According to Dennis and Strickland (2002), institutional investors have a short investment horizon. Their investment decisions are mainly based on past stock market returns, inducing them to sell equities during a stock market decline. In contrast, individual investors are generally supposed to make decisions based on long-term criteria, but they are strongly exposed to psychological biases as well. An example of a psychological bias is the disposition effect, which refers to the investment behavior of selling past winners, but refusing to sell past losers (e.g., Odean 1998). As documented by Shapira and Venezia (2000), however, the disposition effect not only affects individual investors but institutional investors as well.

Herding: Herding refers to situations in which a group of individuals react coherently without there being any co-ordination between them.⁴ Institutional investors might have a preference for herding because they have to fear a reputation damage (e.g., Scharfstein and Stein, 1990, Dennis and Strickland, 2002), or because they have a desire for conformity (e.g., Bikhchandani and Sharma, 2001). In contrast, Lakonishok et al. (1992), Grinblatt et al. (1995), and Wermers (1999) find only weak empirical evidence for herding behavior of mutual fund and pension fund managers, respectively.

Overconfidence: Psychologists have argued that people in general tend to put unduly more weight on success than on failure, i.e., they are overconfident.⁵ Gervais and Odean (2001) argue that overconfidence affects individual investors to a lesser extent than professional traders. Overconfidence may induce excessive portfolio turnover (e.g., Odean, 1999; Barber and Odean, 2000) or imperfect portfolio diversification (e.g., Blume et al., 1974; Ivkovic et al., 2005). While the adverse effects of overconfidence on investor performance are well-known, any effects on market prices are largely unresolved.

Regulations and tax treatments: Certain types of institutional investors are regulated with respect to their asset allocation decisions, e.g., insurance companies and pension funds. The main goal of insurance regulation is to make sure that there are always sufficient funds to meet the expected claim payments and to guarantee that households can buy financial products that are suited for their needs. Pension regulation has the objective to ensure retirement income security for individuals. Given that

⁴ See Dennis and Strickland (2003) for a brief survey on herding theory and evidence.

⁵ See Gervais and Oden (2001b) for an overview of related work.

pension funds are a major investment force on the Swiss capital markets after pension plans became mandatory in the mid-eighties, they are also expected to strongly influence the behavior of the larger group of institutional investors.

On a theoretical level, it is not always clear how and to what extent the sources of investor heterogeneity affect asset allocation decisions. Similarly, it is generally not possible to link a specific observed behavior to one or several investor characteristics listed in this section. What is known, however, is that a large part of the institutional investors are regulated with respect to their portfolio allocation decisions and that these restrictions do not apply to the other investor types. We conjecture that macroeconomic conditions will have a direct impact on whether these restrictions are binding or not. Accordingly, we expect to observe divergent investment behavior between institutional investors on the one side and private as well as commercial investors on the other side with respect to changes in the stages of the business cycle.

3. Data description

3.1. Total 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 (in money terms) deposited with 342 banks located in Switzerland and Liechtenstein and cover about 95% of the total value invested. Portfolio holdings are measured at market prices and converted into Swiss francs. The data are disaggregated according to the type of the depositor, the residence of the depositor and the issuer (domestic or foreign), the category of securities, and their currency of denomination (Swiss Franc, US Dollar, Euro, Pound Sterling, or Japanese Yen). We consider three types of depositors: (1) private investors (*PRIV*), (2) commercial investors (*COMM*), and (3) institutional investors (*INST*). Private investors comprise individuals that are employed, self-employed, out of the labor force or retired, and students. The group of commercial investors consists of non-financial companies, governmental entities, and non-profit organizations. Finally, institutional investors include financial firms, 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) equities, (5) money market funds, (6) other mutual funds, and (7) others.

Our sample consists of monthly end-of-period observations of stock and bond holdings by the three different investor groups between November 1998 and November 2004. This is an interesting time span because it covers both the stock market bubble during the late 1990s and the subsequent bear

market in the early 2000s. Figure 1 depicts the total value of all types of securities deposited with Swiss banks, including deposits in all currencies held by residents and non-residents. The total value of all deposits reached its peak in April 2001 with 3'690 billion Swiss francs. This figure dropped significantly during the subsequent stock market downturn to roughly 2'700 billion Swiss francs, but it returned to a value of 3'460 billion Swiss francs by November 2004. In addition to stock market movements, however, changes in the total value of deposited securities can also be caused by new money inflows into or withdrawals from Swiss banks. Our data are not detailed enough to shed further light on this issue. During our sample period the fraction of total holdings of private investors amounted to 42.8%, whereas institution investors held 46.3%.

[Insert figure 1 here]

In what follows, we restrict the full sample to domestically issued securities. Over time, this sub-sample represents 39.9% of total asset holdings, on average.⁶ The purpose of this limitation is to reduce the amount of leakage in our data and to avoid asset allocation decisions that are not accounted in our sample. However, we cannot completely avoid leakages. For example, if a German or U.S. investor holds a security issued by a Swiss firm and deposits it with a non-Swiss bank, this transaction would not be included in our dataset.⁷ Figure 2 shows the monthly total values of domestically issued securities held by the three investor groups. While private investors hold roughly 43% of all securities, on average, their fraction drops to 30% when only domestically issued portfolio holdings are considered. In contrast, institutional investors hold 46% of all securities, on average, but their holdings of domestically issued securities are 53%, on average, reflecting the importance of pension funds as investors into Swiss securities.

[Insert figure 2 here]

3.2. Equity and bond holdings by investor groups

The first variable we use in our tests is the fraction of domestic corporate equities that are allocated by the three different investor groups. For each investor type j (where $j = COMM, PRIV, INST$) and each period t we compute the ratio of the market value of domestically issued equities held to the total market value of domestically issued equities, denoted as $FRACEQU_{jt}$:

⁶ The fraction of domestically issued securities that is held by Swiss residents amounts to 58.5% on average.

⁷ To assess the amount of leakage, take the example of Novartis AG. Based on the share register in 2005, 53% of the shares registered by name are deposited within Switzerland and 36% are held by approximately 850 holders in the U.S. Roughly 14% of the shares registered are held by retail or individual investors, while 86% are held by institutional investors.

$$(1) \quad FRACEQU_{jt} = \frac{Equity_{jt}}{\sum_j Equity_t}.$$

Similarly, we construct the variable $FRACBOND_{jt}$ to measure the fraction of bonds held by each investor group j (where $j = COMM, PRIV, INST$) in each time period t relative to the total value of all domestically outstanding fixed income securities:

$$(2) \quad FRACBOND_{jt} = \frac{Fixed\ income_{jt}}{\sum_j Fixed\ income_t}.$$

Panel A of table 1 shows descriptive statistics of $FRACEQU$ and $FRACBOND$. Institutional investors allocate about 60% of all domestically issued equities, on average. Private investors and commercial investors hold about 30% and 10% of all corporate equities, respectively. Similarly, with holdings of roughly 58% percent of all outstanding bonds, institutional investors are also the most important investor group in fixed income assets, followed by private investors and commercial investors with 35% and only 7%, respectively. Given that institutional investors are the largest investor group in Switzerland, it is particularly interesting to analyze whether their portfolio decisions can influence the investment behavior of private investors.

[Insert table 1 here]

In addition to looking at an investor group's equity and bond holdings relative to the total amount of domestic asset holdings, we analyze their portfolio composition more in detail by computing their allocations into equities and bonds. Therefore, we compute a second set of ratios that refers to the value of corporate equities held by the investor group relative to the total value of all assets held by this investor group. Specifically, the variable $EQUSH_{jt}$ denotes the ratio of the total value of equities held by investor group j (where $j = COMM, PRIV, INST$) to the total value of assets held by this investor group in period t :

$$(3) \quad EQUSH_{jt} = \frac{Equity_{jt}}{Equity_{jt} + Fixed\ income_{jt}}.$$

Figure 3 shows the fraction of equities held in the portfolios of all three investor groups. The corresponding summary statistics are given in panel B of table 1. It is noteworthy that our ratios are comparatively high because they do not account for cash as an additional asset class. Commercial investors have the highest equity allocation in their portfolios. Equity allocations decreased mechanically for all investor groups during the stock market downturn in 2001 and 2002, and they have been ris-

ing during the subsequent stock market recovery. Again, it is impossible to determine to what extent these findings are driven by trading, investor specific equity and bond returns, and/or changes in the total amount of outstanding securities.

[Insert figure 3 here]

3.3. Explanatory variables

As regressor variables we include two standard predictor variables for excess stock market returns. As in Cohen (2003), we use the dividend yield (*DIVYIELD*) and the slope of the term structure of interest rates (term spread) (*TERMY*) as explanatory variables for the two types of asset allocation ratios introduced in section 3.2 above. The motivation for these regressor variables follows from the prior asset pricing literature. Both the dividend yield and the term spread positively predict stock market returns and are generally regarded as proxies for the equity risk premium. Fama and French (1989), Chen (1991), as well as Estrella and Hardouvelis (1991) link this phenomenon to changing business conditions. While the dividend yield captures medium- and long-term changes in the business cycle, the term spread reflects short-term fluctuations in the business conditions. Both variables tend to be high when the macroeconomic conditions are poor and the stock market risk premium is high (e.g., Harvey, 1988; Cochrane, 1999).

The dividend yield is taken from the Datstream database and refers to the monthly Datastream total market index for Switzerland. To measure the slope of the term structure of interest rates, we compute the term spread as a monthly difference between the yield on 10-year Swiss government bonds and the 1-month interest rate for Eurocurrency deposits in Swiss francs. Figure 4 presents the time evolution of the two variables.

[Insert figure 4 here]

Alternatively, we combine the dividend yield and the term spread to generate expected excess returns using the fitted values from the following predictive regression:

$$(4) \quad ER_t = \beta_0 + \beta_1 DIVYIELD_{t-1} + \beta_2 TERMY_{t-1} + u_t,$$

where ER_t denotes the excess stock market return in period t . To generate predictions, the predictor variables are lagged by one period.⁸ Given the estimated values for the intercept and the slope coef-

⁸ The excess market return, denoted as ER_t , is computed by subtracting the 1-month interest rate for Eurocurrency deposits in Swiss francs from the monthly stock market return. As in Fama and French (1989) for U.S. data, we find that *DIVYIELD* and *TERMY* are positive and significant predictors of excess returns in our Swiss data.

ficients in equation (4), we use the time series of the instrument variables to compute the fitted values for each period t , labeled EER_t , and take them as proxies (in-sample predictions) for expected excess returns.

4. Methodology and empirical results

4.1. Regression-based tests

To relate an investor's asset allocation decisions to changes in the macroeconomic environment, we follow Cohen (2003) and regress the fraction of total domestic equities and bonds held by each investor group, $FRACEQU$ and $FRACBOND$, respectively, as well as the allocation into equities in each investor's portfolio, $EQUSH$, on contemporaneous values of the dividend yield and the term spread. To avoid multicollinearity in the presence of regressor correlation, we include the dividend yield and the term spread jointly into our regressions as well as separately one at a time. Alternatively, we use the fitted values of the expected excess return as the only explanatory variable. Given the structure of our data, the regression residuals will be autocorrelated. To obtain consistent estimates, we use ordinary least square with standard errors based on the heteroscedasticity and autocorrelation consistent covariance matrix according to Newey and West (1987).

Because our time series are short, we also perform a robustness test to compute the standard errors. Specifically, we use a bootstrap technique that runs the regressions on artificially created data having the same autocorrelation structure as the real data. The number of repetitions is 1'000. This procedure results in consistent estimates of the true regression standard errors but adjusted for the autocorrelation in the error term. The results from this bootstrapping analysis are very similar to those from the Newey-West procedure, and thus we omit a detailed presentation.

4.1.1. Fraction of equities and bonds held by investor types

We start by considering the ratio of the market value of equities held by each investor group and the total market value of equities, denoted as $FRACEQU_{jt}$, with $j = PRIV, COM, INST$. This ratio denotes the fraction of domestically issued equities allocated by one of the three investor types. For each investor type, we run the following time series regression:

$$(5) \quad FRACEQU_{jt} = \beta_0 + \beta_1 DIVYIELD_t + \beta_2 TERMY_t + \varepsilon_{jt},$$

where the business cycle components of $DIVYIELD$ and $TERMY$ are interpreted as proxies for the expected stock market return. Alternatively, we follow the notion that the equity risk premium is low at business cycle peaks and high at business cycle troughs (e.g., Fama and French, 1989; Coch-

rane, 1999) and use the fitted values of the expected excess return, labeled EER , as an alternative business cycle indicator to run the following regression:

$$(6) \quad FRACEQU_{jt} = \gamma_0 + \gamma_1 EER_t + u_{jt}.$$

Because the relative weights of equities held by the three different investor types sum to one by construction, it would be sufficient to run these regressions for only two of them. A related implication is that the estimated coefficients on each business cycle variable sum up to zero over all three regressions. To facilitate comparison between the different investor groups, in table 2 we report the results for all three investor groups in each regression specification.

[Insert table 2 here]

Panel A of table 2 shows the regression results of equation (5), involving $FRACEQU$ as the dependent variable and the dividend yield and the term spread as expected return proxies. It is apparent that the investment behavior of private and commercial investors differs from the conduct of institutional investors. Most important, for institutional investors the coefficients on both the dividend yield and the term spread are positive and statistically significant, indicating that they tend to hold a larger fraction of domestic equities when the expected stock market return is high. In contrast, private and commercial investors hold a lower fraction of domestic equities when the expected stock market return is high. Panel B of table 2 provides the results of estimating equation (6). Again, the results indicate that private and institutional investors react in opposite ways to changes in expected excess returns. The fraction of domestically issued equities held by institutional (private) investors is higher when expected excess returns are higher (lower).

Except for commercial investors, where the term spread does not load significantly, all coefficients are statistically significant at conventional levels. Moreover, the effects are economically relevant. Looking at the results with both predictor variables in table 3, an increase of the dividend yield by one standard deviation (1.72%) leads to a reduction of private investors' relative equity holdings by 1.3%, whereas the relative equity holdings of institutional investors increase by more than 2%, on average. The effects are even more pronounced when only one predictor variable is used. Overall, the significance of the F -statistics generally indicates high explanatory power of our model.

Our results indicate that institutional investors hold a larger fraction of domestically issued equities when the expected stock market return is high (i.e., in the bad state). In contrast, private and commercial investors exhibit a cyclical behavior and allocate a larger fraction of all domestic equities

when the expected return is low (i.e., in the good state). An immediate explanation for these patterns in the fraction of domestic equities is that trading occurs between the different investor groups. If our results were driven by volume effects, institutional investors buy shares from private investors when the expected return is high, and they sell shares to private investors when the expected return is low. However, there are several caveats with this interpretation. First, one potential problem is that changes in the variable *FRACEQU* may simply pick up institutional or legal changes that imply that the funds of a particular investor group grow or shrink in total size, but which are unrelated to their asset allocation decisions. Second, the fraction of equities held by institutional investors increases whenever they buy from private and/or commercial investors (volume effects) and when institutional equity holdings perform better than those of individual and/or commercial investors (price effects). Depending on a portfolio's risk exposures, stock and bond market movements can have very different effects on relative portfolio holdings. Accordingly, another source of investor heterogeneity is the ex ante choice of a portfolio's risk profile. Successful market timing and/or stock picking potentially drives our results, but without access to investor specific returns we cannot further explore this possibility. Yet another explanation refers to unexpected changes in the number of domestically outstanding shares. For example, if the total stock market capitalization increases during periods of heavy initial public offering activities (as it was the case during the late 1990s), and if these new issues are more than proportionally allocated to institutional investors, their fraction of total equity holdings increases mechanically. Banks could favor institutional investors in the allocation of new equity issues (e.g., Cornelli and Goldreich, 2001), and/or institutional investors bid stronger for initial public offerings because they follow indexing strategies that require them to include every new issue in their portfolio.

One possibility to better control for effects unrelated to asset allocation is to examine the behavior of *FRACBOND*, the fraction of all outstanding bonds that are allocated by the different investor groups. One potential explanation for the observed pattern of *FRACEQU* is that private investors are more recession sensitive and simply become poorer in terms of risk aversion in a bad state to a larger extent than institutional investors. If this was the case, private investors should hold a lower fraction of domestic equities during bad states, but also a lower fraction of all outstanding bonds. To test this hypothesis, we run the following time series regressions:

$$(7) \quad \text{FRACBOND}_{jt} = \beta_0 + \beta_1 \text{DIVYIELD}_t + \beta_2 \text{TERMY}_t + \varepsilon_{jt}, \text{ and}$$

$$(8) \quad \text{FRACBOND}_{jt} = \gamma_0 + \gamma_1 \text{EER}_t + u_{jt},$$

where all variables are defined as introduced above. To put this test procedure into perspective, note that Cohen's (2003) results for U.S. data indicate that while high levels of the dividend yield cause private investors to hold a low fraction of outstanding equities, they hold a high fraction of outstanding bonds at these times. In contrast, our results provide support for the hypothesis that private investors are more recession sensitive than institutional investors (e.g., because of declining labor income). Our results involving *FRACEQU* for private investors as the dependent variable in equation (7) shows that both the dividend yield and the term spread are estimated significantly negative. The regression results with *FRACBOND* as the dependent variable are reported in table 3. The most important observation is that the signs of the estimated coefficients remain unchanged, i.e., both the dividend yield and the term spread still load significantly negative.

[Insert table 3 here]

Similarly, the corresponding coefficients for institutional investors are both estimated significantly positive, irrespective of whether *FRACEQU* or *FRACBOND* is used as the dependent variable. As for equity holdings, private and commercial investors tend to hold a higher (lower) fraction of all outstanding domestic bonds when expected excess returns are low (high), and institutional investors exhibit exactly the opposite behavior. While data limitations do not allow ruling out that trading occurs between the different investor groups (and, in particular, with investors outside Switzerland that are not accounted here), our results indicate that private investors do not systematically move from equities into bonds by selling equities to institutional investors and purchasing bonds from them in bad states.⁹ Instead, they provide support for the hypothesis that private investors are more recession sensitive than institutional investors. Plausible (albeit not mutually exclusive) explanations are that private investors become poorer in bad states to a greater extent than institutional investors (e.g., because of their dependence on labor income), that their risk aversion increases in bad states, and/or that their risk exposure makes them more sensitive to adverse market movements. A closely related scenario is that they reallocate a larger portion of their portfolio assets (equities and bonds) into cash and other liquid instruments (e.g., money market accounts) than institutional investors during bad times. This explanation is also consistent with the observation that central banks tend to increase the money supply after adverse shocks. The additional liquidity will presumably be held in investors' deposits and only serves for wealth preservation without triggering inflationary pressure.

⁹ Clearly, we cannot strictly rule out that Swiss private investors trade domestically issued equities for bonds (and vice versa) with foreign institutional investors that are not accounted in our data.

4.1.2. Level of equities held by investor types

In their asset allocation decisions investors are unlikely to view the fraction of the stock market they hold in their portfolio as the choice variable. We therefore look directly at asset allocation levels and the fraction of assets invested in equities. For each investor group, we measure the equity allocation by computing the ratio of equity holdings and total asset holdings (as the sum of equities and bonds), denoted as $EQUUSH_{jt}$, for $j = PRIV, COM, INST$, and run the following regressions:

$$(9) \quad EQUUSH_{jt} = \beta_0 + \beta_1 DIVYIELD_t + \beta_2 TERM_t + \varepsilon_{jt}, \text{ and}$$

$$(10) \quad EQUUSH_{jt} = \gamma_0 + \gamma_1 EER_t + u_{jt}.$$

The results are reported in table 4. All three investor groups have significantly smaller than normal equity holdings when the dividend yield is high. This is not surprising because the dividend yield must rise when the stock market falls (and the expected stock market return is high). In equilibrium, therefore, the average investor must have lower equity holdings when the stock market falls. Similarly, all three investor groups significantly reduce their equity holdings when the term structure of interest rates increases. The results are robust when the fitted values of expected excess returns are used as the explanatory variable.

[Insert table 4 here]

Our results are again opposite to Cohen's (2003) findings for the U.S., where only private investors appear to change their equity holdings in recessions, but not institutional investors (the estimated coefficient is negative, but statistically insignificant). He interprets his results as indicating that institutional investors buy shares from individual investors when expected stock market returns are high, although not enough to increase their allocations given the previous drop in the stock market. Therefore, rebalancing could most probably characterize the investment behavior of institutional investors. This simple interpretation does not hold for our Swiss data set. The estimated coefficients on our expected return proxies are significantly negative in most specifications and for all three types of investors. This implies that all three investor groups allocate a lower fraction of equities in their portfolios when the expected stock market return is high, i.e., in a bad state after stock prices have dropped. This result is consistent with the behavior of the average investor, although we cannot rule out that trading occurs between investor groups. Noting that $(1-EQUUSH)$ is the fraction of bonds held in investors' portfolios, there is again no evidence in our data that institutional investors

systematically buy shares from private investors and sell bonds to them when expected stock market returns are high, and vice versa.

A simple way to control for stock and bond market movements and focus on changes in asset allocations is to compute deviations from a “let-it-ride” strategy. Note that the *EQUSH* variable must increase if the stock market performs well (and possibly better than the bond market). Therefore, lacking investor specific data, a simplified approach is to take the equity and bond allocation from the previous period and, assuming that the equity portion grows at the value-weighted stock market return and the bonds at the 10-year government bond rate, compute the equity allocation that would have ensued if the portfolio had no other changes during that month. We subtract the let-it-ride allocation from the end of quarter allocation to obtain the deviation, which is used as an alternative regressand in our analysis. Our results do not deliver any new insights, and we thus omit detailed reporting. We find that all investor groups have significantly negative reactions to the contemporaneous stock market return after accounting for let-it-ride. This effect could represent the growth of other asset (e.g., labor income) not fully accounted here. The other explanatory variables we have used previously do not load significantly. Most important, and in contrast to Cohen’s (2003) results, we do not find that lagged stock market returns affect the three investor groups differently. While he reports evidence for feedback-trading by private investors and rebalancing by institutional investors, with our Swiss data the lagged market return is estimated insignificantly in all specifications.

4.2 Structural relationships between investor groups

Our data do not allow disentangling deliberate changes in asset allocations through trading between the different investor groups from mere price movements. While we cannot rule out price effects in our data, an alternative test methodology is to use a non-stationary vector autoregression framework including cointegration and error correction restrictions. By explicitly modeling lead-lag relationships between the variables of interest, we shed light on the issue whether one investor group follows another in terms of portfolio adjustments. This contributes another dynamic dimension to the analysis of investment behavior, although the portfolio adjustments (error corrections) towards the common cointegrating relationship can again be accomplished through volume and/or price effects. However, the VAR-error correction approach has the advantage that it is not based on contemporaneous correlations that are at least partly driven by stock market movements, but it rather investigates systematic asymmetric dynamic relationships between the three different investor groups.

We work with the *EQUSH* variables and recognize that, strictly speaking, allocations (percentages) cannot be integrated series of order one. However, this assumption may be a reasonable approxima-

tion as long as we observe apparently permanent changes in the allocations into equity. In fact, our *EQUSH* variables are highly persistent series with first order autocorrelations above 0.95, and an augmented Dickey-Fuller test indicates that the null hypothesis of a unit root cannot be rejected for the series of all three investor groups. As a robustness check, we also perform our tests using the natural logarithm of the level of equity holdings, but the results do not change qualitatively. We test combined unit root and cointegration hypotheses in the framework of a level vector error correction that allows for the possibility of a stationary VAR. Our empirical results are based on estimations of a VAR with lag length of 1, which is appropriate according to the Schwarz information criterion.¹⁰

In a first step, we omit the drift term (intercept) and compute the Johanson (1991) trace test statistic for the number of cointegrating relationships between the *EQUSH* variables. Table 5 reports the results. The Johanson trace test is based on the eigenvalues of a stochastic matrix and computes the linear combination of the *EQUSH* variables that is most stationary. If there was no long-run equilibrium relationship between the series (as described by a linear combination of these series), a multivariate dynamic analysis would not be meaningful. The null hypothesis of no cointegration relationship can be rejected at the usual 5% level. In contrast, the null hypotheses of at most 1 and at most 2 cointegration relationships cannot be rejected. We therefore conclude that our data consist of three series that are integrated of order one and have one cointegrating relationship.

[Insert table 5 here]

The Engle and Granger (1987) method suggests running a regression of one integrated variable on the other integrated variables. Because the *EQUSH* variables are cointegrated, the following regression defines the long-run equilibrium (cointegrating) relationship between the series:

$$(11) \quad EQUSH_{COMM,t} = \alpha_0 + \alpha_1 EQUSH_{INST,t} + \alpha_2 EQUSH_{PRIV,t} + z_{jt}.$$

The (normalized) linear combination of the percentage equity allocations in the portfolios of commercial, institutional, and private investors is [1.00, -0.25, -1.78], where only the estimated slope coefficient for private investors is statistically significant at the 1% level (see panel A in table 6). According to the Granger-representation theorem, a vector autoregressive model on differences of variables that are integrated of order one will be misspecified if these variables are cointegrated. The model only becomes well specified when the lagged disequilibrium terms are included as ex-

¹⁰ The sequential likelihood ratio test, the final prediction error criterion, and the Hannan-Quinn as well as the Akaike information criteria suggest lag lengths for our VAR system that vary between 1 and 6. Our results are not sensitive to the choice of the lag length.

planatory variables. This procedure delivers a vector error correction model whereby deviations from the long-run equilibrium (cointegrating relationship) are automatically corrected:

$$\begin{aligned}
 \Delta EQUSH_{COMM,t} &= \alpha_1 + \beta_1 \Delta EQUSH_{COMM,t-1} + \beta_2 \Delta EQUSH_{INST,t-1} + \beta_3 \Delta EQUSH_{PRIV,t-1} + \gamma_1 z_{t-1} + \varepsilon_{COMM,t} \\
 (12) \quad \Delta EQUSH_{INST,t} &= \alpha_2 + \beta_4 \Delta EQUSH_{COMM,t-1} + \beta_5 \Delta EQUSH_{INST,t-1} + \beta_6 \Delta EQUSH_{PRIV,t-1} + \gamma_2 z_{t-1} + \varepsilon_{INST,t} \\
 \Delta EQUSH_{PRIV,t} &= \alpha_3 + \beta_7 \Delta EQUSH_{COMM,t-1} + \beta_8 \Delta EQUSH_{INST,t-1} + \beta_9 \Delta EQUSH_{PRIV,t-1} + \gamma_3 z_{t-1} + \varepsilon_{PRIV,t}
 \end{aligned}$$

where Δ denotes the first difference operator, and z_{t-1} is the lagged disequilibrium term computed as the residual from equation (11). The absolute magnitude of the estimated coefficients γ_1 , γ_2 , and γ_3 determines the speed of adjustment back to the long-run equilibrium following a shock. The results in panel A of table 6 show that the error correction coefficients for commercial and private investors have the correct negative and positive sign, respectively. Given that only the error correction term for private investors is statistically significant (although with 0.041 rather small in magnitude) any adjustments towards the cointegrating relationship are accomplished only slowly through changes in the equity allocation of private investors. The error correction coefficients of commercial and institutional investor are estimated insignificantly.¹¹ Overall, the results suggest that the percentage equity allocation in the portfolio of institutional investors can possibly be excluded from the cointegrating relationship. Moreover, the error correction coefficient is only estimated significantly in the equation involving the group of private investors.

[Insert table 6 here]

In a second step, the data allow us to restrict the model by incorporating two types of restrictions. First, we set the coefficients on the equity allocation of commercial and institutional investors in the cointegration vector to 1 and 0, respectively. Second, we constrain the error correction coefficients in those equations involving the equity allocations of commercial and institutional investors to 0. The results of this restricted vector error correction model are reported in panel B of table 6. The restrictions that have been imposed identify the cointegration vector, as can be checked numerically by the rank of the appropriate Jacobian matrix (Boswijk, 1995). In addition, we compute a likelihood ratio test statistic to test the binding restrictions. As indicated in the bottom line of table 6, the chi-square test statistic is only 1.81, indicating that the restrictions imposed on the cointegration vector and the error correction structure cannot be rejected at conventional levels. Most important, the estimated error coefficient on the equity allocation in the portfolios of private investors carries

¹¹ Note that at least on error correction coefficient must be estimated significantly.

the correct sign and is highly significant. With 0.051, however, the magnitude of this coefficient again suggests a rather slow adjustment in the equity holdings of private investors to those of commercial investors.

Overall, we interpret these results from our restricted vector error correction model as follows: The behavior of commercial investors seems to lead, and private investors adopt their investment behavior only slowly over time. The investment behavior of institutional investors is not systematically affected by the actions of private and commercial investors. The actions of institutional investors in one period also do not impact the actions of private and commercial investors in a subsequent period. Therefore, we conclude that the equity allocation in institutional portfolios is weakly exogenous and not related to the decisions of the other investor groups in the long-run. Given that institutional investors are by far the largest investor group, as shown in table 1, this result is clearly surprising. Our findings also provide support for the notion that commercial investors are possibly better trained and/or better informed (probably supported by the consulting activities of commercial banks) than private investors, and thus they are the first to react when information is spread out in the market. The observation that institutional investors show no reaction could be explained by regulatory restrictions.

There is again one caveat. Our results remain silent about the nature of the adjustment (error correction) towards the cointegrating relationship. Any adjustment can be accomplished through trading (where private investors follow commercial investors in their activities) and/or differential performance of the portfolios for some reasons not accounted here. However, our results cannot simply be driven by stock market movements, because they are not based on contemporaneous correlations but rather on systematic asymmetric dynamic relationships. This notion can also be inferred from table 7, where the correlations of the error correction VAR residuals are shown. The unexpected changes (residuals) in the equity allocation of commercial investors are only weakly correlated with those of the other two investor groups. In contrast, the correlation of the unexpected changes in the equity allocations in the portfolios of institutional and private investors is strongly positive, and this co-movement is probably brought about by (contemporaneous) stock market movements, which are mostly unexpected. These results again suggest a special role of commercial investors, who respond differently to market movements than private and institutional investors.

[Insert table 7 here]

5. Conclusions

The purpose of this paper has been to investigate heterogeneity in the investment behavior of different types of investors groups. We use a hitherto unexplored data set provided by the Swiss National Bank (SNB) that includes monthly portfolio holdings of private, commercial, and institutional investors deposited with Swiss banks between November 1998 and November 2004. In the first part of the paper we regress the equity and bond holdings of all three investor groups on familiar business cycle indicators to explore how their allocations change in different states of the world. Our main result is that private investors do not systematically move from equities into bonds by selling equities to institutional investors and purchasing bonds from them in bad states (i.e., when expected returns are high). Possible explanations are that private investors become poorer in bad states to a greater extent than institutional investors (e.g., because of falling labor income), that their risk aversion increases in bad states, and/or that their risk exposure makes them more sensitive to adverse market movements. Alternatively, they simply reallocate a larger portion of their portfolio assets (equities and bonds) into cash and other liquid instruments (e.g., money market accounts) than institutional investors during bad times. However, our interpretations are clearly subject to the limitation that we cannot disentangle price and volume effects in our data set due to a lack of investor specific portfolio returns.

In the second part of the paper we use a non-stationary vector error regression (VAR) framework including cointegration and error correction restrictions. This alternative methodology is not based on simple contemporaneous correlations that are at least partly driven by stock market movements, but it rather investigates systematic asymmetric dynamic relationships between the investment decisions of the three investor groups. Our main observation is that the behavior of commercial investors seems to lead, and private investors adopt their investment behavior only slowly over time. In contrast, the investment behavior of institutional investors is not systematically affected by the actions of private and commercial investors. These observations could be explained by better information on the side of commercial investors and regulatory restrictions imposed on institutional investors. Again, we cannot distinguish whether the error corrections reflect price and/or volume effects.

This paper is the first study that investigates investor heterogeneity using Swiss data. Even though our results point out to some potentially interesting mechanisms, further research is needed to gain a better understanding of the underlying decision processes. We can only speculate that the investment regulations imposed on pension funds and insurance companies, which are the major institutional investors in Switzerland, potentially play an important role for our results. Furthermore, we

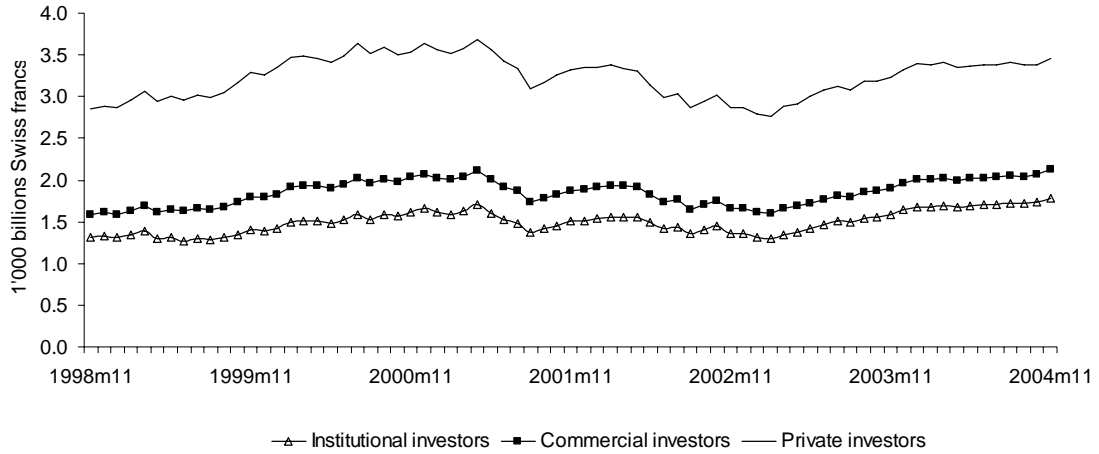
consider three different types of investors and implicitly assume that the investors are homogenous within each group. As King (2000) argues, however, there might be significant heterogeneity within different types of investors with respect to preferences and their investment behavior in response to changing business conditions. In particular, one could conjecture that institutional investors form a very heterogeneous investor group with different investment behavior. For example, while mutual funds experience strong inflows of money in bull markets, forcing them to buy equity, such external forces are not observable for pension funds. Given that our results for institutional investors are clearly surprising, i.e., that their investment decisions are exogenous, we suppose that it is not appropriate to regard institutional investors as one large, homogenous group. More detailed analysis would require to look at investors at a more disaggregated level in order to identify the underlying mechanisms.

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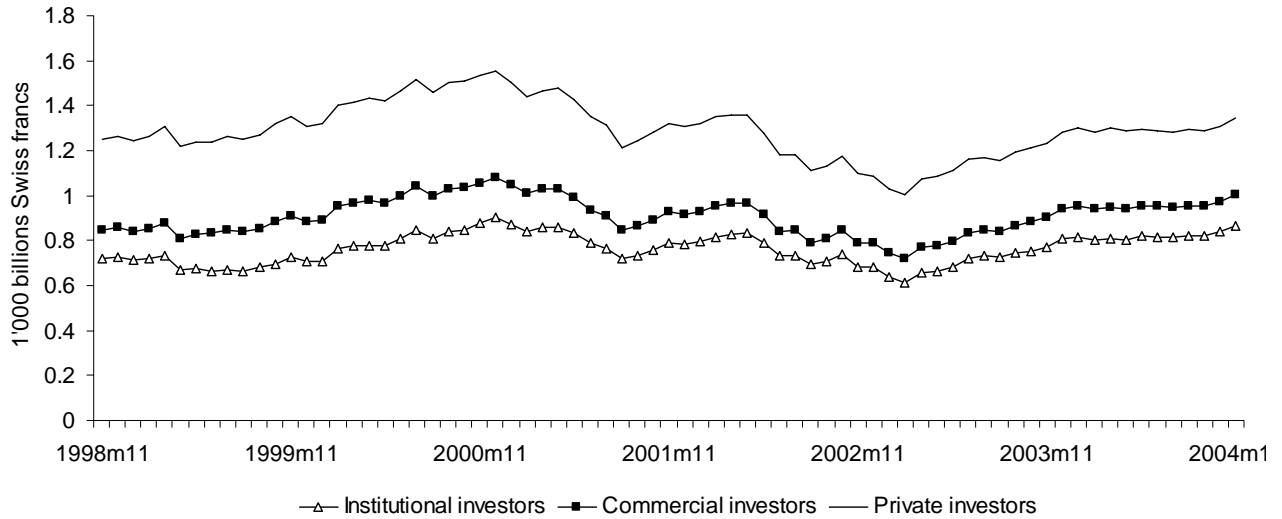
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Figure 1: Total value of assets held by each investor group



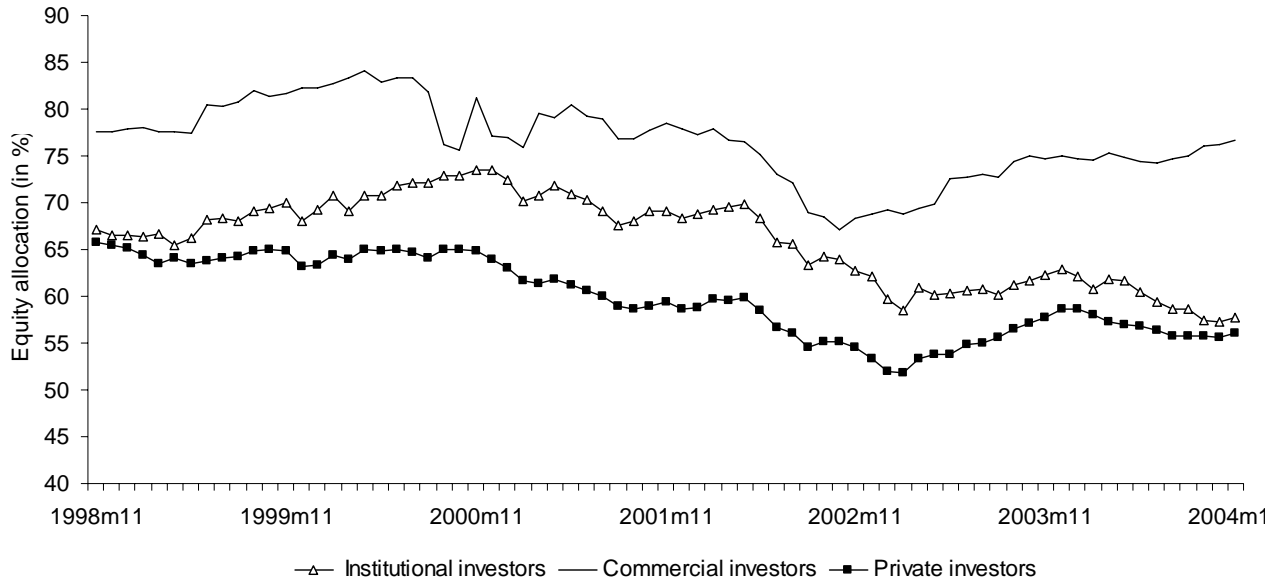
The figure shows the total value of deposits in billions of Swiss Francs held by private, commercial and institutional investors (stacked) over time. The values include all deposits of domestic and foreign securities held by residents and non-residents. The data are taken from the monthly survey on portfolio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

Figure 2: Total value of domestically issued securities held by each investor group



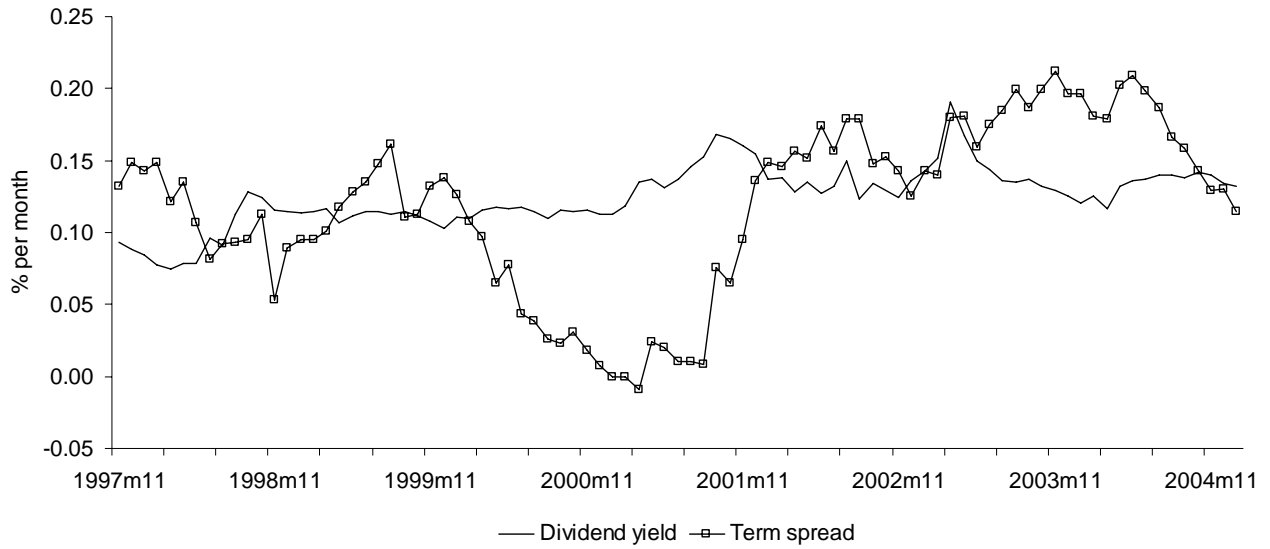
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Figure 3: Fraction of equities held in the portfolios of each investor group



The figure shows the time-evolution of the fraction of equities held in the portfolios of private, commercial and institutional investors. This variable is denoted as *EQUISH* in the text. 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) between November 1998 and November 2004.

Figure 4: Monthly dividend yield and term spread over time



The figure shows the dividend yield and term spread for Switzerland. The dividend yield is taken from the Datastream database and refers to the Datastream total market index for Switzerland. The term spread is the difference between the yield on 10-year Swiss government bonds and the 1-month interest rate for Eurocurrency deposits in Swiss francs. The time period is between November 1998 and November 2004.

Table 1: Descriptive statistics

(in %)	Mean	Std. dev.	Min.	Max.
<i>Panel A: Equity and bond holdings relative to total holdings</i>				
<i>FRACEQU</i>				
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
<i>FRACBOND</i>				
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
<i>Panel B: Equity allocation in investor portfolios</i>				
<i>EQUISH</i>				
All investors	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 measures of equity and bond holdings includes the deposits of domestically issued securities held by residents and non-residents. The variable *FRACEQU* is defined as the ratio of the market value of equities held by an investor group and the total market value of domestically issued equities. The variable *FRACBOND* is defined as the ratio of the market value of bonds held by an investor group and the total market of all outstanding bonds. The variable *EQUISH* denotes the ratio of the total value of equities held by an investor group relative to the total value of equities and bonds held by this investor group. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank between November 1998 and December 2004.

Table 2: Effects of business cycle conditions on the fraction of equities held by each investor group relative to total equity holdings (*FRACEQU*)

	Private investors			Commercial investors			Institutional investors		
<i>Panel A: Dividend yield and term spread as explanatory variables</i>									
<i>DIVYIELD</i>	-76.40** (23.99)	-86.59** (24.41)		-47.76** (17.76)	-50.35** (17.43)		124.16** (37.94)	136.94** (37.04)	
<i>TERMY</i>	-12.64* (5.12)		-17.11** (5.25)	-3.21 (3.34)		-6.00 (3.65)	15.85* (7.70)		23.11** (8.07)
Constant	0.39** (0.03)	0.38** (0.03)	0.29** (0.01)	0.20** (0.02)	0.20** (0.02)	0.14** (0.01)	0.42** (0.05)	0.42** (0.05)	0.57** (0.01)
<i>F(x,y)</i>	9.97**	12.58**	10.61**	4.45**	8.35**	2.71	9.63**	13.66**	8.20**
<i>N</i>		73			73			73	
<i>Panel B: Fitted values of excess market returns as explanatory variable</i>									
<i>EER</i>		-0.91** (0.31)			-0.24 (0.20)			1.15* (0.46)	
Constant		0.27** (0.01)			0.13** (0.01)			0.59** (0.01)	
<i>F(x,y)</i>		8.62**			1.41			6.14*	
<i>N</i>		73			73			73	

The table reports results from regressing the ratio of the market value of equities held by an investor group and the total market value of domestically issued equities, *FRACEQU*, on contemporaneous values of the dividend yield (*DIVYIELD*) and the term spread (*TERMY*) (panel A) and the fitted value of excess market returns (*EER*) (panel B). The fitted values of excess market returns are computed by regressing excess market returns on the lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West covariance matrix and corrected for serial correlation up to the third lag. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and (*) respectively. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank between November 1998 and November 2004.

Table 3: Effects of business cycle conditions on the fraction of outstanding bonds held by each investor group relative to total bond holdings (*FRACBOND*)

	Private investors			Commercial investors			Institutional investors		
<i>Panel A: Dividend yield and term spread as explanatory variables</i>									
<i>DIVYIELD</i>	-38.09 (27.30)	-67.57 ^(*) (37.12)		-17.00 ^(*) (9.34)	-20.94 [*] (9.62)		55.10 ^(*) (32.77)	88.51 [*] (42.39)	
<i>TERMY</i>	-36.57 ^{**} (5.85)		-38.80 ^{**} (5.63)	-4.89 ^{**} (1.77)		-5.88 [*] (2.30)	41.46 ^{**} (6.26)		44.68 ^{**} (6.46)
Constant	0.44 ^{**} (0.03)	0.43 ^{**} (0.05)	0.39 ^{**} (0.01)	0.10 ^{**} (0.01)	0.10 ^{**} (0.01)	0.08 ^{**} (0.003)	0.46 ^{**} (0.04)	0.46 ^{**} (0.05)	0.53 ^{**} (0.01)
<i>F(x,y)</i>	23.54 ^{**}	3.31 ^(*)	47.48 ^{**}	4.98 ^{**}	4.74 [*]	6.67 [*]	26.82 ^{**}	4.36 [*]	47.82 ^{**}
<i>N</i>		73			73			73	
<i>Panel B: Fitted values of excess market returns as explanatory variable</i>									
<i>EER</i>		-2.25 ^{**} (0.34)			-0.33 [*] (0.14)			2.58 ^{**} (0.42)	
Constant		0.35 ^{**} (0.01)			0.08 ^{**} (0.002)			0.57 ^{**} (0.01)	
<i>F(x,y)</i>		42.84 ^{**}			5.39 [*]			38.21 ^{**}	
<i>N</i>		73			73			73	

The table reports results from regressing the ratio of the market value of bonds held by an investor group and the total market value of all outstanding bonds from domestic issuers, *FRACBOND*, on contemporaneous values of the dividend yield (*DIVYIELD*) and the term spread (*TERMY*) (panel A) and the fitted value of excess market returns (*EER*) (panel B). The fitted values of excess market returns are computed by regressing excess market returns on the lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West covariance matrix and corrected for serial correlation up to the third lag. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and (*) respectively. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank between November 1998 and November 2004.

Table 4: Effects of business cycle conditions on the equity allocation in the portfolios of each investor group (*EQUSH*)

	Private investors			Commercial investors			Institutional investors		
<i>Panel A: Dividend yield and term spread as explanatory variables</i>									
<i>DIVYIELD</i>	-145.7** (24.16)	-169.92** (32.91)		-99.34** (32.63)	-121.10** (39.35)		-74.81** (26.75)	-115.90* (48.63)	
<i>TERMY</i>	-29.99** (4.88)	-38.53** (8.38)		-26.99** (7.53)	-32.80** (8.01)		-50.97** (5.11)	-55.35** (6.86)	
Constant	0.82** (0.03)	0.82** (.04)	0.64** (0.01)	0.93** (0.04)	0.92** (0.05)	0.81** (0.01)	0.82** (0.03)	0.81** (0.06)	0.73** (0.01)
<i>F(x,y)</i>	53.88**	26.66**	21.13**	12.43**	9.47**	16.74**	55.58**	5.65*	65.04**
<i>N</i>	73			73			73		
<i>Panel B: Fitted values of excess market returns as explanatory variable</i>									
<i>EER</i>	-1.99** (0.51)			-1.68** (0.43)			-3.12** (0.44)		
Constant	0.61** (0.01)			0.77** (0.01)			0.67** (0.01)		
<i>F(x,y)</i>	15.19**			15.32**			49.85**		
<i>N</i>	73			73			73		

The table reports results from regressing the ratio of the total value of equities held by an investor group relative to the total value of domestically issued equities and bonds held by this investor group, *EQUSH*, on contemporaneous values of the dividend yield (*DIVYIELD*) and the term spread (*TERMY*) (panel A) and the fitted value of excess market returns (*EER*) (panel B). The fitted values of excess market returns are computed by regressing excess market returns on the lagged values of the dividend yield and the term spread. Standard errors are in brackets and are based on the Newey-West covariance matrix and corrected for serial correlation up to the third lag. Coefficients that are significantly different from zero at the 1%, 5%, and 10% level are marked with **, *, and (*) respectively. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank between November 1998 and November 2004.

Table 5: Johanson trace test

Number of hypothesized cointegrating relations (R)	$H_0: r \leq R$ vs. $H_1: r > R$	
	Eigenvalue	Trace statistics
None	0.293	39.849*
At most 1	0.127	15.236
At most 2	0.075	5.560

The table reports the Johanson trace test for $STKSH_j$ ($j = COMM, PRIV, INST$). $STKSH$ denotes the ratio of the total value of equities held by an investor group relative to the total value of domestically issued equities and bonds held by this investor group. * (**) denotes rejection of the hypothesis at the 5% (1%) level.

Table 6: Vector error correction (VAR) model

<i>Panel A: Unrestricted vector error correction model</i>						
	$\Delta EQUSH_{COMM,t}$		$\Delta EQUSH_{INST,t}$		$\Delta EQUSH_{PRIV,t}$	
	Coefficient	<i>t</i> -value	Coefficient	<i>t</i> -value	Coefficient	<i>t</i> -value
<i>Cointegrating equation:</i>	1.000	n.a.	-0.251	-0.734	-1.776	-4.715
$\Delta EQUSH_{COMM,t-1}$	-0.054	-0.419	0.065	0.720	-0.039	-0.680
$\Delta EQUSH_{INST,t-1}$	-0.302	-1.435	-0.206	-1.066	0.079	0.655
$\Delta EQUSH_{PRIV,t-1}$	0.701	1.853	0.386	1.433	0.268	1.592
z_{t-1}	-0.022	-0.582	-0.021	-0.772	0.041	2.432
Adjusted R ²	0.011		0.024		0.164	
<i>Panel B: Restricted vector error correction model</i>						
	$\Delta EQUSH_{COMM,t}$		$\Delta EQUSH_{INST,t}$		$\Delta EQUSH_{PRIV,t}$	
	Coefficient	<i>t</i> -value	Coefficient	<i>t</i> -value	Coefficient	<i>t</i> -value
<i>Cointegrating equation:</i>	1.000	n.a.	0.000	n.a.	-1.985	-8.188
$\Delta EQUSH_{COMM,t-1}$	-0.048	-0.375	0.067	0.749	-0.032	-0.565
$\Delta EQUSH_{INST,t-1}$	-0.411	-1.526	-0.212	-1.116	0.061	0.511
$\Delta EQUSH_{PRIV,t-1}$	0.723	1.919	0.391	1.467	0.290	1.722
z_{t-1}	0.000	n.a.	0.000	n.a.	0.051	5.086
Adjusted R ²	0.059		0.028		0.152	
<i>LR-test for binding restrictions (rank = 1): $\chi^2(3) = 1.809, p\text{-value} = 0.613$</i>						

The table reports the results from an unrestricted (panel A) and restricted (panel B) vector error correction model (VEC) with VAR lag length of 1 for the *EQUSH* variables. *EQUSH* is the ratio of the total value of equities held by an investor group relative to the total value of domestically issued equities and bonds held by this investor group. z_{t-1} denotes the lagged error term based on the cointegration relationship between the three variables. The restrictions in panel B are as follows: The coefficients on the equity allocation of commercial and institutional investors in the cointegration vector are restricted to 1 and 0, respectively. The error correction coefficients in the equations involving the equity allocations of commercial and institutional investors are constrained to 0. *LR-test* indicates a likelihood ratio test for the null hypothesis that these restrictions are well specified. The data are taken from the monthly survey on portfolio holdings of Swiss Banks conducted by the Swiss National Bank between November 1998 and November 2004.

Table 7: Correlations of VAR residuals

	$EQUSH_{COMM}$	$EQUSH_{INST}$	$EQUSH_{PRIV}$
$EQUSH_{COMM}$	1.000	0.265	0.230
$EQUSH_{INST}$	0.266	1.000	0.808
$EQUSH_{PRIV}$	0.230	0.808	1.000

The table reports the correlation matrix of the error correction VAR residuals from the restricted model in panel B of table 6.

International Portfolio Holdings and Swiss Franc Asset Returns

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JEL-Classification: E43, G11, G12

Keywords: Portfolio Choice, Asset Returns, Switzerland

1. Introduction

Swiss Franc assets carry much lower returns than comparable assets in other currencies. This fact has been called the puzzle of the “Swiss Interest Rate Island” and a number of explanations have been advanced, all of which continue to be controversial. Broadly speaking, the explanations can be grouped into three categories. The first category emphasises the role of real factors that set Switzerland somewhat apart from many other countries such as a high savings rate or the high level of foreign assets. According to this explanation low real returns are the natural consequence of a high income level and capital intensive production at decreasing marginal returns. Although this explanation applies mainly to the closed economy it may hold even in an open economy under certain circumstances.¹ An alternative “real” explanation for low real returns is based on a failure of relative purchasing power parity leading to a continuous real exchange rate appreciation of the Swiss Franc. A real exchange appreciation could be due to protectionism that reduces productivity in the non tradable sector (the so called

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1 CUNAT (2003) provides an overview of the theoretical models on growth that predict differences in real rates of return even among open economies.

“Swiss Price Island”), or it could be due to very high productivity growth in the tradable sector (Balassa-Samuelson effect). Both would lead to a faster growth in Swiss prices of non tradable goods and thus to a real exchange rate appreciation, which could compensate investors for low real returns.

The second category of explanations focuses on monetary and exchange rate anomalies of the Swiss Franc. Investors may be prepared to accept lower returns in nominal (exchange rate corrected terms) if they expect that the Swiss Franc appreciates in times of distress or catastrophic events. According to this line of argument low returns on Swiss Francs could be observed in tranquil times, even over long periods if no catastrophic event occurs. If this explanation holds, the return puzzle would only constitute a short run phenomenon and would be resolved eventually. In the meantime one faces a so called peso problem. Some indirect evidence for this explanation was presented in KUGLER and WEDER (2000).

A third and very widespread explanation links political and regulatory factors of Switzerland with low returns. The proposition is: Switzerland has a high level of political stability and a very secure banking system, which also offers shelter from the tax man. Therefore, there is a high foreign demand for deposits in Swiss Banks and this foreign demand drives down returns on Swiss assets. One of the problems of this proposition is that it should only apply to assets which are held at Swiss banks. However, as shown in KUGLER and WEDER (2002) the interest rate puzzle is also present in Euro deposits, i. e. short term deposits in Swiss Francs, which are held outside Switzerland. One of the main contributions of this paper is to study the possible role of foreign demand for Swiss Franc securities deposited at Swiss banks, which is possible for the first time thanks to a new data set on portfolio holdings.

The Swiss National Bank collects data on portfolio holdings of residents and non-residents on a monthly basis since end of 1998.² The original reason for collecting this data was that the Swiss National Bank was concerned that large portfolio shifts might take place after the introduction of the Euro and wanted to monitor these flows. The data comprises all securities deposited at the monthly reporting Swiss banks (henceforth called deposits) and is very detailed: it includes a detailed break down by type of security (i. e. money market papers, bonds, stocks or equity) the currency composition, the location of the issuer and a break down by residence. The only drawback is that non residents are combined into one group so it is not possible to locate the origin of non residents' asset stocks and flows.

2 We thank the Department of Statistics of the SNB for providing this data.

The innovations of this paper are fourfold: First we study return differentials more comprehensively than in the previous literature by comparing three asset classes : money market instruments, bonds and equities across countries. Second, we document the structure of international portfolio holdings in Switzerland. Third, we examine the merit of one of the most commonly held beliefs about the nature of the puzzle: the role of foreign demand for Swiss Francs, possibly motivated by banking secrecy. Fourth, we propose a new explanation for the puzzle based on a portfolio perspective.

The main findings are as follows: We find that returns are only lower for fixed income assets and not for equity. Moreover, it is mostly due to a long run deviation from uncovered interest rate parity, not a deviation from purchasing power parity. These findings cast some doubt on two of the most wide spread explanations for the interest rate island. If the puzzle was mainly due to real or structural forces such as high capital intensity or a productivity differential between non tradables and tradables it should manifest through a deviation from purchasing power parity. If the puzzle could be explained by a peso problem it should apply also to equity.

Turning to the role of foreign demand for Swiss assets (possibly due to banking secrecy) we find that this demand is quantitatively small since non residents hold their deposits mostly in other currencies. Furthermore, non residents hold Swiss Franc deposits mostly in equity, where we did not find a return differential. We find little evidence for a role of banking secrecy since non residents have a very limited preference for fixed income instruments issued by foreign debtors, which should be the prime instruments for tax evasion since they are exempt of withholding taxes that apply to resident issues. We conduct a dynamic factor analysis to examine whether the portfolio shift of residents and non residents can explain the returns on Swiss assets and find that foreign demand had almost no impact on Swiss Franc asset prices.

Finally, we propose a new explanation for low returns on Swiss fixed income assets, namely the diversification benefits offered by these instruments. We use reversed portfolio optimization to back out the implied returns when taking into account observed depositors choices and the covariance between assets. This exercise shows that the estimated pattern of returns conforms very well with the actually observed pattern. In other words, the puzzle of low returns on Swiss fixed income assets can be resolved in a portfolio perspective.

The paper is organized as follows: Section 2 analyses the real and nominal (exchange rate corrected) return differentials between money market, bonds and equities assets in Swiss Francs and three major currencies. Section 3 presents some descriptive statistics on the structure of deposits of non residents at Swiss banks.

Section 4 studies the role of foreign demand more formally using a dynamic factor analysis. Section 5 analyses the pattern of returns implied in de facto choices of investors. Section 6 concludes.

2. Real and Nominal Return Differentials between Swiss and Foreign Assets

We start by analyzing differences in real returns on money market (3 month Euro deposits), bonds (10 year government bonds) and equities for three currencies. We compare Swiss Franc assets with Euro (Deutsche Mark before 1999), British Pound and US Dollar assets using quarterly end of period return data from 1980–2003.³ Yields are calculated based on return indices, which incorporate coupons and dividends as well as price changes. To obtain real ex post returns we deflate the nominal returns with the consumer price index. It is worth mentioning that this procedure correctly measures the ex post return of longer term fixed income instruments, for instance 10 year bonds. The common practice of measuring real returns on such instruments based on the yield to maturity has important statistical problems since it would involve the inflation rate over the next 10 years. This problem is usually circumvented by using actual or past average realized inflation rates, which may lead to substantial biases. Using quarterly return indices, the returns will not suffer from this bias.

Table 1 shows the return differences between Swiss Franc assets and the corresponding assets in three major currencies. We are interested in the long run pattern, therefore, we show the mean over the period 1980 to 2003.

**Table 1: Mean real ex post return differences (percent per annum)
Swiss Franc DM, Pound and Dollar, Money Market, Bonds, Equity, 1980–2003**

	DM(Euro)	Pound	Dollar
Money Market (3 M)	1.49***	2.69***	1.56***
Bonds (10J)	2.21***	4.23***	3.08**
Equity	-0.81	-0.60	-0.43

*, ** and *** indicates statistically significantly different from zero (one-sided test), respectively.

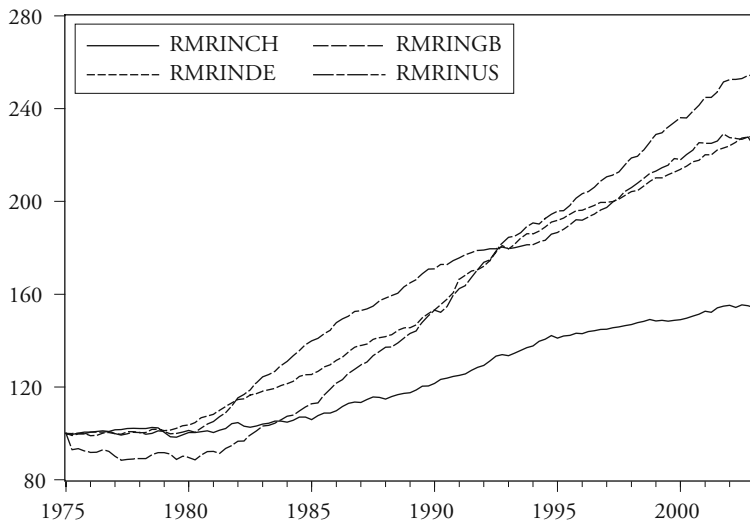
3 The data source for money market rates, bond returns (10 year government bond) and the MSCI-stock market indices is Datastream. Consumer prices are from IFS (IMF).

The upshot of table 1 is that there are positive return differences between Swiss Franc fixed income instruments, i. e. money market and bonds. Swiss franc fixed income instruments have yielded less than the corresponding instruments in any other currency. The difference is largest for bonds, which yielded between 2.2 and 4.2 percent less in DM and Pound respectively. But even short-term Swiss Franc money market instruments have yielded clearly lower returns than money market investment in DM, Pound or Dollars.

The other notable result in table 1 is that the return differential is minimal and even slightly negative in the case of equity. Furthermore, the return differentials are statistically significant for fixed income instruments, but not for equity.⁴

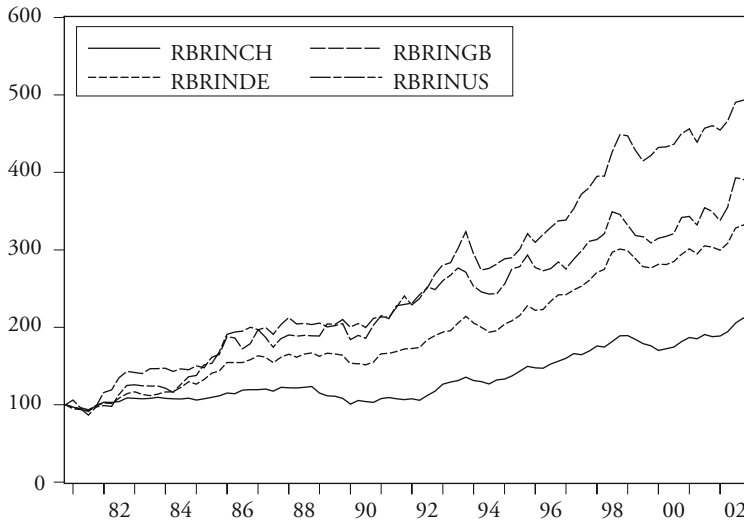
Figures 1 to 3 show the real return indices for money market, bonds and equities. The advantage of this presentation is that it illustrates the cumulative effect of annual return differentials over time.

Figure 1: Real return indices for money market paper in Swiss Francs (RMRINCH), DM (RMRINDE), Pound (RMRINGB) and Dollar (RMRINUS)

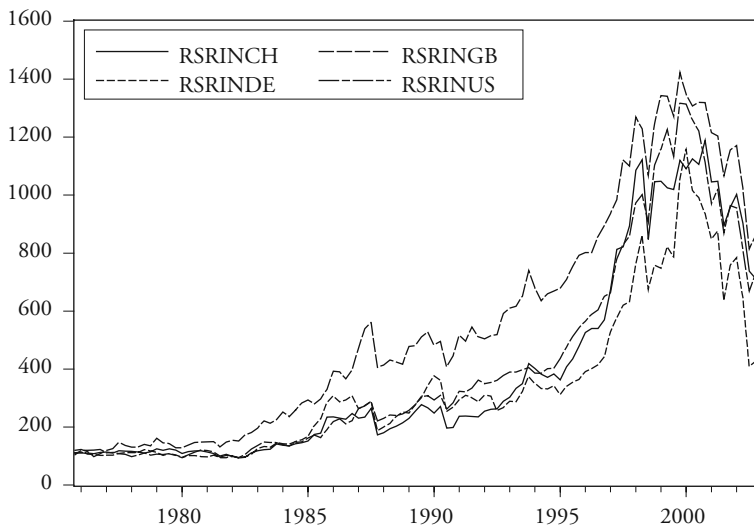


4 In addition KUGLER and WEDER (2003) estimates VAR based mean returns and also finds significant differences for fixed income but not for equity.

**Figure 2: Real return indices for 10-year bonds
in Swiss Francs (RBRINCH), DM (RBRINDE), Pound (RBRINGB)
and Dollar (RBRINUS)**



**Figure 3: Real return indices for equities
in Swiss Francs (RSRINCH), DM (RSRINDE), Pound (RSRINGB)
and Dollar (RSRINUS)**



These graphs show that the “wealth malus” of an investment in Swiss Franc (fixed income) assets has been substantial. Over the last 20 years, an investment in money market paper doubled its value in other currencies, while in Swiss Francs it increased only by 50 percent in real terms. The difference is even more pronounced for bonds: In DM the investment increased threefold, in British Pounds is increased fourfold, while in Swiss Francs it only doubled. Again, the situation is different for equities, where we find no systematic differences in the long run real returns.

How can such large differences in real returns of fixed income assets be sustained over a period of 20 years? This question is particularly pertinent since capital movements have been free over this period and the issue cannot be one of market segmentation. In other words, why have informed investors not profited from this arbitrage opportunity to take short positions in Swiss Franc assets?

One reason why this may not have been a profitable proposition for say a German investor is that her primary interest is the real value of the investment expressed in Euros. In other words, she cares for the nominal return of the investment deflated by the German, rather than the Swiss consumer price index. This real return will be equal to the one calculated above, if and only if the Swiss Franc / Euro exchange rate obeys relative purchasing power parity. Thus, one straightforward source of real return differences could be compensatory movements in the real exchange rate. There would be no profit opportunity for a foreign investor if the return differential was compensated by a Swiss Franc appreciation in real terms.

In theory there could be two sources of lower real returns of Swiss Franc. First a real appreciation, which implies that the nominal exchange rate did not move to compensate the inflation differential and therefore relative purchasing power parity failed. Second a failure of uncovered interest rate parity, which implies that the nominal exchange rate did not compensate the mean nominal return differential.

To gain evidence about the source of real return differentials we calculate the nominal return differences corrected for exchange rate changes. The results are shown in table 2.

**Table 2: Nominal return differences (percent, per annum) in Swiss Francs
Swiss Frank DM, Pound and Dollar, Money Market, Bonds, Equity, 1980–2003**

	DM(Euro)	Pound	Dollar
Money Market (3 M)	0.48	2.45	2.15
Bonds (10J)	1.30	3.55	4.46
Equities	-1.43	-1.03	0.74

The most salient feature of table 2 is the similarity of returns with those in table 1. The pattern across currencies and assets is similar. Moreover, real and nominal return differentials (after correcting for exchange rate changes) appear to be of a similar magnitude. This means that real return differentials can be attributed mostly to a failure of uncovered interest rate parity, rather than a failure of relative purchasing power parity.

The only exception to this rule is the return differential between fixed income instruments in Swiss Francs and in Euro: real return differentials are markedly higher than nominal differentials (corrected for exchange rate changes). This suggests, that real appreciation – a failure of relative purchasing power parity – also played a role in this case.

Overall these results are surprising along two dimensions. First, they suggest that real interest rate parity fails for the Swiss Franc even in the long run⁵. Although the short run failure of RIP is widely accepted today there are many studies published in the last 15 years (for example, MODJTAHEDI, 1988; KUGLER and NEUSSER, 1993; WU and CHEN, 1998; FOUNTAS and WU, 1999; DREGER and SCHUMACHER, 2003) providing more favorable results for the RIP hypothesis in the sense that real rates move together and are equalized for many pairs of countries in the long run. Second, and *prima facie* even more surprising is the finding of a long run failure of uncovered interest rate parity in Swiss fixed income instruments. Again, it is well known that uncovered interest rate parity fails in the short run for most currencies and this is considered one of the puzzles in

5 The hypothesis that real interest rates are equalized across countries was analyzed empirically in numerous studies. The first generation of these studies (for example, CUMBY and OBSTFELD, 1984; MISHKIN, 1984; FRANKEL and McARTHUR, 1988) focused on the short run validity of this proposition. These studies typically rejected the hypothesis. These finding are not surprising given the fact that we know today that the two ingredients of the real interest rate parity (RIP), namely uncovered interest rate parity (UIP) and purchasing power parity (PPP) are violated in the short run.

international finance. However, this failure of UIP refers to an anomalous short run reaction of the exchange rate to changes in the interest rate. Here we are finding that UIP does not hold over a 22 year period, something that is unique to the Swiss Franc and is not found for any other major currency.⁶

This largely descriptive section already allows a first assessment of the validity of common explanations of the return puzzle. The findings so far do lend little support to approaches that try to explain low returns by appealing to real factors such as high saving rates or low productivity of the non-tradable sector. These imply that the return should be due to a failure of PPP not UIP. But also the peso story receives a negative assessment in the light of these findings: if a expected appreciation in the event of a catastrophe was causing low returns in fixed income assets, this should also apply to equities.

3. Structure of International Portfolio Holdings in Switzerland

A very common proposition for explaining low yields is the high demand from non-residents for Swiss Franc assets. Recall from above the argument: non-residents deposit their wealth in Switzerland because of advantages such as the banking secrecy, which allows them to evade the scrutiny of their tax authorities. They are prepared to accept low returns since these still exceed what they would have received after taxes. Hence, the foreign demand for Swiss Franc assets might be driving down returns.

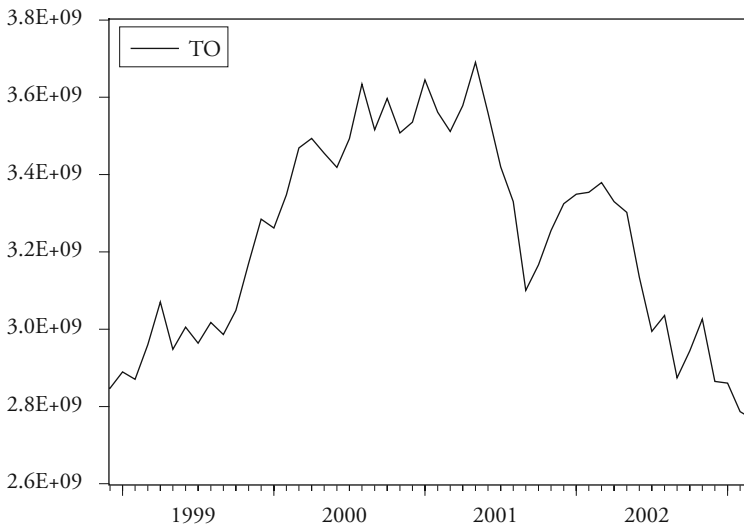
In this section we discuss the plausibility of this claim by examining the structure of international deposits of non-residents in Switzerland. Before turning to this analysis it is worth pointing out that there are a few stylised facts that do not conform with the claim. First, there is the fact that Switzerland has persistent current account surpluses and is therefore a net exporter – not an importer – of capital. Second, the return differential is present even on Swiss Franc assets that are not deposited in Switzerland and are therefore not subject to banking secrecy. In the analysis above, we showed a significant return differential in 3 month Euro market deposits. Third, the fact that return differentials exist only for fix income assets is at odds with the claim that foreign demand is at the root of lower yields, since this demand would presumably affect all assets.

The Swiss National Bank collects data on portfolio holdings of residents and non-residents on a monthly basis since end of 1998. Figure 4 shows the monthly

6 See KUGLER and WEDER (2002).

evolution of the total value of all deposits in Switzerland. Clearly these are large numbers: at the peak of the stock market the value of all deposits was about nine times the size of GDP and even after the stock market correction it is still seven times GDP.

**Figure 4: Value of all Deposits at Swiss Banks
in 1000 SFr, monthly 1998/12–2003/3**



Next we examine the share of deposits held by residents or non-residents and the currency composition. Table 3 shows that on average 45 percent of deposits were held by residents and non-residents held about 55 percent. The share of non-residents has increased over time from about 53 percent to about 57 percent.

Turning to the currency composition of non-residents' portfolios, table 3 shows that they hold about one third of their deposits in Swiss Francs. This foreign demand for Swiss Francs amounts, however, to only about 20 percent of total deposits. To evaluate the possible impact of banking secrecy the demand for Swiss Franc assets issued by a non-resident is particularly relevant: These assets are not subject to the Swiss withholding tax and should therefore constitute the first investment choice for non-residents seeking to avoid taxes. Table 3 shows that this demand constitutes a minor part of non-residents holdings: they are only about 8 percent of non-residents holdings and only about 4 percent of total deposits at Swiss banks. Together, these numbers suggest that foreign demand

and the banking secrecy is unlikely to be a cause of low yields, since non-residents hold the bulk of their deposits in foreign currencies and have no particular preference for tax-exempt instruments.

Table 3: Deposits at Swiss Banks
Average 1998/12–2003/3

	in billions of SFr.	in percent of total deposits
Total deposits in Switzerland	3230	100%
Deposits of residents	1462	45%
Deposits of non-residents	1768	55%
of which held in Swiss Francs	622	19%
of which by a foreign issuer	144	4%

Next we examine how non-residents allocate the Swiss Franc portion of their portfolio. Table 4 shows that non-residents hold most of their portfolio in equity. Over 70 percent of Swiss Franc assets are equity and mutual funds add another 10 percent. By contrast, bonds and money market instruments are of minor importance. This finding is particularly interesting, if we recall from above that the return discount was found only in fixed income instruments not in equity. In other words, foreigners appear to be aware of the return differences and allocate their portfolio accordingly. Below we show that their actual holdings can be explained well by a portfolio optimisation model. However, this behaviour seems to contradict the claim that large foreign demand is causing low yields.

Table 4: Swiss Franc portfolio of non-residents
Average 1998/12–2003/3

	in billions of SFr.	in percent of Swiss Franc portfolio of non-residents	in percent of total deposits of non-residents
Equity	446	72%	25%
Mutual Funds	66	11%	4%
Money Market	3	0%	0%
Bonds	108	17%	6%
Total	623	100%	35%

Table 5 shows the composition of non-resident investors who hold Swiss Francs. The upshot of this table is that the vast majority of non-residents' deposits in Swiss Francs come from institutional investors. Private clients, who are more likely to seek the protection of banking secrecy make only a third of all Swiss Franc deposits of foreigners. The table also illustrates that private clients hold only a minor part of their deposits in Swiss Francs. Together these figures again suggest that banking secrecy does not seem to induce a large demand for Swiss Franc assets.

Table 5: Composition of non-resident investors in Swiss Francs
Average 1998/12–2003/3

	in billions of SFr.	in percent of Swiss Franc deposits of non-residents	in percent of total deposits of non-residents
Commercial Clients	29	5%	2%
Institutional Investors	420	68%	24%
Private Clients	170	27%	10%
Total Swiss Franc deposits of non-residents	622	100%	35%

On the contrary, we find that foreigners have no particular preference for Swiss Franc assets and they hold most of their Swiss Franc assets in equity and not fixed income instruments. Moreover, institutional investors hold most of Swiss Franc assets and the Swiss Franc bonds of foreign issuer (which are withholding tax exempt) are held only in marginal quantities. This does not imply that banking secrecy is irrelevant for the income of banking sector and its market share in global wealth management. However, it seems to indicate that it is irrelevant in explaining low returns on Swiss assets.

We now present systematic evidence on the impact of foreign demand on asset returns and exchange rates by applying factor analysis.

4. Impact of Foreign Demand on Swiss Franc Returns and Exchange Rates – Results from a Factor Analysis

In this section we examine whether the changes in portfolios holdings of non-residents at Swiss banks may be able to explain the patterns of returns on Swiss Franc assets. We do this by comparing the influence of shifts in the portfolios of non residents with those of residents.

As before we consider assets in three currencies, namely the Swiss Franc, Euro and US-Dollar, which account for over 90 percent of all deposits. The data set consists of monthly data from 1998/12 to 2003/3 and covers 11 financial market prices: rate of change in the exchange rate of the Franc against the Euro and the Dollar, rate of returns in the three money, bond and stock markets, as well as the value of 88 different deposits. The latter are disaggregated with respect to instruments, issuer, depositor and currency. As a rule seven instruments are considered: money market papers, commercial bonds, government bonds, stocks, mutual funds, money market funds as well other securities⁷. Moreover, we have data for resident and non-resident depositors and issuers, the latter distinction being important for tax reasons.

In order to determine the influence of foreign demand we consider two data sets⁸. The first one comprises holdings of both residents and non-residents (all available 99 series) and the second one contains only the holdings of residents (and has only 55 series). The basic idea is to compare the systematic or common component of Swiss Franc asset returns obtained with and without the demand of non-residents.

Given our aim and the wealth of our data we apply factor analysis. This approach decomposes the vector of the observable series (x_t with dimension N times 1) into a systematic component caused by a small number of K common factors (χ_t) and an idiosyncratic component which is specific to each single series (ξ_t):

$$x_t = \chi_t + \xi_t = Af_t + \xi_t, \quad t = 1, \dots, T$$

Classical factor analysis proceeds by Maximum Likelihood estimation and testing based on the assumption of independent and normal distribution of factors and

- 7 For Swiss Franc assets issued by Swiss debtors we have the additional split into federal bonds and special bonds issued by Swiss banks (Kassenobligationen).
- 8 First differences of the log stocks of securities were taken in order to get stationary data series.

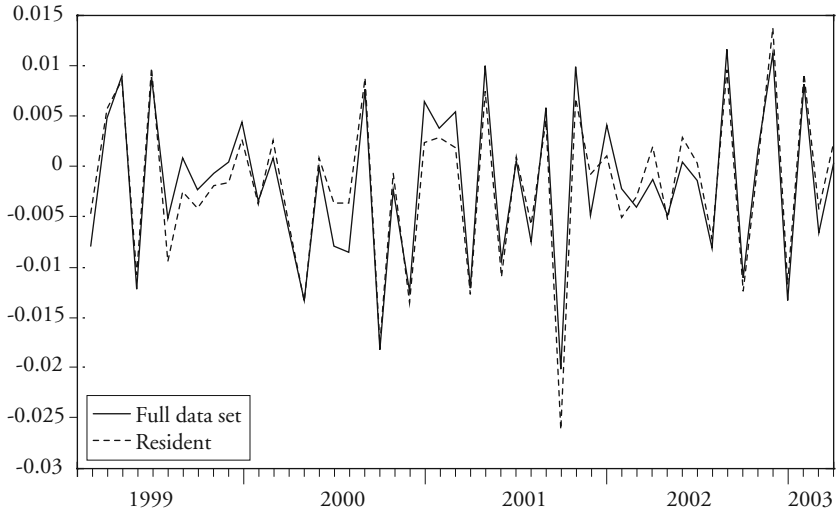
idiosyncratic components. Of course these assumptions are doubtful in our application given the time series data used in our application. Moreover, there is a more basic problem, namely that we are in the case of a so called large cross section with $N > T$. This means that the sample covariance matrix of x is not of full rank and Maximum Likelihood analysis is not applicable. However, the case of a large cross section is not only a complication of classical factor analysis but offers attractive simple solutions for the extraction of the common component. CHAMBERLAIN and ROTHSCHILD (1983) show that the problem reduces to a standard principal component analysis of the data and that the above result holds even when the specific components are weakly contemporaneously correlated (the so called generalized factor model). This result was extended by FORNI, HALLIN, LIPPI and REICHLIN (2000) to autocorrelated data sets. These authors show that the common component in the so called generalized dynamic factor model can be approximated by projecting the x vector on the first q dynamical principal components of x which are obtained by a frequency-wise decomposition of the spectral matrix of x . There is even a simpler way to extract the common component in this framework: more recently STOCK and WATSON (2002) show that the common component in the generalized dynamic factor model can be approximated by projecting the x vector on the largest first r static principal components of x .

Figures 5 to 9 contain the estimate of the common component of the changes in the log Franc/Euro and Franc/Dollar exchange rate as well as that of the money market, bond and stock market return for Swiss Francs using the FORNI, HALLIN, LIPPI and REICHLIN (2000) approach. Details on these estimations and more results obtained in the factor analytic framework are given in KUGLER and WEDER (2004)⁹.

These figures show that the inclusion of non-residents securities deposited with Swiss banks hardly has an effect on the systematic component of returns. Indeed, the correlation of the two estimates of the common components are in the range from 0.953 (for the SFr/Euro exchange rate) to 0.985 (for the stock market return). Therefore, our factor analysis supports the view that the changes in the securities deposited by non-residents have no influence on the exchange rate of the Swiss franc or on the rate of return on Swiss franc denominated assets and confirms our expectations given the simple descriptive statistics outlined in section 2.

9 Briefly, $q = 3$ dynamic factors seem to be appropriate for both data sets using a Bartlett (time domain) window with 7 lags for spectral estimation. Moreover, we should mention that the application of the Stock and Watson $r = 6$ static principal components, which is not presented here, resulted in essentially the same pattern of results. The dynamic common components were calculated using the MATLAB procedure KESTIMATE provided on www.dynfactors.org.

**Figure 5: Common Component of Change in log FR/Euro Exchange Rate
1999/2–2003/3**



**Figure 6: Common Component of Change in log Fr/Dollar Exchange Rate
1999/2–2003/3**

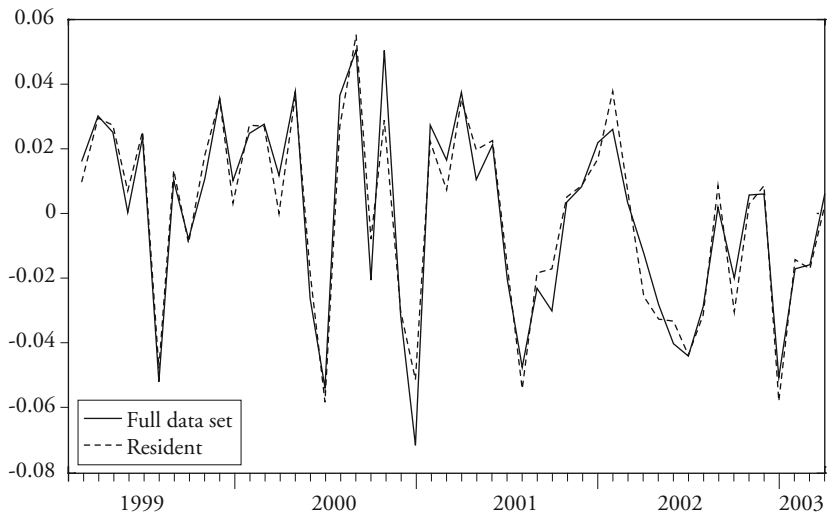


Figure 7: Common Component of Swiss Franc Money Market Return
monthly (non annualized) returns 1999/2–2003/3

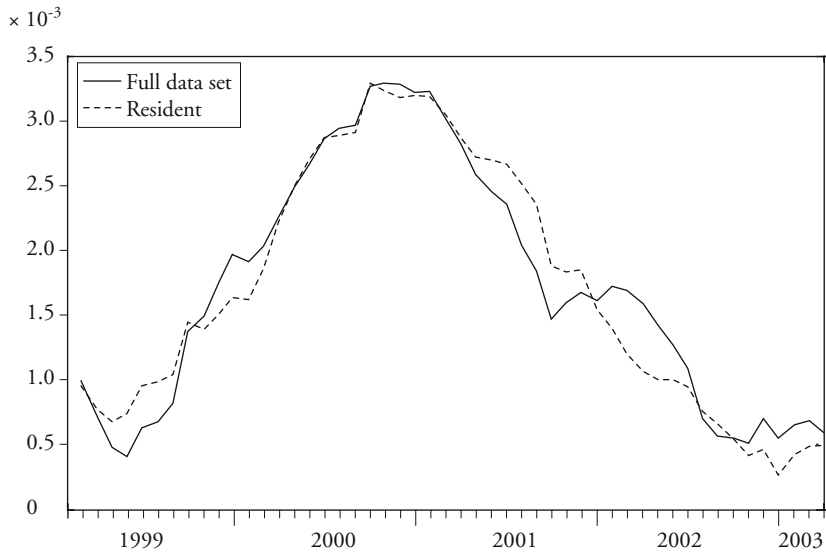
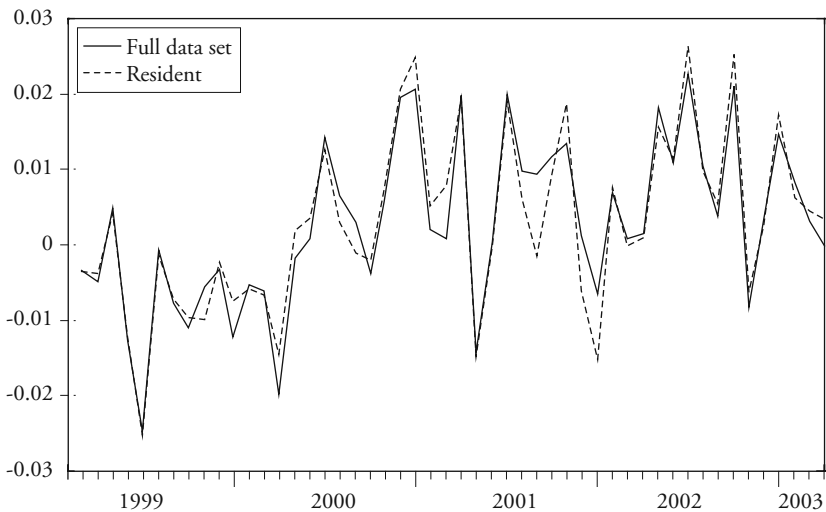
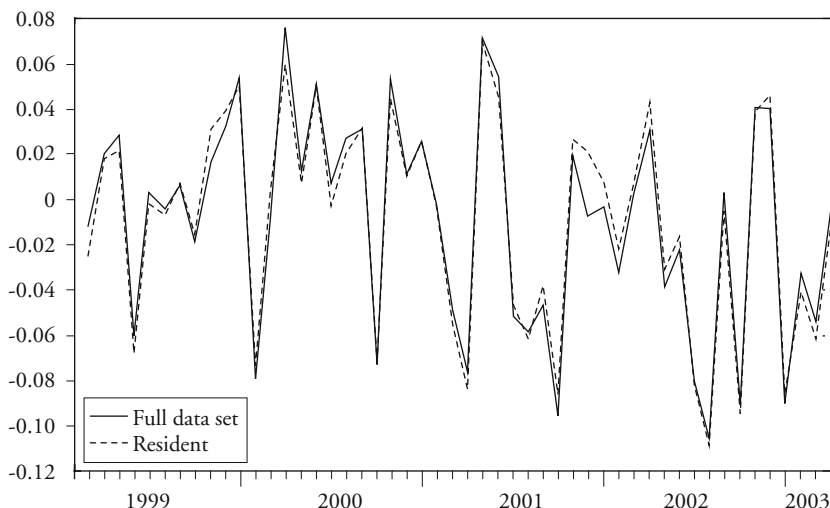


Figure 8: Common Component of Swiss Franc Bond Market Return
monthly (non annualized) returns 1999/2–2003/3



**Figure 9: Common Component of Swiss Franc Stock Market Return
monthly (non annualized) returns 1999/2–2003/3**



5. Return Differentials from a Portfolio Perspective – Results of Reversed Portfolio Optimization

From the viewpoint of portfolio theory return differences are to be explained by the variances and covariances of assets. In this section we will follow this line of argument to see whether the low returns of Swiss Franc fixed income instruments can be accounted for by a diversification advantage of Swiss Franc fixed income assets in a portfolio of Franc, Euro and Dollar money market assets, bonds and stocks. Investors might accept a low rate of return on a specific asset because it offers diversification benefits in the context of the full portfolio, i. e. a low or even negative correlation of an asset with other assets in the portfolio may compensate for a low rate of return of the former.

In this exercise we consider the issue from the view point of a Swiss resident who is interested in returns expressed in Swiss Francs. This approach is taken for reasons of data limitations: for Swiss residents we have all the information on their securities holding for the period 1978/12 to 2003/3. However, for non-residents we have only aggregated data and we do not know how these securities holding are split up into Euro and Dollar based non-residents. Nevertheless,

the data available for residents should provide interesting information on the issue at hand. In a first step we examine the correlation matrix of the eight risky assets (Swiss money market paper is the risk free investment) under consideration reported in table 6.

Table 6: Correlation of Returns on Risky Assets from the Viewpoint of a Swiss Resident (monthly data 1980–2003)

	Euro (DM) Money Market	Dollar Money Market	Franc bonds	Euro (DM) bonds	Dollar bonds	Franc equity	Euro (DM) equity	Dollar equity
Euro (DM) Money M	1.0000	0.3537	-0.0586	0.6243	0.3050	0.1543	0.4193	0.3198
Dollar Money M	0.3537	1.0000	-0.0766	0.0864	0.7937	0.2932	0.3297	0.6855
Franc bonds	-0.0586	-0.0766	1.0000	0.3334	0.1152	0.1191	-0.0627	-0.0594
Euro (DM) bonds	0.6243	0.0864	0.3334	1.0000	0.3537	0.1607	0.3441	0.1694
Dollar bonds	0.3050	0.7937	0.1152	0.3537	1.0000	0.3126	0.2873	0.6496
Franc equity	0.1543	0.2932	0.1191	0.1607	0.3126	1.0000	0.6984	0.6592
Euro (DM) Equity	0.4193	0.3297	-0.0627	0.3441	0.2873	0.6984	1.0000	0.6128
Dollar stocks	0.3198	0.6855	-0.0594	0.1694	0.6496	0.6592	0.6128	1.0000

Table 6 generally indicates a positive correlation between returns expressed in Swiss Francs. It is in particular strong among stock returns but it is although quite sizable for many other pairs of returns¹⁰. An exception are the returns on Swiss franc bonds which have a very low or even negative correlation with the returns of other risky asset. Therefore, Swiss Franc bonds appear interesting from a diversification point of view and this could be a reason for the relative low return on this asset. In order to shed more light on the implications of the

10 For rate of returns of assets denominated in the same currency exchange rate changes are an important source for the positive correlation of the returns on these assets expressed in Swiss Francs.

covariance structure of returns we use the so called reversed portfolio optimization approach introduced by BLACK and LITTERMAN (1992).

In this framework we calculate implied excess returns which are consistent with portfolio optimization given an observed portfolio allocation of the assets using a model closely related to the CAPM. Basically we assume that investors maximize the utility of wealth using a constant relative risk aversion utility function with coefficient γ . Under the assumption of normally distributed returns this leads to the following first order condition linking the portfolio shares collected in the column vector w to the expected return vector π of same dimension

$$\pi - \gamma\Omega w = 0 ,$$

where Ω is the covariance matrix of the returns of the risky assets. This system is usually solved for portfolio shares w given expected returns π . In the framework of the reversed approach we take the shares w as given (from the actual shares in the portfolio allocation of residents) and calculate the implied expected excess returns.

The implied excess returns for the 8 risky assets are now calculated for the period 1998/12 to 2003/3 given the monthly assets shares of residents reported in the SNB securities statistic introduced in section 2. The covariance matrix Ω is estimated using the full sample from 1980/12 to 2003/3. and γ is set to 3 indicating a “reasonable” degree of risk aversion. However, the results do not change essentially when we use only a reduced sample as 1980–1998 or 1995–2003. Moreover, there is no indication of major ARCH effects in the monthly returns. Therefore, our assumption of a time invariant covariance matrix seems to be adequate for our data set. The calculated time series of excess returns are displayed in Figure 10 to 12.

These figures show a pattern of results which is consistent with findings reported in section 2: first we note that the implied excess return of the Euro and Dollar money market from the Swiss perspective is around 40 bp and between 150 and 200 bp which is surprisingly close to the mean ex post returns. Second, the return difference of implied returns for bonds is around 40 bp for the Euro and between 160 and 200 bp for the Dollar. This pattern of results is qualitatively in line with the ex post returns although the absolute values are smaller. Finally, the excess returns for stock returns are very similar (they are usually in a band of 50bp) and conform to the pattern we reported for mean ex post returns.

Therefore, we can conclude that the low returns on Swiss fixed income instruments seem to be in line with portfolio optimization of a Swiss resident and are not puzzling from this perspective. It would be interesting if we could do

the same exercise from the perspective of a Euro or Dollar based non-resident. Unfortunately the aggregation of the SNB securities data with respect to non-residents does not permit this exercise. However, it should be mentioned that a diversification advantage could even exist from the viewpoint of non-residents if the correlation of the Swiss Franc exchange rate with domestic and foreign interest rates is different. Indeed, this seems to be the case as the replication of the reversed portfolio exercise for a synthetic foreigner consisting to 45% to an Euro and Dollar resident and to 10% to a Pound resident produces the same discount on Swiss Franc fixed income returns even if the differences are smaller than those reported above.

Figure 10: Implied Excess Returns
Euro (ERIGE) and Dollar Money Market (ERIGD) Returns 1998/12 – 2003/3

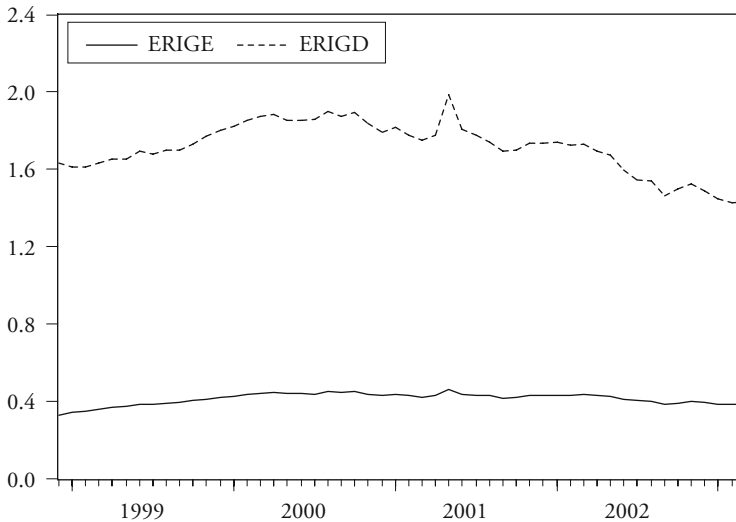


Figure 11: Implied Excess Returns of Franc (ERIBF), Euro (ERIBE) and Dollar (ERIBD) Bond Market Returns 1998/12 – 2003/3

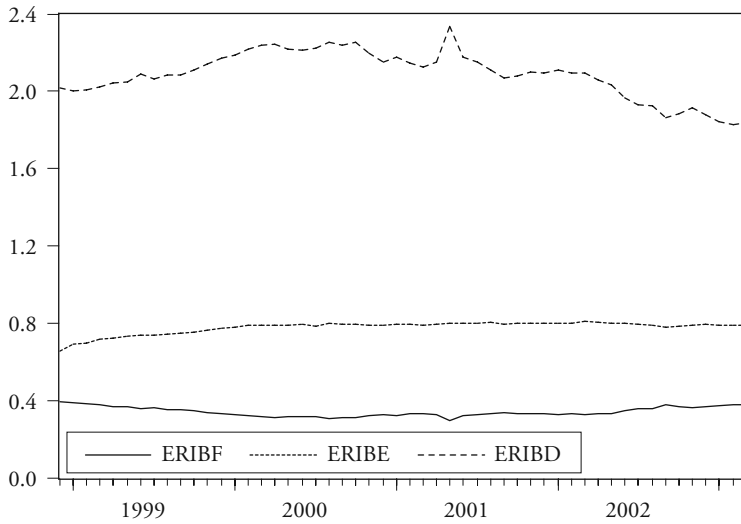
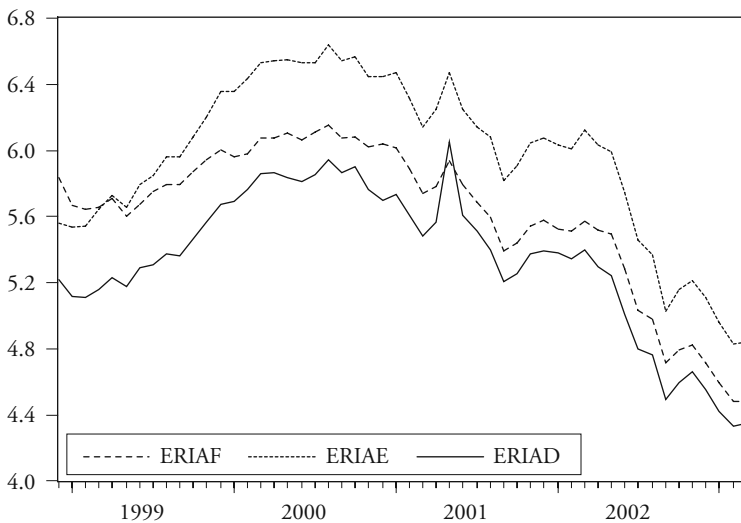


Figure 12: Implied Excess Returns of Franc (ERIBF), Euro (ERIBE) and Dollar (ERIBD) Stock Market Returns 1998/12 – 2003/3



6. Conclusions

This paper does three things: (i) it shows that the puzzle of the Swiss Interest Island is limited to fixed income assets and is due to a deviation from uncovered interest rate parity, (ii) it shows that the impact of foreign demand on Swiss asset returns is very small, and (iii) it proposes a new solution to the puzzle based on diversification benefits in a portfolio perspective.

The finding in this paper also sheds some new light on existing explanations for low returns. Real and structural explanations for the puzzle have the problem that they would have to work through a deviation from purchasing power parity. If the reason for low real returns was to be found in the differential growth rates of productivity in non tradables and tradables this should manifest itself as a real appreciation of the Swiss Franc. However, we show that with the exception of the Swiss Franc/ Euro pair, the main source of the real interest rate differential is a deviation of uncovered interest rate parity, which has persisted over more than 20 years. Of course such a long run deviation from UIP constitutes a puzzle in its own right, especially when considering that over this period capital accounts were open and financial markets increasingly sophisticated. The explanation of a peso problem is attractive because it suggests that the puzzle is not a puzzle in the very long run: investors may be prepared to accept lower returns in good times, expecting a higher return in really bad times, through a appreciation of the Swiss Franc. When bad times hit and the appreciation occurs the puzzle disappears. The problem of this explanation is that it would have to hold for all Swiss assets since it is based on the behaviour of the exchange rate. Thus we would have to observe lower returns for equity as well as for fixed income.

On the role of foreign demand for Swiss assets we find that this demand is quantitatively small since non residents hold their deposits mostly in other currencies and their Swiss Franc deposits are mostly equity. Moreover, we find little evidence for a role of banking secrecy since non residents have a very limited preference for fixed income instruments issued outside Switzerland. More importantly, based on a dynamic factor analysis we show that portfolio shift of non residents have a negligible impact on Swiss asset returns.

In the end we propose a new explanation for low returns on Swiss fixed income assets, namely the diversification benefits offered by these instruments. A reversed portfolio optimization was applied to back out the implied returns in existing portfolio allocations. It turns out that the diversification benefits of Swiss fixed income assets (their low correlation with other assets in other currencies) is sufficient to explain lower returns. Of course, our proposed solution to the puzzle

now raises a new question, namely what is the cause of the diversification benefit? This question will be left for future research.

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SUMMARY

This paper revisits the puzzle of low returns on Swiss Franc assets using a new data set of portfolio holdings of residents and non residents at Swiss banks. The main findings are as follows. First, we find that the return anomaly is present only for fixed income assets and not for equity. Second, it is mostly due to a long run deviation from uncovered interest rate parity, not a deviation from purchasing power parity. Third, it is unlikely that foreign demand for Swiss assets (possibly due to banking secrecy) is driving down returns: This demand is quantitatively small especially for Swiss Franc fixed income instruments. A dynamic factor analysis confirms that foreign demand had almost no impact on Swiss Franc asset prices. Finally, we propose a new explanation for low returns on Swiss fixed income assets, namely the diversification benefits offered by these instruments. Applying reversed portfolio optimization to back out the implied returns reveals that the estimated pattern of this returns conforms very well with the observed pattern.

ZUSAMMENFASSUNG

In dieser Arbeit wird die Erklärung der im internationalen Vergleich niedrigen Realzinsen auf Schweizerfrankenanlagen anhand von Daten über die Wertpapierdepots von In- und Ausländern bei Schweizerischen Banken empirisch analysiert. Dabei wurden die folgenden Ergebnisse erhalten: Erstens zeigte diese Anomalie nur bei Geldmarktanlagen und Obligationen und nicht bei Aktien. Zweitens ist das Phänomen auf eine langfristige Abweichung von der ungedeckten Zinsparität und nicht von der relativen Kaufkraftparität zurückzuführen.

Drittens ist es unwahrscheinlich, dass die ausländische Nachfrage nach Schweizerfranken Obligationen und Geldmarktanlagen (möglicherweise durch das Bankkundengeheimnis ausgelöst) die Erträge niedrig halten: Diese Nachfrage ist relativ gering und mit einer dynamischen Faktoranalyse konnte kein wesentlicher Einfluss der ausländischen Nachfrage auf die Erträge von Schweizerfrankenanlagen festgestellt werden. Schliesslich wird anhand einer „reversed“ Portfolio Optimierung der Diversifikationsvorteil von schweizerischen Obligationen und Geldmarktanlagen als neue Erklärung für ihre niedrigen Realzinsen vorgeschlagen.

RÉSUMÉ

Cette analyse donne une explication du fait que les taux d'intérêt réel en Francs suisses sont significativement plus bas qu'ailleurs. En analysant des dépôts d'étrangers et de citoyens suisses les auteurs obtiennent les résultats suivants. Premièrement, cette anomalie ne se trouve que sur les marchés obligataires et monétaires et ne s'étend pas sur les marchés d'action. Deuxièmement, cette anomalie est due à une déviation à long terme de la parité des taux d'intérêt et non de la parité des pouvoirs d'achat. Troisièmement, il est invraisemblable que la demande étrangère pour des investissements en Francs suisses (soit en obligation soit sur le marché monétaire), peut-être dû au secret bancaire, est responsable des bas taux d'intérêt réel car cette demande est relativement faible. En outre, une analyse factorielle dynamique a montré que la demande étrangère a une influence négligeable sur les rendements en Francs suisses. Finalement, les auteurs proposent une nouvelle explication basée sur l'avantage que présente le Franc suisse pour la diversification des portefeuilles.

