Preferred Risk Habitat of Individual Investors*

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Preliminary.
Comments are welcome!

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Abstract

The preferred risk habitat hypothesis, introduced here, is that individual investors select stocks with volatilities commensurate with their risk aversion; more risk-averse individuals pick lower-volatility stocks. The investors' portfolio perspective overlooks return correlations. The data, 1995-2000 holdings of over 20,000 customers of a German broker, are consistent with the predictions of the hypothesis: the portfolios contain highly similar stocks in terms of volatility, when stocks are sold they are replaced by stocks of similar volatilities, and the more risk averse customers indeed hold less volatile stocks. Cross-sectionally, the more risk averse investors also have a stronger tendency to invest in mutual funds. Major improvements in diversification are concentrated during periods when investors add money to their account.

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I Introduction

Portfolio theory suggests that individual investors buy and hold diversified portfolios. Polkovnichenko (2005), using recent waves of the US Survey of Consumer Finances, however, reports that many US households who participate in the stock market still only hold a handful of names even though mutual funds offer cheap diversification and are widely available in defined contribution retirement plans.

How do individuals select stocks for their portfolios? Probably in as many ways as there are stock holders. A unified description of all individuals' portfolios is unlikely to emerge. Rather, one can look for important features of individuals' portfolios.

The basic premise of this paper is that a substantial number of investors forego a holistic portfolio optimization approach along the lines advocated by Markowitz (1952) and Markowitz (1959), and rather, select stocks sequentially. These are people who, exhibiting narrow framing, evaluate one stock at a time, or perhaps compare the relative merits of one stock versus another. Their total portfolio consideration is limited to awareness of the number of stocks they hold and their weights.

The prototypical individual hypothesized here does not view his portfolio risk as the relevant unit to be evaluated, nor does he seriously consider all the stocks in the market for his portfolio. Despite his limited ability to follow and choose among many stocks, he behaves as if he is somewhat aware of the benefits of diversification and his portfolio consists of a few stocks. However, improvements in diversification are not so much the result of a conscious decision to hold a better diversified portfolio, but the by-product of new cash that needs to be invested.

Evaluating each stock on its own merits, an individual tends to follow, evaluate, and select stocks with the risk characteristics that suit his attitude to risk. This is the hypothesis of stock selection guided by preferred risk-habitat – in short, the preferred risk habitat hypothesis.

This paper examines the preferred risk habitat hypothesis using trading records between 1995 and 2000 of over twenty thousand customers of a German discount brokerage. Studying the same trading records, Dorn and Huberman (2005) document that these customers' behavior indeed deviates considerably from the standard theory's recommendation to buy and hold a diversified portfolio: even when accounting for the investors' mutual fund holdings, the typical portfolio consists of little more than three stocks.

In the mean-variance framework of portfolio theory, the portfolio's aggregate volatility is the only measure of risk an investor should be concerned with. The preferred risk habitat hypothesis leads to a focus on a different measure: the portfolio's average component volatility, or ACV, which is the value-weighted average of the return volatilities of the portfolio components. For investors who essentially disregard the return correlations between their holdings, this measure is more appropriate than overall portfolio volatility. Kroll et al. (1988), Lipe (1998), and Siebenmorgen and Weber (2003), among others, report that people fail to properly account for return correlations when making investment decisions in experimental settings.[1]

Similarly to much of portfolio theory, the empirical implications of the preferred risk habitat hypothesis rely on variation in investors' attitude toward risk. Classical portfo-

[1] In an asset allocation experiment similar to that in Kroll et al. (1988), Kroll and Levy (1992) report that finance MBA students make investment choices that are more in line with portfolio theory.

lio theory predicts that variation in attitude to risk will affect variation in the relative weights of the safe and risky portions of investors' portfolios. One should expect no variation in the volatilities of the risky portions of the portfolios of investors who follow the prescription of classical portfolio theory. In contrast, the preferred risk habitat hypothesis predicts that the more risk averse investors will have portfolios with lower ACV.

Usually variation in investors' attitude to risk is not directly observable, and a frequent handicap of studies of portfolio theory is the absence of even a proxy of investors' attitude to risk. One advantage of the sample studied here is that it does offer a survey-based proxy of attitude to risk for a sub-sample of clients who participate in survey administered after the end of the sample period. Survey respondents indicate their risk aversion on a four-point scale from "not at all willing to bear high risk in exchange for high expected returns" to "very willing to bear high risk in exchange for high expected returns" (like participants in the U.S. Survey of Consumer Finances). Consistent with the preferred risk habitat hypothesis, self-reported risk aversion is negatively correlated with ACV.

If each investor focuses on stocks with similar volatilities, then the volatilities of the stocks in his portfolio should be more concentrated than the volatilities of a similarly-weighted portfolio consisting of random stocks (that match key characteristics of the actual holdings such as country of issue, industry, and size). The data are consistent with this prediction.

Consider a replacement of a stock in a portfolio by one or more other stocks. The preferred risk habitat hypothesis suggests that the purchased stocks are likely to have similar volatilities to the sold stock. The data are consistent with this prediction.

Variation in individuals' attitude to risk combined with narrow framing are at the heart of the argument made here. How stable is the variation in risk attitude? Its stability implies that investors whose portfolios have relatively low ACV at the beginning of the sample period are more likely to be among those whose portfolios have relatively low ACV at the end of the sample period, and vice versa. The data are consistent with this prediction as well.

Another determinant of a portfolio's riskiness is the number of its risky assets and the distribution of their weights. The Herfindahl-Hirschmann Index (HHI) captures this in a single statistic which serves to gauge the portfolio's degree of diversification. The HHI is between 0 (perfect diversification) and 1 (a single stock in the portfolio). The neoclassical model suggests that HHI should be very near 0 and predicts no systematic variation in it.

The records studied here consist of the investors' holdings of stocks and of mutual funds. The more risk averse investors show a stronger tendency to invest in funds. Not surprisingly, therefore, their portfolios have lower HHIs. The relation between risk aversion and portfolio HHI disappears when funds are excluded.

Simple algebra suggests that variations in portfolio volatility are explained by variations in portfolio ACV and HHI. Since variation in risk aversion explains both variation in portfolio ACV and portfolio HHI, it follows that higher risk aversion results in lower portfolio volatility by causing ACV and HHI to be lower.

Do more risk averse investors also have less risky portfolios because they choose stocks with less correlated returns? This effect, so central to portfolio theory, seems absent: investor risk aversion fails to explain variation in portfolio risk once variation in ACV and HHI are accounted for. Moreover, variation (across portfolios) of average return correlation is unrelated to variation in risk aversion (across portfolio holders). Thus, the portfolios seem to have been constructed by individuals oblivious to return correlations and their impact on portfolio volatility.

Diversification as understood by financial economists seems to have only a second order place in the consideration of the investors studied here. Consequently, their portfolios are under-diversified. If indeed diversification is a not a major concern but rather a by product of selection of good stocks (those with seemingly high Sharpe ratios, for example) and rejection of bad stocks, then major instances of diversification will be when new money is added to the holdings – as opposed to the rebalancing of existing positions. The data are consistent with this conjecture.

The next section introduces the data and some of the statistics used in this study. Section III documents that the behavior of the sample investors is consistent with the preferred risk habitat hypothesis, Section IV studies diversification, Section V studies the relation between average component volatility and returns, Section VI offers a discussion, and Section VII concludes the paper.

II The Data

The analysis in this paper draws on a complete history of transaction records for a random sample of 21,500 clients at one of Germany's three largest discount brokers during the period January 1995 to May 2000. All sample investors were invited to participate in a survey administered at the end of the sample period. Survey responses are available for a subset of 1,300 respondents.

The opening position as well as complete transaction records from the account opening date until May 31, 2000 or the account closing date – whichever comes first – allow us to unambiguously reconstruct client portfolios at a daily frequency. The typical record consists of an identification number, account number, transaction date, buy/sell indicator, type of asset traded, security identification code, number of shares traded, gross transaction value, and transaction fees.

In principle, brokerage clients can trade all the bonds, stocks, and options listed on German exchanges, as well as all the mutual funds registered in Germany. Here, the focus is on the investors' individual stock and stock fund holdings and trades for which Datastream provides comprehensive daily asset price coverage: stocks on Datastream's German research stocks list (this includes foreign stocks listed on German exchanges), dead or delisted stocks on Datastream's dead stocks list for Germany (this also includes foreign stocks), and mutual funds registered either in Germany or in Luxembourg. As of May 2000, the lists contain daily prices for 8,213 domestic and foreign stocks and 4,845 mutual funds. These stocks and stock funds represent roughly 90% of the clients' holdings and 80% of the trading volume, with the remainder split between term deposits, bonds, bond and money-market funds, options, as well as stocks and mutual funds for which Datastream does not provide prices or returns. The broker provides a classification of mutual funds that allows us to distinguish stock funds from other funds, for example, bond or balanced funds. As of January 1, 2000, the average value of a portfolio considering only holdings of individual stocks is 100,000 Deutsche Mark [DEM] or 50,000 US Dollars [USD] (see Panel A of Table I). The average value of a portfolio considering holdings of both stocks and stock funds is DEM 120,000 (see Panel B of Table I).

The questionnaire elicited information on the investors' investment objectives, risk attitudes and perceptions, investment experience and knowledge, portfolio structure, and demographic and socio-economic status. The time to fill out the questionnaire was estimated to be 20-25 minutes; respondents could elect to be entered into a raffle for a cash prize of roughly USD 3,500 or a trip to New York valued at the cash prize. Dorn and Huberman (2005) describe the survey in detail.

The broker is labeled as a "discount" broker because no investment advice is given. Because of their low fees and breadth of their product offering, German discount brokers attract a large cross-section of clients ranging from day-traders to retirement savers. For example, the selection of mutual funds offered by discount brokers during the sample period was much greater than that offered by full-service brokers (typically divisions of the large German universal banks that were constrained to sell the products of the banks' asset management divisions).

It is likely that the sample is representative of the broader population of discount brokerage clients; at the end of the sample period, the top three German discount brokers commanded more than 80% of the German discount market in terms of accounts and had homogeneous product offerings. Moreover, discount brokerage accounts are an important subset of retail accounts. In June 2000, at the end of the sample period, there were 1.2 million retail accounts at the top three discount brokers (see Van Steenis and Ossig (2000)) – a sizable number, given that the total number of German investors with exposure to individual stocks at the end of 2000 was estimated to be 6.2 million (see Deutsches Aktieninstitut (2003)). Note that all German retail and discount brokerage accounts are taxable accounts as opposed to the US, where tax-deferred accounts, often with a restricted investment menu such as 401(k) accounts, play an important role.

Portfolio Risk

Portfolio risk is quite an elusive term from the perspective of the individual investor who may lack the statistical and computational tools to estimate a variance-covariance matrix of returns or the historical variance of returns of his portfolio. Therefore a few measures of portfolio risk are entertained.

In the mean-variance framework of portfolio theory, the portfolio's aggregate volatility is the measure of risk an investor should be concerned with. The annualized volatility of a given portfolio during a given time period consisting of T trading days is calculated as

$$VOL \equiv \sqrt{\frac{252}{T-1}\sum_{t=1}^{T}(r_t - \bar{r})^2} \tag{1}$$

where r_t is the portfolio's value-weighted return measured from the close of trading day $t-1$ to the close of trading day t, adjusted for stock splits and dividends, and $\bar{r}$ is the simple average across the portfolio returns during the time period. Table I reports summary statistics of portfolio volatility and the additional portfolio risk attributes described below for the period January 1, 2000 to May 31, 2000, assuming that portfolio weights remain constant at their levels of January 1, 2000 throughout the sample period. Panel A of the Table reports the statistics based on holdings of individual stocks only and Panel B reports them based on holdings of individual stocks and stock funds. The assumption of constant portfolio weights is made to make the different portfolio risk measures comparable. The focus on the end of the sample period is due to the number of sample investors increasing over time and to the survey responses being elicited after the end of the sample period. The average volatility of a portfolio considering only individual stocks is 52% (see Panel A of Table I). The average volatility of a portfolio considering both stocks and stock funds is 43% (see Panel B of Table I). By comparison, the Dax 100, a German stock market index consisting of the one hundred largest and most liquid stocks, had an annualized volatility of 28% during the first five months of 2000; the Nemax 50 Index, consisting of the fifty largest and most liquid stocks listed on the Neuer Markt (the Frankfurt Stock Exchange's market segment for growth and technology stocks), had an annualized volatility of 56%.

Three summary statistics are central to the determination of portfolio volatility; the number and weights of the components, value-weighted average component volatility, and a weighted average of the pairwise return correlations.

The Herfindahl-Hirschmann Index (HHI) is another proxy for portfolio risk and a natural measure of portfolio diversification. The HHI captures the number and weights of the portfolio components:

$$HHI \equiv \sum_{i=1}^{N} w_i^2 \qquad (2)$$

where N is the number of portfolio positions and w_i is the portfolio weight of position i. The index lies between zero and one; higher values indicate less diversified portfolios. The index value for a portfolio of n equally-weighted stocks is $\frac{1}{n}$. We recognize the benefits of diversification provided by a mutual fund by assuming that each fund holds 100 equally-weighted positions that do not appear in another holding of the investor. For example, an investor whose entire portfolio consists of one mutual fund has an HHI of 0.01; an investor holding two mutual funds has an HHI of 0.005. The calculation of the HHI requires no knowledge of the volatility of the portfolio's return or the return of the components of the portfolio.

The simplicity and accessibility of the HHI are at once its strength and weakness. Strength, because it is salient to the investor. Weakness, because HHI is invariant to the properties of the returns of the stocks to which the weights are assigned. The average HHI of a portfolio considering only individual stocks as of January 1, 2000 is 0.47 – the equivalent of investing equal amounts in two stocks (see Panel A of Table I). The average HHI considering both stocks and stock funds is 0.28 (see Panel B of Table I).

The portfolio-weighted average volatility of the portfolio's components (ACV) is a third, fairly accessible, measure of risk. The ACV for a given time period is calculated as

$$ACV \equiv \sum_{i=1}^{N} w_i \sigma_i \tag{3}$$

where N is the number of portfolio positions and σ_i is the annualized standard deviation of daily returns of security i during the time period. Average component volatility is particularly appealing when investors pick the stocks in their portfolio one at a time, and consider the volatility of each stock separately, regardless of overall portfolio considerations. The average ACV across investors of a portfolio considering only individual stocks for the period January 1, 2000 to May 31, 2000 is 69% (see Panel A of Table I); the average ACV considering both stocks and stock funds is 59% (see Panel B of Table I).

Finally, the volatility of portfolio returns depends on the pairwise correlations of the components' returns. For a portfolio of N stocks with w_i as the weight of stock i, σ_i as the standard deviation of returns of stock i, and $\rho_{i,j}$ the pairwise correlation of i's and j's returns, the standard deviation of portfolio returns is

$$\sigma_p^2 \equiv \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_i \sum_{j \neq i} w_i w_j \sigma_i \sigma_j \rho_{i,j} \tag{4}$$

The weighted average of the pairwise return correlations is then calculated by constraining the correlation coefficients to be equal to a single parameter RHO in Equation 4:

$$RHO \equiv \frac{\sigma_p^2 - \sum_{i=1}^{N} w_i^2 \sigma_i^2}{\sum_i \sum_{j \neq i} w_i w_j \sigma_i \sigma_j} \tag{5}$$

The calculation of RHO requires that the investors hold at least two positions, hence the smaller number of observations relative to the VOL, ACV, and HHI calculations reported in Table I. The average RHO of holdings of individual stocks between January 1, 2000 and May 31, 2000 is 18%; the corresponding statistic for holdings of individual stocks and stock funds is 25%.

The higher average RHO for holdings of stocks and funds is due to portfolios containing multiple stock funds (almost three out of four investors who have at least two positions, one of which in a stock fund, hold more than one stock fund). Returns of any two funds tend to be more highly correlated than returns of any two individual stocks, partly because the holdings of the funds may overlap, and partly because the funds' returns are more driven by common exposure to systematic risk than by exposure to idiosyncratic risk (which usually dominates at the individual stock level).

Portfolios containing multiple stock funds are also responsible for the lower correlations between RHO and the other portfolio risk measures VOL, ACV, and HHI (comparing Panels A and B of Table I). These portfolios tend to have higher RHOs as argued above, but also lower VOL, ACV, and HHI.

Not surprisingly, all three risk component measures are positively correlated with portfolio volatility. However, not all portfolio risk attributes are positively correlated with each other. For example, less concentrated portfolios consist of positions whose returns tend to be more highly correlated with each other. The logarithm of portfolio value as of January 1, 2000, is negatively correlated with all the risk measures except RHO.

The use of Datastream as a provider of stock returns raises a number of methodological concerns (Ince and Porter (2005) elaborate on this point). For example, Datastream sometimes replaces missing values or pads values with the last available value indicating stale price problems or outright data errors. Manually inspecting stock-months with extremely high return volatilities uncovers several data errors – for instance, a 100:1 stock split that wrongly reduces the stock's return index level (Datastream datatype RI) leading to a daily return of -99%. To obtain the results reported in the paper, we thus eliminate the top and bottom 1% of stock-months in terms of volatility – this eliminates all stock-months for which annualized volatility is less than 5% or more than 200%. We have experimented with other data filters. To address the issue of stale prices, for example, we have eliminated stocks if Datastream recorded the same price or return index value for an entire month or longer during the sample period. The results are similar. We have also run the simulations described in Section III.A without the filters. The results are qualitatively similar.

III Different Investors Select Stocks with Different Volatilities

A number of results are presented here: Actual portfolios have concentrated volatilities in comparison with the dispersion of volatilities available from the population of stocks. Investors are persistent in the volatilities of the stocks they select for their portfolios. Using a survey-based measure of risk aversion, it appears that the more risk averse investors select less volatile stocks for their portfolios. The more risk averse also have a stronger tendency to invest in mutual funds. The concentration of the stock portion of the portfolio (captured as HHI) is insensitive to the investor's risk aversion but it is higher for the less risk averse once stock fund holdings are taken into account. The return correlations of the portfolio components appear to be unrelated to risk aversion.

A Dispersion of Volatility

It is fairly straightforward to assess the volatility of individual stocks. It is perhaps even easier to assess diversification as captured by the portfolio's HHI. In contrast, the assessment of a portfolio's overall volatility is more challenging for the individual investor, especially when he is in the process of forming the portfolio rather than during a prolonged period of portfolio ownership. Moreover, narrow framing will lead investors to focus on attributes of individual stocks rather than reflect on the way they aggregate in a portfolio context. In particular, it is likely that an investor's attitude to risk translates into focusing on stocks within a narrow volatility range.

To examine the hypothesis that investors focus on stocks within a narrow volatility range, the dispersion of the volatilities of the stocks in each investor's portfolio is compared with the typical dispersion of the volatilities of similarly-weighted portfolios whose stocks are selected at random.

Given a portfolio consisting of N stocks where w_i is the fraction of the portfolio invested in stock i, σ_i is the standard deviation of returns of stock i, and ACV is the value weighted average component volatility of the portfolio, volatility dispersion is defined as

$$D = \sum_{i=1}^{N} w_i(\sigma_i - ACV)^2 \tag{6}$$

To test the conjecture that investors hold homogenous portfolios in terms of stock volatilities, we compare the observed volatility dispersion to simulated volatility dispersions of artificial portfolios that match key characteristics of the actual portfolios. To judge whether stocks are similar in a given portfolio, only investor-months with positions in at least two individual stocks are considered (more than three out of four investor-months).

The next step is the random assignment of a matching stock to each stock position established by the investor. Several matching procedures are considered. For a given month, all stocks actually held are matched by

1. Country of issue (domestic versus foreign[2]): for example, a German stock actually held in a given month is matched with another German stock randomly drawn from the population of German stocks that month, with all German stocks having an equal chance of being drawn – including the stock actually held.

2. Country of issue and Datastream industry classification: for example, a German banking stock is matched with a stock randomly drawn from the population of German banking stocks.

[2]We do not use a finer classification of foreign firms as many of the more than fifty countries of issue are only represented by a handful of stocks. The US accounts for the majority of foreign stock holdings in terms of both value and number of stocks.

3. Country of issue and market capitalization rank that month (small, medium, and large terciles): for example, a large German stock actually held in a given month is matched with a stock randomly drawn from the population of large German stocks that month.

4. Country of issue, industry, and size: for example, a large German banking stock is matched with a stock randomly drawn from the population of large German banking stocks that month. The median number of stocks in a month-country-industry-size bucket is five, which suggests a close match.

5. Country of issue, industry, and size, but with the probability of drawing a given stock in a particular month-country-industry-size bucket being equal to the number of times that stock appears in the sample accounts at the end of a month, divided by the number of times all stocks in the bucket appear in the end-of-the-month positions.

We match stocks using country of issue, industry, and size because these attributes are systematically related to return volatility. For example, the returns of small stocks tend to be more volatile than the returns of large stocks. Investors may hold homogenous portfolios in terms of component volatilities because they tend to pick stocks in the same industry.

Column (1) of Table II reports summary statistics of the actual dispersion of component volatilities in the client portfolios. The mean and median of the actual dispersion are 3.1% and 1.4% across all investor-months – roughly speaking, the actual component volatilities are likely to lie in a band of 20% in a typical investor-month.[3]

[3]This interpretation is complicated by variance and standard deviation being non-negative and by portfolio weights not being equal.

By comparison, when actual and simulated holdings are matched by country of issue, the mean and median of the simulated volatility dispersion are 5.5% and 5.1% (see Column (2) of Table II) – roughly speaking, the simulated component volatilities are likely to lie in a band of 40% in a typical investor-month. Although simulations that match additional stock characteristics do reduce volatility dispersion (see Columns (3)-(6) of Table II) – partly because a finer matching procedure increases the chance of matching a stock with itself – the median simulated volatility dispersion is substantially greater than the median actual dispersion regardless of the simulation policy. This suggests that the observed lack of volatility dispersion is not merely due to investors picking stocks of a similar size or sector.

To assess the statistical significance of the results, we repeat the simulation one hundred times for each of the roughly 600,000 investor-months and compute an artificial volatility dispersion for each investor-month combination after each simulation run. Next, we compute the standardized dispersion for each investor-month by taking the difference between the actual dispersion and the average of the simulated dispersions for that investor-month, and dividing the difference by the standard deviation of the simulated dispersions for that investor month. The resulting variable is comparable across investor-months and has a mean of zero under the null hypothesis; under the alternative hypothesis of preferred risk habitat the mean is predicted to be negative. To account for the correlation of volatility dispersions over time – a portfolio with a low dispersion in month t is likely to have a low dispersion in month $t+1$, especially if the underlying positions are the same – we average standardized dispersion by investor. Assuming that standardized dispersion is independent across investors but perfectly correlated across time yields t-statistics ranging between -20 and -132. In other words, one would not expect the observed homogeneity of portfolio positions in terms of component volatilities if investors picked stocks at random – even if the randomly assigned stocks match the country of issue, industry, and size of the actual holdings and the aggregate random portfolio matches the actual portfolio held by the sample investors in aggregate.

A possible dismissal of the documented concentration of component volatility is the argument that investors hold stocks outside their account with the broker studied here. A subset of more than 400 questionnaire respondents state that they have no other brokerage account. Table III reports the results for them. The numbers are similar and the statistics are still highly significant.

The results in Tables II and III reflect only stock holdings. Similar results obtain when the simulations are extended to stock funds. In this extension a matching stock fund is assigned to each stock fund position established by the investor, in addition to matching individual stocks as described above.[4] The results are not tabulated.

B Stability of Average Component Volatility over Time

The previous subsection provides evidence consistent with the prediction that investors will hold portfolios of homogenous stocks with respect to volatility. A related prediction of the preferred risk habitat hypothesis concerns trading: when investors sell securities in their portfolios, they will replace them with securities of volatilities similar to those of the securities they sell.

To examine this prediction, we consider the sub-sample of investor-quarters in which an investor both sells and buys stocks. For a given quarter, we compute the ACV of

[4] The broker assigns each fund to one of more than fifty categories. In the simulation, we replace actual funds held by randomly drawing a fund from the same category, for example, large-cap German stocks.

stocks sold and the ACV of stocks bought by the same investor. For each quarter, we assign investors to a sell ACV tercile and to a buy ACV tercile according to the rank of the ACV of the stocks they sell and those they buy among all stocks sold and all stocks bought (respectively) in that quarter. In the absence of a tendency to replace stocks of a certain volatility with stocks of a similar volatility, the two assignments to terciles would be independent.

Panel A of Table IV shows that investors who sell low-volatility stocks are almost twice as likely to buy low-volatility stocks as to buy higher-volatility stocks. Similarly, investors who sell high-volatility stocks are much more likely to buy high-volatility stocks than lower-volatility stocks.

Next, consider the stability of the tendency to focus on stocks of particular volatilities by comparing portfolio choices over longer periods of time. Specifically, restrict attention to the 4,000 investors who opened accounts on or before December 31, 1995, kept their accounts open until March 31, 2000, and held stocks both in the first quarter of 1996 and the first quarter of 2000. Investors' portfolios are classified into terciles according to their ACV during both periods. Panel B of Table IV shows that investors with low-ACV portfolios during the first period also tend to hold low-ACV portfolios during the second period and investors who hold volatile assets during the first period also do so during the second period. To address the concern that these results may be driven by buy-and-hold types – investors who buy stocks before 1996 and hold them until 2000 – focus on the 1,800 investors who satisfy the above criteria and, in addition, hold completely different portfolios in 1996 and 2000 – that is, none of the stocks held in 1996 appears in the portfolio in 2000. The results, reported in Panel C of Table IV, are virtually identical. The transition matrices are similar when both individual stocks and stock funds are considered. The transition matrices are also similar when ACV is calculated using one-quarter-lagged returns instead of contemporaneous returns. These results are therefore not reported.

C Less Risk-Averse Investors Pick More Volatile Stocks

The temporal stability of ACV suggests that the investor's risk posture is the result of a relatively stable personal trait. Risk aversion is a candidate trait. The preferred risk habitat hypothesis predicts that more risk-averse investors will pick docile stocks whereas less risk-averse investors will gravitate towards volatile stocks.

Survey responses allow us to construct a measure of risk aversion for a sub-sample of 1,300 investors who respond to a questionnaire administered by the broker at the end of the sample period (described in detail in Dorn and Huberman (2005)). Like participants in the U.S. Survey of Consumer Finances, survey respondents indicate their risk aversion on a four-point scale: (1) very willing to bear high risk in exchange for high expected returns (lowest risk aversion), (2) willing to bear high risk in exchange for high expected returns, (3) unwilling to bear high risk in exchange for high expected returns, and (4) not at all willing to bear high risk in exchange for high expected returns (highest risk aversion).

By and large, the univariate correlations between sample investor characteristics and risk aversion resemble those documented using recent waves of the U.S. Survey of Consumer Finances: Dorn and Huberman (2005) find that the sample investors who profess to be less risk-averse tend to be more predominantly male, younger, and are more likely self-employed.

Panel A of Table V reports mean VOL, ACV, HHI, RHO, and portfolio value for the period January 2000 to May 2000 based on holdings of individual stocks for the four categories of investors grouped by their self-professed risk attitude. Panel B of Table V reports the corresponding statistics for holdings of individual stocks and stock funds.

One additional variable is reported in Panel B: the average fraction of the portfolio held in stock funds. It suggests that the more risk averse have a stronger tendency to invest in mutual funds. A similar observation emerges from a comparison of the number of observations in the two panels. A portfolio is represented in Table V if it contains at least two securities. (Otherwise RHO cannot be calculated.) Panel B includes portfolios not represented in Panel A: those with a single stock and one or more stock funds as well as those with at least two stock funds. From Panel A to Panel B the number of observations across the different risk aversion categories increases at an increasing rate – from 11% (that is, from 155 to 172) to 14%, 19%, and to 31% (that is, from 117 to 153) – suggesting a positive correlation between the tendency to invest in funds and aversion to risk.

Both portfolio volatility and average portfolio volatility decrease with self-professed risk aversion. Focusing on the stock portions of the portfolios (Panel A), HHI appears to decrease in risk aversion, but the mean HHI of a portfolio in the lowest risk aversion group is not significantly different from the mean HHI of a portfolio in the highest risk aversion group. RHO appears unrelated to risk aversion.

A column-by-column comparison of Panels A and B of Table V indicates that the inclusion of stock funds in the portfolios leads to lower volatilities, lower ACVs, lower HHIs and higher RHOs (the latter because pairwise correlations of fund returns are higher than those of stock returns). Moreover, since the more risk averse are heavier users of mutual funds, in Panel B HHI decreases with risk aversion whereas RHO seems to increase with risk aversion.

Do the results reported in Table V reflect the behavior of investors to whom the account studied here is not important? To address this question one can look at two subsets of investors: those who report that they have no other brokerage account and those whose brokerage account represents a substantial fraction of their total wealth. Based on the self-reported net worth, asset allocation, and the account's size at the end of the sample period, the typical investor is estimated to hold half of his financial wealth in the observed account. Separate tabulations for investors without other brokerage accounts and investors who hold an above-median fraction of their financial assets in the observed account (unreported) yield results which are indistinguishable from those reported in Table V.

Further unreported checks suggest that the results are robust to selecting earlier sample periods to compute the portfolio risk measures and to using weekly returns instead of daily returns. The documented relation between self-reported risk aversion and the portfolio risk measures is thus not an artifact of the turbulent end of the sample period.

For Panel A of Table V, the statistic RHO is inapplicable to an investor who holds a single stock. The holdings of such investors are not reflected in Panel A of Table V. Panel C of Table V summarizes the relation between these investors' attitude to risk and the volatilities of the single stocks they choose to hold. Again, the more risk averse hold less volatile stocks.

A comparison between the ACVs reported in Panel A and the volatilities reported in Panel C suggests that those less diversified in terms of HHI tend to hold more volatile stocks, an observation consistent with the 0.21 correlation between HHI and ACV in Panel A of Table I. Thus, it appears that those who choose more volatile stocks fail to compensate by choosing more stocks, or that those who choose fewer stocks fail to compensate by choosing less volatile stocks.

Tables VI and VII report a series of regressions designed to explore the relation between attitude to risk and attributes of portfolio risk. The data underlying Table VI are stocks only, whereas the data underlying Table VII are stocks and stock funds.

Column (1) of Table VI and Column (1) of Table VII report the sensitivities of ACV to various individual attributes, other than attitude to risk. The second columns of the same tables include also the sensitivities to risk aversion. These sensitivities are of the right sign, statistically significant and increase the regressions' R-squared at least threefold. The interpretation of the magnitude of the coefficients of Column (2) of Table VI is that, other things being equal, an investor who reports being very unwilling to trade off high risk and high expected returns holds a portfolio with an ACV that is 20% below that of a peer who indicates to be very willing to make that trade-off (55% as opposed to 75%). Other things being equal, less risk-averse investors pick more volatile stocks.

Summary

The standard paradigm suggests that the measure of a portfolio's risk is its return volatility. This section documents that the volatilities of the stocks of which the portfolio consists are important and are negatively related to the portfolio owner's risk aversion.

Next, this paper explores risk considerations in the aggregation of these stocks into portfolios – that is, diversification.

IV Diversification

The next subsection explores further the relation between risk aversion and portfolio volatility and the following subsection establishes the role of cash flows into the accounts in effecting changes in their degree of diversification.

A Diversification, Risk Aversion, and Volatility

Does risk aversion affect portfolio volatility outside of its impact on ACV? Possibly, the more risk averse have better diversified portfolios (that is, lower HHIs) and lower pairwise return correlations of their portfolio constituents (that is, lower RHOs). The relations between these two portfolio risk attributes and attitudes to risk are examined:

Do more risk averse investors have better diversified portfolios, controlling for the available demographic and socio-economic attributes? When one focuses exclusively on stock holdings, Columns (3) and (4) of Table VI suggest a negative answer. When one extends the assets considered to include stock funds, the answer is that indeed, the more risk averse tend to be better diversified. (See Columns (3) and (4) of Table VII.) However, a comparison between Columns (2) and (4) of Table VII suggests that the marginal impact of risk aversion on HHI is lower than its marginal impact on ACV: the baseline regressions, reported in Columns (1) and (3), have similar explanatory powers (R-squared), but the explanatory power of the regression reported in Column (2) is much higher than that of the regression reported in Column (4).

The statistic summarizing the pairwise correlations of the returns of the portfolios components, RHO, appears unrelated to the portfolio holders' attitudes to risk. This observation emerges from Columns (5) and (6) of both Table VI and Table VII.

Tables VI and VII indicate that the more risk averse hold less volatile portfolios. The analysis so far suggests that this is primarily because the more risk averse tend to hold less volatile securities rather than because they are better diversified or because they tend to hold securities whose pairwise correlations are lower. In fact, the preferred risk habitat hypothesis predicts that variation in portfolio volatility should not be explained by variation in risk aversion after controlling for ACV and HHI. The last three regressions reported in Tables VI and VII explore this.

First, the regressions reported in Column (7) of each table suggest that variation in the demographic and socio-economic variables used here explains little of the variation in portfolio volatility. Second, the addition of risk aversion as an explanatory variable improves the explanatory power and the coefficients are monotone with the right signs (Column (8)). Finally, the last regressions reported in Column (9) of Tables VI and VII suggest that once ACV and HHI are used as regressors, the marginal explanatory power of risk aversion is insignificant (Table VII) or small and with the wrong sign.

The slope coefficients of risk aversion in the regression reported in Column (9) of Table VI suggest that controlling for all else (especially the main explanatory variables, ACV and HHI), the more risk averse show a stronger tendency to select stocks whose pairwise return correlations are high. Thus, they show stronger specialization in stocks than do the less risk averse. Possibly, the more risk averse have stronger propensity to invest in more familiar stocks. A by-product of such a propensity would be higher pairwise return correlations of the portfolio constituents. Huberman (2001) suggests that investors tend to invest in the familiar but does not relate variation in risk aversion to variation in this tendency.

Table VIII reports the results of ordered probit regressions in which the dependent variable is risk aversion as captured by the responses to the questionnaire. These regressions link variations in portfolio risk attributes to variation in risk aversion. The table has two parts, one in which only the stocks holdings are considered (Columns (1)-(4)) and the other in which both the stock and the fund holdings are considered (Columns (5)-(8)). Columns (1), (2), (5), and (6) indicate that when allowing for variation in both VOL and ACV to explain variation in risk aversion, ACV has the correct sign – those with higher ACV are less risk averse – whereas VOL has the wrong sign.

The correlation between ACV and VOL is 0.9 (see Table I), and the regressions' estimates reflect this collinearity. Nonetheless, standard theory suggests that when both VOL and ACV are the explanatory variables in a regression with risk aversion as the dependent variable, it is the slope coefficient of VOL that should have the negative sign and ACV should have no explanatory power. Thus, these regressions offer a summary of one of the paper's main messages.

A related prediction of the preferred risk habitat hypothesis is that controlling for ACV and HHI, variation in the average correlation of the component asset returns (RHO) should not explain variation in risk aversion. This prediction motivates the analysis underlying the other columns in Table VIII. Consistent with the prediction, risk aversion loads negatively on ACV, but fails to load on either RHO or HHI when both individual stock and stock fund holdings are considered (see Columns (7) and (8) of Table VIII).

The results are similar for holdings of individual stocks, with one exception: controlling for ACV and HHI, risk aversion is positively correlated with RHO (see Columns (3) and (4) of Table VIII). The sensitivity of risk aversion to RHO suggests that controlling for other variables (mainly ACV), the more risk averse tend to have stocks with more highly correlated returns, that is, more similar stocks along some dimension. Possibly, that dimension is familiarity – the more risk averse are more comfortable investing in more familiar stocks.

Taken together, the regression results presented above suggest that the investor's risk perception is dominated by the return volatility of the individual portfolio positions.

The distribution of HHI suggests pervasive under-diversification. More than one out of eight investor-months has a portfolio consisting of a single stock. Among investor-months with multiple stocks (and possibly mutual funds), the median HHI is 15% and in only one out of five such investor-months is the HHI less than 1% (meaning that the portfolio essentially consists of mutual funds).

The partition of investor-months (considering only the portion of the portfolio invested in individual stocks and only portfolios that contain at least two individual stocks) into HHI-ranked deciles affords an examination of the relation between diversification and the concentration of portfolio volatility, summarized in Figure 1. The concentration of portfolio volatility is captured by the ratio of observed and simulated volatility dispersion.

Two simulation policies underlie Figure 1. The first policy matches the country of issue; the second matches the country of issue, industry, and size of the actual holdings.

Actual volatility dispersion is typically well below simulated volatility dispersion regardless of the HHI decile considered. Even in the decile containing the most diversified portfolios – more than 11 positions in individual stocks – actual dispersion is little more than one half of simulated dispersion when the simulation matches country of issue, size, and industry of the actual holdings. The gap between actual and simulated dispersion widens as HHI increases – less diversified investors typically hold portfolios that are even more homogenous in terms of component volatility. (As emphasized by Huberman and Jiang (2006), correlations derived from aggregated quantities may be misleading. Here, however, the individual-level correlation between the log ratio of actual and simulated dispersion and HHI is -0.2, consistent with the impression given by the Figure.)

B Cash Flows and Diversification

Underlying the discussion so far is the view that the investors' attitudes to risk manifest themselves in the volatilities of the stocks they choose and in their tendency to invest in mutual funds. Improvements in diversification are not so much the result of a conscious decision to hold a better diversified portfolio, but the by-product of new cash that needs to be invested.

HHI can change in one of three ways. First, cross sectional variation in the returns of the portfolio components changes the components' weights and thereby the portfolio's HHI. Second, purchasing securities with cash brought from outside the account or selling securities and taking the proceeds outside the account will result in a change to the portfolio's weights and thereby to the HHI. Third, selling a position (or part thereof) and using the proceeds to purchase a new position (or increase an existing one) will also change the HHI. These different ways are often at work simultaneously. In particular, since it is unlikely that the investor will exactly match up sales and purchase amounts in rebalancing transactions, rebalancing will typically be accompanied by (relatively small) changes in cash.

An investor who follows the tenets of portfolio theory will buy and hold a diversified portfolio from the outset. Such passivity will allow the portfolio's HHI to fluctuate because the component returns are likely to be different, but these HHI fluctuations will seldom cause the investor to rebalance his holdings.

An investor may have a target level of HHI, reflecting his desired level of diversification. Such a target level may emerge from a trade-off between the cost of following, selecting and monitoring a large number of stocks (processes necessary to actively manage a portfolio) and the risk-reducing benefits of diversification. Such an investor will rebalance his portfolio following an increase in his HHI.

Over time investors may improve their diversification because the array of available attractive mutual funds may increase or because they learn about diversification's benefits. Such improvements in diversification are likely to come from rebalancing rather than from cash transfers.

To assess the importance of cash flows in a non-parametric fashion, we classify each investor-month into one of five categories based on the net cash flow during the month: addition of a substantial cash amount, addition of a small amount, zero cash flow, withdrawal of a small amount, and withdrawal of a substantial amount. We define "substantial amount" as greater than or equal to the smallest holding of the investor at the beginning of the month. Investor-months with only rebalancing – investors selling part of their existing holdings and reinvesting the proceeds – will likely fall in the "small cash flow" categories.[5]

Panel A of Table IX summarizes the HHI changes – the natural logarithm of HHI in month t divided by HHI in month $t-1$ – for the full sample of investor-months. Portfolios become better diversified during months with substantial cash inflows; in a typical investor-month, HHI decreases by 10%, that is, the number of stocks in the portfolio increases by 10%. Portfolios also become better diversified during months with small cash inflows but much less so; in a typical investor-month, HHI decreases by 1%. In contrast, there is no improvement in diversification during months with zero cash flows or cash outflows, on average.

Major changes in diversification are identified as HHI changes exceeding 25% in absolute terms, corresponding to Columns 5 (HHI improvement) and 7 (HHI deterioration).[6] Most of the major improvements in diversification appear in the first row, corresponding to relatively big cash inflows, and then in the second row, corresponding to moderate and small cash inflows. The investor months with large cash inflows constitute more than 2/3 of all investor months with inflows, and on average the HHI reduces by 10% for these investor months.

The number of large HHI changes for investor-months with zero cash flows is relatively small. The number of investor-months with cash outflows is relatively small and, again, most of them are not associated with big HHI changes.

[5] One concern is that investors systematically liquidate positions towards the end of a given month and re-invest the proceeds at the beginning of the next month, for example. Such rebalancing would be interpreted as cash out- and inflows. However, such turn-of-the-month rebalancing happens rarely and the reported results are almost unchanged when we exclude months with non-zero net cash flows if the preceding month had net cash flows of the opposite sign.

[6] The 25% hurdle is chosen because it represents moving from a three-stock portfolio (the median HHI across all investor-months is roughly one-third) to a four-stock portfolio).

Conceivably the results reported in Panel A of Table IX reflect customers' activities with multiple brokers. For instance, it is possible that the cash labeled here as "new" was generated through a securities sale at another broker. Hence Panel B of Table IX which reports similar results for the 500 customers – about 40% of the respondents – whose survey responses included a statement that they had no other brokerage account. The results are similar.

Fixed trading costs are another possible explanation for the results. Fixed trading costs should play a lesser role in larger portfolios, however. Each month, we identify the largest quartile of portfolios and examine them separately. The results, reported in Panel C of Table IX, are qualitatively similar – if anything, large improvements in diversification are even more concentrated during months with large cash inflows.

Given the important role that mutual funds play in the investors' diversification decisions, at least in principle, the above results are calculated for both individual stocks and stock funds. Recalculating the above statistics for holdings of individual stocks only yields similar results, which are not reported.

V Average Component Volatility and Returns

The popularity of returns comparisons motivates this final section, which asks whether portfolios with higher ACV also deliver higher returns, and whether the returns they deliver are higher than benchmark returns. Ang et al. (2006) report that stocks with high idiosyncratic volatility have low average returns.

The procedure followed here is standard: Investors are ranked by their average ACV rank during the entire sample period and sorted into five equally sized ACV-based investor quintiles ranging from the lowest ACV quintile (1) to the highest ACV quintile (5). Each month, we assign ACV ranks from zero (lowest) to one (highest) to all active portfolios that month. To get an ACV ranking by investor, we average his ACV rank over time for each investor and group investors by this average. One could also rank investors simply by their time-series average ACV. The disadvantage of this method is that return volatility tends to be higher towards the end of the sample. Relatively junior clients thus tend to be classified as high-ACV clients even if they hold portfolios with below-average ACV during their tenure. Next, the monthly raw return for a given ACV group is computed in two steps: first each member's portfolio return is computed and then the equally-weighted group average is taken.

To calculate monthly benchmark returns for a given investor's portfolio, we create a value-weighted benchmark based on the investor's beginning-of-the-month holdings as follows. To each German stock, we assign an equally-weighted portfolio of German stocks with the same Datastream industry designation and in the same market capitalization tercile based on the beginning-of-the-month market cap (the size terciles are calculated separately for every month-industry combination of German stocks). To each foreign stock, we assign an equally-weighted portfolio of foreign stocks that have the same Datastream industry designation and are in the same market cap tercile. The monthly excess return is the difference between the actual portfolio return during the month and the return of the benchmark portfolio assuming that the securities are held throughout the month.

To assess the effects of trading cost on performance, we consider trading commissions, bid-ask spreads, and intra-day returns as follows. If an investor bought 200 shares of an individual stock at a price of DEM 50 per share (this is the actual transaction price, that is, it reflects the bid-ask spread and any price impact), paid a commission of DEM 90, and the Datastream closing price for the stock on the trading date were 49, then the associated trading costs would be DEM 290 (90+200*(50-49)). Across all transactions, trading costs average 1.2% of transaction value; by themselves, trading commissions average 0.9% of transaction value. To calculate monthly excess returns after trading costs, we sum the trading costs across all transactions of a given investor and month, divide this sum by the average actual portfolio value during the month, and subtract this ratio from monthly excess returns.

Panel A of Table X reports the five group's average monthly raw returns, excess returns, and excess returns after fees. The first observation is that all investor groups do very well in terms of raw returns – a reflection of the roaring late 1990s. Second, all investor groups underperform their benchmarks and most of them significantly so, especially once trading costs are taken into account. Third, although excess returns tend to be higher for lower ACV groups, there are no statistically significant performance differences across the groups. Given the size of the sample and the upmarket of the late 1990s, however, it is difficult to make definitive statements about the performance of investors grouped by their tendency to pick or avoid volatile stocks.

Panel B of Table X reports the corresponding results when both holdings of individual stocks and stocks funds are considered. The excess return of a particular fund is calculated by subtracting the average return of the fund's peer group (funds investing in large-cap German stocks, for example) from the fund's raw return. The fees generated by mutual fund transactions include front- and back-end loads, possibly adjusted by rebates offered by the sample broker. The return patterns in Panel B are similar to those in Panel A, with one exception: the low ACV group significantly outperforms the high ACV group in terms of excess returns and excess returns after fees.

VI Discussion

This paper offers a behavioral perspective on stock selection. A unified description of all individuals' portfolios is unlikely to emerge. Rather, one can look for important features of individuals' portfolios. The disposition to sell winners and hold on to losers is a prominent example of investors' behavior. (Shefrin and Statman (1985) introduced it to the academic discourse.) According to Odean (1998) many individuals are subject to it, although, as reported by Barberis and Xiong (2006), an adequate explanation of this behavior is still lacking.

Breaking up a large problem into smaller and simpler subproblems, and solving those without taking into account the implications of the solutions of the smaller problems to the original, larger, and more complex problem is narrow framing. Experiments demonstrating the propensity for narrow framing are reviewed in Read et al. (1999); theoretical asset pricing models based on narrow framing are explored by Barberis et al. (2001) and Barberis and Huang (2001).

The preferred risk habitat hypothesis is reminiscent of Shefrin and Statman (2000) who contemplate portfolio choices of people who overlook return correlations between entire asset classes. In contrast to Shefrin and Statman (2000) whose focus is "on the structure of portfolios rather than the timing of buy/sell decisions for individual securities" (p. 142), however, the present paper is all about the individual stocks that investors choose to hold and trade.

Two of the novel observations made here are that investors tend to have portfolios consisting of stocks with volatilities within narrow ranges and that the more risk averse choose stocks with lower volatility. Another, unsurprising, observation is that the more risk averse investors tend to make heavier use of mutual funds.

What do the most risk averse people do? They are probably outside the population represented by the sample studied here as they shun stocks altogether. Under the preferred risk habitat hypothesis they will not invest in stocks if the volatilities of the stocks they follow are excessively high. Thus, they will not participate in the stock market. This is a novel explanation of the stock market participation puzzle. (For other explanations of the low level of stock market participation see Vissing-Jørgensen (2002) and Guiso et al. (2005).)

Investors' narrow framing notwithstanding, they usually hold more than a single stock, thereby showing some tendency to diversify. When attention is confined to the stock portions of the portfolios, diversification and risk aversion of the portfolio owner appear uncorrelated. On the other hand, the full portfolios (including mutual funds) of the more risk averse typically have lower HHIs.

The survey-based measure of risk aversion is correlated both with the portfolios' average component volatility and HHI (when funds are included) and therefore, not surprisingly, also with portfolio volatility itself. In general, portfolio volatility depends on the number of stocks in the portfolio and their weights, the volatilities of the portfolio stocks themselves and on the correlations of the returns of the stocks. These correlations are cognitively the least accessible. If investors availed themselves of that third channel of risk management, and if sensitivity to returns correlation related to the investors' attitudes to risk, then their portfolio volatilities should be related to investors' risk aversion even after controlling for ACV and HHI. It is not. Moreover, a direct estimate of intra portfolio return correlation appears unrelated to risk aversion. The absence of this relation is further evidence of narrow framing.

The correspondence between the survey-based measure of risk aversion and actual behavior is remarkable. With the simplest of analyses, variation in the survey responses explains two unrelated features of the data: variation in average component volatility of the stock portions of the portfolios and variation in the fractions invested in mutual funds. It is surprising that those who say that the they are "not at all willing to bear high risk in exchange for high expected returns" indeed have portfolios with lower ACV and higher proportions invested in funds than those who say the are "very willing to bear high risk in exchange for high expected returns." The question itself does not ask the respondents to compare their attitudes to risk or the riskiness of their holdings against those of other respondents. Nonetheless, the responses are effective at predicting variations in the riskiness of the respondents' portfolios. Even if they answer it trying to compare the riskiness of their portfolios with those of other respondents', it is unclear how they make such comparisons, not knowing either other people's responses or their portfolios.

The human propensity to diversify is well known. (For instance, Read and Loewenstein (1995) report on an experiment in which children preferred a diversified bundle of Halloween candy bars although when offered them sequentially, they consistently chose the same bar.) In fact, Rubinstein (2001) offers experimental examples in which subject diversify although it is best not to do so.

Little is known about the relation between the tendency to diversify and other attributes. Risk aversion could be quite relevant to the tendency to diversify. It turns out to be irrelevant when the stock portions of the portfolios are studied.

In the context of security selection, diversification is a well known, valid, beneficial risk-reducing measure. The sample investors do diversify. Most of them have portfolios with more than the equivalent of three stocks, that is, their HHIs are lower than 33%. But they do not diversify very well relative to simply holding a mutual fund. A tendency to adhere to a handful of choices rather than to diversify over many choices is observed in Huberman and Jiang (2006) in the context of 401(k) investors most of whom allocate their money to no more than four investment options. In the 401(k) context the harm of such limited diversification is probably minimal because the investment choices are well diversified mutual funds. (Company stock is an important exception. Huberman (2001) argues that the tendency to invest in it is a manifestation of the tendency to invest in the familiar.) The investors studied here, in contrast with most 401(k) investors, forego a substantial amount of risk reduction because they are not diversified enough.

Investors appear to manage the HHIs of their portfolios somewhat casually, perhaps because diversification takes a back seat to picking stocks with high perceived returns. Specifically, an identifiable instance of improvement in diversification (that is, reduction in HHI) is the addition of new money into the portfolio and the associated purchase of new securities. This suggests that the improvement in diversification is opportunistic or even unintended.

The results reported here reflect not only the behavior of the average sample investor. A separate check indicates that they apply equally to the wealthier among the investors, to those who hold a large portion of their financial wealth with the broker studied here, and to those who have no other brokerage account. Another reason to pay attention to this sample: collectively, the trades of this brokerage's customers move prices, even lead price changes as reported in Dorn et al. (2007).

VII Conclusion

The Markowitz one-period mean variance optimization is an elegant and parsimonious formulation of the investor's problem. Its implementation, however, is quite challenging, once attention is paid to real-world issues such as parameter estimation and the temporal evolution of the portfolio. The nature of stock selection does not lend itself to a Markowitz-like program, unless aided by a computer or otherwise done methodically. Thus, it is reasonable to expect that individual investors apply heuristics to their portfolio selection: they select a few stocks, each stock selection based on the stock's own merits (including the stock's volatility) and invest in more than one stock to reduce the portfolio risk. Within this loose framework, the investor pays little attention to the portfolio' overall risk; risk considerations are secondary to return temptations.

However, the overall picture is not chaotic. Investors specialize in the stocks they follow and pick. According to the preferred risk habitat hypothesis, the more risk averse investors will buy the less volatile stocks.

The main evidence consistent with the preferred risk habitat hypothesis is that the volatilities of the stocks in individuals' portfolios are less dispersed than they would be if the portfolio holders chose the stocks at random. Moreover, the holders of the less volatile stocks tend to be individuals who are more risk averse according to survey-based indicators of risk aversion.

Although risk aversion is related to the volatilities of the stocks in the portfolio, it appears unrelated to the degree of diversification of the stock portion of the portfolio. The addition of new money into the portfolio is associated with improvement in diversification, suggesting a somewhat casual attitude toward diversification.

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Figure 1: Median Ratio of Actual Volatility Dispersion to Simulated Dispersion by HHI Decile

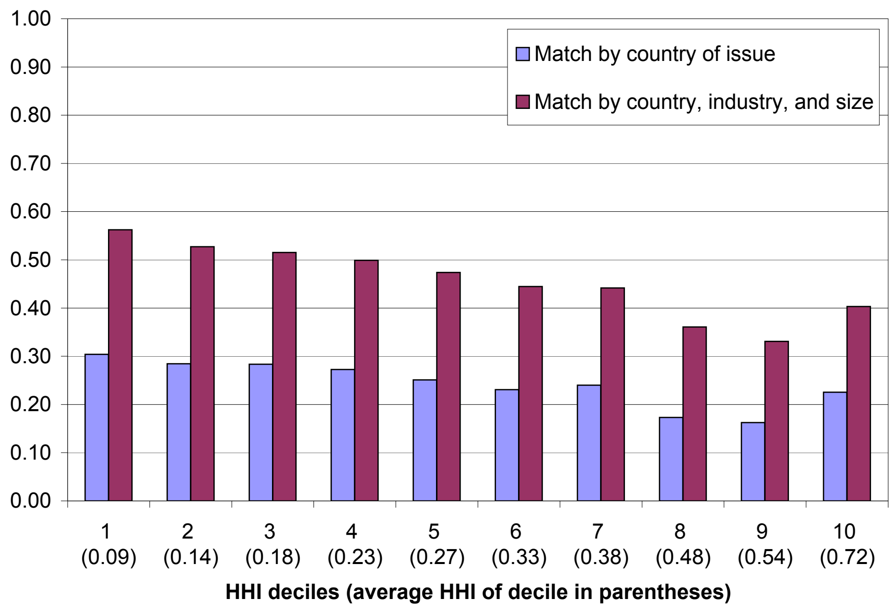

Table I: Summary Statistics

Annualized portfolio volatility (VOL), value-weighted average component volatility (ACV), Herfindahl-Hirschmann Index (HHI), weighted average correlation of portfolio components (RHO), and portfolio value are calculated based on the sample investors' holdings of individual stocks and stock funds as of January 1, 2000 for the period January 1, 2000 to May 31, 2000. Portfolio values are in Deutsche Mark [DEM] and calculated as of January 1, 2000. To ensure the consistency of the different portfolio risk components, portfolio weights are assumed to stay constant throughout the sample period. Panel A reports summary statistics for holdings of individual stocks; Panel B reports the summary statistics for holdings of individual stocks and stock funds. For the purpose of the HHI calculation, stock funds are assumed to hold 100 equally-weighted positions that do not appear in another holding of the investor. All summary statistics for RHO are calculated for investors with at least two positions. During the sample period, the average USD/DEM exchange rate was roughly 2 DEM for 1 USD.

Panel A: only stocks	VOL	ACV	HHI	RHO	Portfolio value [DEM]
Number of investors	17,913	17,913	17,913	14,575	17,913
Mean	52%	69%	47%	18%	100,733
Bottom quartile	32%	51%	20%	9%	8,719
Median	46%	65%	36%	16%	29,044
Top quartile	65%	86%	70%	26%	85,352
Pairwise correlations					
ACV	0.90				
HHI	0.58	0.21			
RHO	0.35	0.27	-0.11		
ln(Portfolio value)	-0.46	-0.25	-0.65	0.25	
Panel B: stocks and stock funds					
Number of investors	19,731	19,731	19,731	17,440	19,731
Mean	43%	59%	28%	25%	119,650
Bottom quartile	28%	42%	5%	12%	14,845
Median	37%	55%	17%	22%	42,511
Top quartile	53%	72%	40%	34%	112,797
Pairwise correlations					
ACV	0.90				
HHI	0.60	0.40			
RHO	0.09	-0.11	-0.36		
ln(Portfolio value)	-0.33	-0.15	-0.46	0.14	

Table II: Dispersion of Volatility

The sample consists of all investor-months in which an investor holds at least two stocks at the end of the month – a total of 458,013 observations across 18,201 investors. Actual dispersion of volatility D_{actual} is the value-weighted variance of the volatilities of portfolio components. Artificial dispersions $D_{simulated}$ are simulated by replacing actual stock holdings with random stock holdings that match key characteristics – country of issue (domestic vs foreign), Datastream industry classification, and market capitalization tercile – of the actual holdings. An "equal" matching probability signifies that each candidate matching stock has an equal probability of being drawn; a "proportional" matching probability signifies that the probability of a candidate matching stock being drawn is proportional to the number of sample investors who hold the stock that month. Details of the simulation policies are given in Section III.A. Standardized dispersion $D_{standardized}$ for a given investor-month is the difference between actual dispersion and the average of the simulated dispersions for that investor-month, divided by the standard deviation of the simulated dispersions for that investor-month. The t-statistic assumes that standardized dispersions are independent across investors but perfectly correlated across time. Same stock assignments are the fractions of actual stock positions for which the actual holding and the matching holding are identical.

	Dispersion of Volatility					
	Actual	Simulated (100 draws)				
	(1)	(2)	(3)	(4)	(5)	(6)
Mean across investor-months	3.1%	5.5%	5.5%	4.0%	4.2%	3.3%
Bottom quartile	0.4%	3.3%	2.8%	1.9%	1.6%	0.9%
Median	1.4%	5.1%	4.8%	3.3%	3.3%	2.2%
Top quartile	3.8%	7.3%	7.5%	5.4%	5.9%	4.5%
Fraction of investor-months with $D_{actual} < D_{simulated}$	n/a	86%	85%	78%	78%	67%
Fraction of investors for whom						
$D_{actual} < D_{simulated}$ for all months	n/a	23%	22%	13%	12%	7%
$D_{actual} < D_{simulated}$ for more than three out of four months	n/a	75%	76%	59%	61%	35%
$D_{actual} < D_{simulated}$ for more than one out of two months	n/a	95%	95%	91%	92%	81%
Average of $D_{standardized}$	n/a	-0.334	-0.386	-0.190	-0.309	-0.076
T-statistic	n/a	-124	-132	-64	-108	-20
Stock characteristics matched						
Country (domestic/foreign)	n/a	Yes	Yes	Yes	Yes	Yes
Datastream Industry Classification	n/a	No	Yes	No	Yes	Yes
Size tercile	n/a	No	No	Yes	Yes	Yes
Matching probability	n/a	equal	equal	equal	equal	proportional
Same stock assignments	n/a	0%	6%	1%	15%	34%

Table III: Dispersion of Volatility (for Survey Respondents with a Single Account))

All variables are defined as in Table II. The underlying sample of investor-months, however, is the following subset of observations: a given investor responds to the questionnaire, reports that the observed account is his only brokerage account, and holds at least two stocks at the end of a given month. The subsample consists of a total of 11,733 observations (investor-months) across 444 such investors.

	Dispersion of Volatility					
	Actual	Simulated (100 draws)				
	(1)	(2)	(3)	(4)	(5)	(6)
Mean across investor-months	3.2%	5.8%	5.8%	4.1%	4.4%	3.4%
Bottom quartile	0.5%	3.5%	3.0%	2.0%	1.7%	1.1%
Median	1.6%	5.4%	5.1%	3.5%	3.4%	2.4%
Top quartile	4.0%	7.7%	7.8%	5.5%	6.0%	4.6%
Fraction of investor-months with $D_{actual} < D_{simulated}$	n/a	86%	85%	78%	78%	67%
Fraction of investors for whom						
$D_{actual} < D_{simulated}$ for all months	n/a	22%	19%	12%	11%	6%
$D_{actual} < D_{simulated}$ for more than three out of four months	n/a	78%	77%	60%	62%	35%
$D_{actual} < D_{simulated}$ for more than one out of two months	n/a	97%	97%	94%	94%	84%
Average of standardized dispersion	n/a	-0.368	-0.422	-0.199	-0.315	-0.077
T-statistic	n/a	-24	-26	-11	-19	-4
Stock characteristics matched						
Country (domestic/foreign)	n/a	Yes	Yes	Yes	Yes	Yes
Datastream Industry Classification	n/a	No	Yes	No	Yes	Yes
Size tercile	n/a	No	No	Yes	Yes	Yes
Matching probability	n/a	equal	equal	equal	equal	proportional

Table IV: Stability of Average Component Volatility

For the transition matrix shown in Panel A, we include investors who both sell and buy stocks during a given quarter. First investors are sorted by the value-weighted component volatility of stocks sold during the quarter and then by the value-weighted component volatility of stocks bought during the quarter. Category 1 is the lowest volatility category; the categories are equally sized. The interpretation of the 20% in the top left cell in Panel A's matrix is that 20% of all investors sell and buy low-volatility stocks during a given quarter; the unit of observation is a investor-quarter. For the transition matrix shown in Panel B, we include investors who hold stocks during the first quarter of 1996 and also during the first quarter of 2000. Investors are sorted twice based on their portfolios' ACVs during the first quarter of 1996 and during the first quarter of 2000. To be included in the matrix shown in Panel C, investors not only have to have active accounts in both 1996 and 2000, but they also have to completely turn over their portfolio between 1996 and 2000 (i.e., none of the positions at the end of March 1996 appears in the portfolio at the end of March 2000).

Panel A		Buy volatility		
		1	2	3
Sell	1	20%	9%	4%
volatility	2	9%	16%	8%
category	3	4%	9%	21%
Panel B		**ACV rank in 1/2000**		
		1	2	3
ACV	1	16%	11%	7%
rank	2	11%	12%	10%
in 1/1996	3	6%	11%	17%
Panel C		**ACV rank in 1/2000**		
		1	2	3
ACV	1	16%	10%	7%
rank	2	10%	12%	11%
in 1/1996	3	7%	11%	15%

Table V: Actual risk postures versus self-reported risk attitudes

The sample consists of investors who assess their risk attitude in a survey conducted in July 2000. The survey respondent's willingness to trade off high risk and high expected returns – (1) very willing to bear high risk in exchange for high expected returns, (2) willing to bear high risk in exchange for high expected returns, (3) unwilling to bear high risk in exchange for high expected returns, and (4) not at all willing to bear high risk in exchange for high expected returns – is used as a proxy for risk aversion. Annualized volatility (VOL), average component volatility (ACV), Herfindahl-Hirschmann Index (HHI), and weighted average correlation (RHO) are calculated based on the respondents' holdings of individual stocks (for observations with at least two stocks, in Panel A) or of both individual stocks and stock funds (for observations with at least two positions, in Panel B) or of one individual stock (in Panel C) as of January 1, 2000 for the period January 1, 2000 to May 31, 2000. To ensure the consistency of the different portfolio risk components, portfolio weights are assumed to stay constant throughout the sample period. Portfolio values are in Deutsche Mark [DEM] and calculated as of January 1, 2000. The Fraction in Funds is the fraction of a client's portfolio invested in stock funds as of January 1, 2000. The reported statistics are mean VOL, ACV, HHI, RHO, and Fraction in Funds across investors grouped by their self-professed risk attitude.

	Nobs	VOL	ACV	HHI	RHO	Portfolio Value [DEM]	Mean Fraction in Funds
Panel A: individual stocks only							
Lowest risk aversion	155	53%	78%	35%	19%	93,918	n/a
2	293	47%	70%	32%	18%	89,272	n/a
3	384	43%	63%	32%	19%	95,664	n/a
Highest risk aversion	117	37%	56%	31%	18%	127,332	n/a
Panel B: individual stocks and stock funds							
Lowest risk aversion	172	48%	70%	24%	24%	109,980	23%
2	335	42%	63%	21%	23%	100,860	26%
3	456	37%	55%	19%	25%	115,210	31%
Highest risk aversion	153	33%	48%	16%	26%	130,360	36%
Panel C: single stock							
Lowest risk aversion	26	98%	n/a	n/a	n/a	7,738	n/a
2	53	91%	n/a	n/a	n/a	28,018	n/a
3	69	82%	n/a	n/a	n/a	10,832	n/a
Highest risk aversion	32	77%	n/a	n/a	n/a	8,642	n/a

Table VI: Sensitivities of Risk Taking Attributes to Attitudes to Risk Based on Holdings of Individual Stocks Only

The dependent variables in the underlying cross-sectional OLS regressions are average component volatility (ACV), Herfindahl-Hirschmann Index (HHI), average return correlations (RHO), and portfolio volatility (VOL). The explanatory variables, objective investor attributes and self-reported risk attitudes, are available for a sub-sample of investors who participate in a survey at the end of the sample period (see Dorn and Huberman (2005)). The portfolio risk measures are based on the survey respondents' holdings of individual stocks as of January 1, 2000 for the period January 1, 2000 to May 31, 2000. Sample investors need to have at least two positions to be included in the regression (a requirement for the calculation of RHO). To ensure the consistency of the different portfolio risk components, portfolio weights are assumed to stay constant throughout the sample period. The objective investor attributes are gleaned from survey responses. Gender is a dummy that is one if the survey respondent is male. College education is a dummy that is one if the survey respondent is college educated. Self-employed is a dummy that is one if the survey respondent is self-employed. The proxy for risk aversion is defined as in Table V. The standard errors in parentheses are corrected for heteroskedasticity as suggested by White (1980). Note: ***/**/* indicate that the coefficient estimates are significantly different from zero at the 1%/5%/10% level.

Dependent variable	(1) ACV	(2) ACV	(3) HHI	(4) HHI	(5) RHO	(6) RHO	(7) VOL	(8) VOL	(9) VOL
Constant	0.807***	0.873***	0.485***	0.498***	0.222***	0.217***	0.624***	0.674***	-0.215***
	(0.044)	(0.047)	(0.047)	(0.050)	(0.030)	(0.031)	(0.039)	(0.042)	(0.013)
Gender	0.038	0.017	-0.023	-0.023	-0.007	-0.005	0.016	0.001	-0.004
	(0.023)	(0.022)	(0.025)	(0.025)	(0.015)	(0.015)	(0.022)	(0.022)	(0.005)
Age	-0.003***	-0.002***	0.000	0.001	-0.002***	-0.002***	-0.003***	-0.002***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
College education	0.004	0.010	-0.016	-0.014	-0.001	0.000	0.004	0.008	0.005
	(0.015)	(0.014)	(0.016)	(0.016)	(0.010)	(0.010)	(0.014)	(0.013)	(0.004)
Self-employed	0.016	0.005	-0.014	-0.015	0.008	0.008	0.003	-0.005	-0.004
	(0.019)	(0.018)	(0.020)	(0.020)	(0.012)	(0.012)	(0.017)	(0.017)	(0.004)
ln(Income)	-0.006	-0.004	0.016**	0.016**	-0.016***	-0.016***	-0.006	-0.004	-0.006***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)
ln(Wealth)	-0.002	-0.002	-0.039***	-0.039***	0.019***	0.019***	-0.009	-0.010	0.006***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.007)	(0.006)	(0.002)
Risk aversion category									
(Lowest category omitted)									
2		-0.066***		-0.030		-0.003		-0.056**	0.008
		(0.024)		(0.021)		(0.013)		(0.022)	(0.006)
3		-0.132***		-0.016		0.011		-0.092***	0.021***
		(0.023)		(0.021)		(0.013)		(0.021)	(0.005)
4 - highest		-0.208***		-0.027		-0.004		-0.149***	0.031***
		(0.028)		(0.026)		(0.016)		(0.026)	(0.006)
ACV									0.818***
									(0.011)
HHI									0.353***
									(0.008)
Ancillary statistics									
Number of observations					855				
R-squared	3.8%	12.4%	4.6%	4.8%	3.2%	3.4%	3.9%	8.7%	94.1%

Table VII: Sensitivities of Risk Taking Attributes to Attitudes to Risk Based on Holdings of Individual Stocks and Stock Funds

The dependent variables in the underlying cross-sectional OLS regressions are average component volatility (ACV), Herfindahl-Hirschmann Index (HHI), average return correlations (RHO), and portfolio volatility (VOL). The portfolio risk measures are based on the survey respondents' holdings of individual stocks and stock funds as of January 1, 2000 for the period January 1, 2000 to May 31, 2000. To ensure the consistency of the different portfolio risk components, portfolio weights are assumed to stay constant throughout the sample period. All other variables are defined as in Table VI. The standard errors in parentheses are corrected for heteroskedasticity as suggested by White (1980). Note: ***/**/* indicate that the coefficient estimates are significantly different from zero at the 1%/5%/10% level.

Dependent variable	(1) ACV	(2) ACV	(3) HHI	(4) HHI	(5) RHO	(6) RHO	(7) VOL	(8) VOL	(9) VOL
Constant	0.753***	0.835***	0.370***	0.403***	0.282***	0.275***	0.588***	0.650***	0.001
	(0.040)	(0.042)	(0.040)	(0.043)	(0.033)	(0.034)	(0.032)	(0.035)	(0.019)
Gender	0.034	0.009	-0.016	-0.024	-0.022	-0.018	0.016	-0.001	-0.003
	(0.022)	(0.020)	(0.022)	(0.022)	(0.018)	(0.018)	(0.019)	(0.018)	(0.007)
Age	-0.003***	-0.002***	0.000	0.000	-0.001**	-0.001**	-0.002***	-0.002***	0.000*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
College education	-0.019	-0.012	-0.027*	-0.024*	0.009	0.008	-0.011	-0.006	0.007
	(0.014)	(0.013)	(0.014)	(0.014)	(0.011)	(0.011)	(0.012)	(0.011)	(0.005)
Self-employed	0.019	0.009	-0.009	-0.012	0.003	0.004	0.006	-0.001	-0.005
	(0.018)	(0.017)	(0.017)	(0.017)	(0.012)	(0.012)	(0.015)	(0.015)	(0.006)
ln(Income)	-0.008	-0.005	0.010	0.011	-0.007	-0.007	-0.005	-0.003	-0.001
	(0.007)	(0.007)	(0.007)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)
ln(Wealth)	-0.005	-0.007	-0.030***	-0.031***	0.009*	0.009**	-0.015**	-0.016***	-0.006***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)	(0.006)	(0.005)	(0.002)
Risk aversion category									
(Lowest category omitted)									
2		-0.071***		-0.041**		-0.003		-0.061***	-0.005
		(0.023)		(0.020)		(0.015)		(0.019)	(0.008)
3		-0.148***		-0.051**		0.018		-0.104***	0.008
		(0.022)		(0.020)		(0.014)		(0.019)	(0.007)
4 - highest		-0.220***		-0.069***		0.023		-0.154***	0.011
		(0.024)		(0.023)		(0.019)		(0.021)	(0.009)
ACV									0.818***
									(0.011)
HHI									0.353***
									(0.008)
Ancillary statistics									
Number of observations					1,002				
R-squared	3.7%	14.3%	3.8%	4.8%	0.9%	1.4%	5.2%	12.1%	83.8%

Table VIII: Self-reported risk aversion versus actual risk postures

The dependent variable in the underlying ordered probit regressions is self-reported risk aversion, available for a subsample of survey respondents and modeled as four dummy variables as in Table VI. The independent variables are portfolio volatility (VOL), average component volatility (ACV), the Herfindahl-Hirschmann Index (HHI), average return correlations (RHO), and objective investor attributes. In Columns (1)-(4), the portfolio risk measures are calculated using holdings of individual stocks only. In Columns (5)-(8), the portfolio risk measures are calculated using holdings of both individual stocks and stock funds. All other variables are defined as in Table VI. Note: ***/**/* indicate that the coefficient estimates are significantly different from zero at the 1%/5%/10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Risk aversion							
Holdings	Stocks only				Stocks and stock funds			
VOL	1.225***	1.250***			0.775*	0.846*		
	(0.427)	(0.431)			(0.435)	(0.444)		
ACV	-2.800***	-2.680***	-1.947***	-1.823***	-2.599***	-2.525***	-2.057***	-1.927***
	(0.398)	(0.402)	(0.193)	(0.196)	(0.369)	(0.373)	(0.185)	(0.187)
HHI			-0.019	-0.020			0.138	0.128
			(0.178)	(0.182)			(0.187)	(0.190)
RHO			0.842***	0.909***			0.254	0.299
			(0.294)	(0.298)			(0.231)	(0.233)
Gender		-0.313**		-0.320**		-0.358***		-0.355***
		(0.126)		(0.126)		(0.116)		(0.117)
Age		0.014***		0.015***		0.015***		0.015***
		(0.004)		(0.004)		(0.004)		(0.004)
College		0.102		0.104		0.089		0.093
		(0.082)		(0.082)		(0.076)		(0.076)
Self-employed		-0.182*		-0.199**		-0.144		-0.139
		(0.100)		(0.100)		(0.093)		(0.093)
ln(Income)		0.035		0.049		0.026		0.029
		(0.044)		(0.045)		(0.042)		(0.042)
ln(Wealth)		-0.006		-0.035		-0.032		-0.040
		(0.037)		(0.038)		(0.034)		(0.034)
Ancillary statistics								
Nobs	855				1002			
Pseudo R^2	4.8%	5.9%	4.8%	6.0%	5.4%	6.5%	5.3%	6.4%

Table IX: Cash Flows and Changes in Diversification

For each investor i and month t, the change in diversification is calculated as logarithm of $HHI_{i,t}/HHI_{i,t-1}$ based on holdings of individual stocks and stock funds at times t and $t-1$. The observations are grouped into five categories depending on the sign and magnitude of the net cash flows during the investor-month. The magnitude of a net cash flow is judged against the smallest holding of the investor at the beginning of the month. For example, if the smallest holding of an investor is DEM 2,000 and the net cash flow during the month is DEM 5,000, the observation is classified into the category "net cash inflow greater than minimum position." Panel A reports statistics for the full sample of investors who are invited to participate in the survey. Panel B reports the corresponding statistics for the sub-sample of investors who actually participate in the survey *and* report that the observed account is their only brokerage account. Panel C reports the corresponding statistics for the sub-sample of observations that are in the top quartile of investor-months in terms of portfolio value.

		(1) Nobs	(2) Mean	(3) Median	(4) # of negative HHI changes	(5) # of negative HHI changes change < -25%	(6) # of positive HHI changes	(7) # of positive HHI changes change > 25%
Panel A: Monthly HHI changes for the full sample of invited survey participants								
Net cash inflow	greater than minimum position	129,488	-10%	-10%	85,684	35,198	40,810	14,837
Net cash inflow	less than minimum position	63,799	-4%	-1%	35,095	8,277	18,670	3,872
Zero cash flow		334,909	0%	0%	114,106	1,152	130,345	1,507
Net cash outflow	less than minimum position	5,659	2%	0%	2,165	666	2,371	673
Net cash outflow	greater than minimum position	10,552	2%	0%	5,250	1,519	5,265	1,804
Panel B: Monthly HHI changes for the survey participants with only one account								
Net cash inflow	greater than minimum position	3,336	-9%	-9%	2,222	837	1,057	349
Net cash inflow	less than minimum position	1,737	-4%	-1%	996	200	559	104
Zero cash flow		7,258	0%	0%	2,652	26	3,025	36
Net cash outflow	less than minimum position	123	-2%	0%	52	11	55	15
Net cash outflow	greater than minimum position	259	7%	4%	115	35	144	61
Panel C: Monthly HHI changes for the top quartile of investor-months in terms of portfolio value								
Net cash inflow	greater than minimum position	41,452	-9%	-7%	27,483	7,670	13,787	3,340
Net cash inflow	less than minimum position	9,188	-2%	-1%	5,355	668	3,534	398
Zero cash flow		62,997	1%	0%	27,184	174	32,544	286
Net cash outflow	less than minimum position	1,463	-1%	0%	654	126	679	85
Net cash outflow	greater than minimum position	3,957	-2%	0%	2,035	469	1,921	368

Table X: Performance of Investors Grouped by Their Average Component Volatility

Five equally-sized investor groups are formed by ranking investors based on the investors' average ACV rank during the sample period (based on holdings of individual stocks only for Panel A, based on holdings of both stocks and stock funds for Panel B). For each group, compute time-series averages and standard deviations of monthly raw returns, excess returns, and excess returns after trading costs. The group's raw return in a given month is the equally-weighted average return across the group's member portfolio returns that month. To compute excess returns, construct an investor-specific benchmark based on the investor's holdings at the beginning of a given month. The benchmark matches each stock in the investor's portfolio at the beginning of a month with an equally-weighted portfolio of stocks with the same Datastream industry designation and with a similar market capitalization. The benchmark for a given stock fund is the equally-weighted average return of funds in the same peer group (e.g., Germany large-cap). To obtain excess returns after fees, subtract the ratio of trading costs incurred during a given month to average portfolio value from an investor's excess return that month; the trading costs include trading commissions, spreads, and price impact for stocks and loads for funds (as described in Section V). ***/**/* indicate that the corresponding group's average (excess) returns are significantly different from zero at the 1%/5%/10% level, assuming that returns are independent across months. The last column indicates whether the average returns of the lowest and the highest ACV groups are significantly different from each other.

Panel A: Individual stocks only							
				ACV quintile			
		1	2	3	4	5	1-5
Raw	Mean	1.7%	2.0%	1.9%	2.0%	2.1%	
	Std	5.0%	5.5%	5.9%	6.8%	9.3%	
Excess	Mean	-0.2%	-0.4%*	-0.5%***	-0.5%***	-0.4%	
	Std	1.5%	1.9%	1.3%	1.3%	2.4%	
Excess minus fees	Mean	-0.4%**	-0.6%**	-0.8%***	-0.9%***	-0.9%***	
	Std	1.5%	1.9%	1.3%	1.3%	2.4%	

Panel B: Individual stocks and stock funds							
		1	2	3	4	5	1-5
Raw	Mean	1.8%	1.7%	1.9%	1.9%	1.9%	
	Std	5.2%	5.2%	5.5%	6.0%	7.9%	
Excess	Mean	0.0%	-0.2%**	-0.4%**	-0.5%***	-0.5%***	***
	Std	0.5%	1.0%	1.4%	1.1%	1.5%	
Excess minus fees	Mean	-0.2%***	-0.4%***	-0.6%***	-0.8%***	-0.9%***	***
	Std	0.5%	1.0%	1.4%	1.1%	1.5%	