FIGHT OR FLIGHT? PORTFOLIO REBALANCING BY INDIVIDUAL INVESTORS*

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This paper investigates the dynamics of individual portfolios in a unique data set containing the disaggregated wealth of all households in Sweden. Between 1999 and 2002, we observe little aggregate rebalancing in the financial portfolio of participants. These patterns conceal strong household-level evidence of active rebalancing, which on average offsets about one-half of idiosyncratic passive variations in the risky asset share. Wealthy, educated investors with better diversified portfolios tend to rebalance more actively. We find some evidence that households rebalance toward a greater risky share as they become richer. We also study the decisions to trade individual assets. Households are more likely to fully sell directly held stocks if those stocks have performed well, and more likely to exit direct stockholding if their stock portfolios have performed well; but these relationships are much weaker for mutual funds, a pattern that is consistent with previous research on the disposition effect among direct stockholders and performance sensitivity among mutual fund investors. When households continue to hold individual assets, however, they rebalance both stocks and mutual funds to offset about one-sixth of the passive variations in individual asset shares. Households rebalance primarily by adjusting purchases of risky assets if their risky portfolios have performed poorly, and by adjusting both fund purchases and full sales of stocks if their risky portfolios have performed well. Finally, the tendency for households to fully sell winning stocks is weaker for wealthy investors with diversified portfolios of individual stocks.

I. INTRODUCTION

What drives time series variations in the asset allocation of individual investors? How do households adjust their risk

exposure in response to the portfolio returns that they experience? Are household portfolios characterized by inertia or high turnover? Financial theory suggests a wide range of motives for active trading and rebalancing at the household level. Realized returns on financial assets induce mechanical variations in portfolio allocation, to which an investor is passively exposed. An investor might fight passive changes by actively rebalancing her portfolio when asset returns are expected to be time-invariant. Changes in perceived investment opportunities, on the other hand, might lead the investor to adopt a flight strategy that would amplify the decline in the share of the worst-performing assets. Furthermore, trading decisions may reflect not only asset allocation objectives, but also a disposition to hold losing and sell winning securities (Shefrin and Statman 1985; Odean 1998).

Equilibrium considerations suggest that aggregate flows from the household sector provide limited and potentially misleading information on individual rebalancing. Consider, for instance, an economy in which households own all financial assets. If the aggregate value of risky securities falls, the average share of risky assets in household portfolios must necessarily fall as well. Thus, the average individual investor cannot fight aggregate variations in equity returns. When households have heterogeneous portfolios, however, there can still be substantial rebalancing at the individual level. For instance, it is an open question whether households with higher passive losses tend to buy or sell risky assets.

The empirical investigation of household rebalancing therefore requires high-quality and comprehensive micro data. Traditional data sets do not meet these requirements and have unsurprisingly led to conflicting answers on household behavior. Surveys, which have been widely used in the household finance literature, only report the allocation of household financial wealth into broad asset classes (e.g., Bilias, Georgarakos, and Haliassos [2008]). They permit the analysis of changes in the share of risky assets in the financial portfolio, but not the computation of active and passive changes. Thus, surveys cannot tell us whether households attempt to offset passive variations in their risky share.

Account data sets, such as 401k and brokerage accounts, present a partial view of financial wealth and do not permit the computation of the risky share. Research based on discount brokerage accounts finds evidence of intense trading activity (e.g., Odean [1999]; Barber and Odean [2000]), whereas substantial inertia is observed in 401k accounts (e.g., Madrian and Shea [2001];

Choi et al. [2002, 2004]; Agnew, Balduzzi, and Sunden [2003]; Ameriks and Zeldes [2004]). These seemingly contradictory results may result from selection bias in account data sets. For example, households may choose a discount broker precisely because they are (over)confident in their ability to process information and intend to engage in high-frequency trading. And households may trade less actively in retirement accounts than in other accounts that they control.

The Swedish data set used in Calvet, Campbell, and Sodini (2007, henceforth "CCS 2007") allows us to overcome these issues. We assembled data supplied by Statistics Sweden into a panel covering four years (1999–2002) and the entire country (about 4.8 million households). The information available on each resident is systematically compiled by financial institutions and corporations and includes demographic characteristics, wealth portfolio, and income. Our administrative data set is therefore more reliable than self-reported data sets, such as surveys. The wealth information is highly disaggregated and provides the worldwide assets owned by the resident at the end of a tax year. All financial assets held outside retirement accounts are reported, including bank accounts, mutual funds, and stocks. However, the database reports neither the exact date of a sale nor information on asset purchases.

In CCS 2007, we found that household portfolios of risky assets have important idiosyncratic exposure, accounting for just over half the variance of return for the median household. Underdiversification causes only modest welfare losses for most of the population *ex ante*; however, the realized returns on household portfolios are heterogeneous *ex post*. In this paper we exploit this cross-sectional variation to analyze the determinants of portfolio rebalancing. The Swedish data set is well suited for such an investigation because we can compute the risky share of every household and decompose its changes into passive and active components.

Our main results are the following. First, we study the dynamics of the risky asset share among participating households. The equal-weighted share of household financial wealth invested in risky assets fell from 57% in 1999 to 45% in 2002, a decline that implies very weak active rebalancing by the Swedish household sector as a whole in response to the equity bear market of the early 2000s. In striking contrast to this aggregate result, individual households actively rebalanced their portfolios in response

to their own returns. Household-level regressions show that on average, active rebalancing compensates for about one-half of idiosyncratic passive variations in the risky share.

We estimate a partial adjustment model for the risky share, with heterogeneous adjustment speeds, and find that financially sophisticated households holding well-diversified portfolios adjust more rapidly toward their target risky share. We also find some evidence that the target risky share increases when households become richer, consistent with theories of declining relative risk aversion, portfolio insurance, or habit formation (Brennan and Schwartz 1988; Constantinides 1990; Dybvig 1995; Campbell and Cochrane 1999; Carroll 2000, 2002).

Second, we study patterns of entry to and exit from risky financial markets. The overall stock market participation rate increased slightly between 1999 and 2002. At the microeconomic level, household demographics influence entry and exit as one would expect: financially sophisticated households, with greater income, wealth, and education, are more likely to enter and less likely to exit. We are able to go beyond this familiar result to see how portfolio characteristics influence exit decisions. We find that households with initially more aggressive investment strategies are generally less likely to exit, although poorly diversified households and those with extremely high initial risky shares are slightly more likely to exit. If we consider mutual funds and directly held stocks as separate asset classes, we find that households are slightly more likely to exit mutual fund holding when their mutual funds have performed badly, but much more likely to exit direct stockholding when their stocks have performed well.

Third, we explore decisions to adjust positions in individual stocks and mutual funds. We begin by examining decisions to fully sell positions. We find that the absolute value of the return on a stock or fund has a positive effect on the probability that a household will sell it. This effect is much stronger for stocks with positive returns (winners) than for stocks with negative returns (losers), but the asymmetry is much weaker for mutual funds. We allow portfolio and household characteristics to influence the strength of these return effects, and find that wealthy investors with diversified portfolios of individual stocks have a weaker propensity to dispose of winning stocks and a stronger propensity to dispose of losers.

We also estimate a rebalancing model for positions that are not fully sold. We find that the passive change in the share of a

stock or mutual fund in the risky portfolio does explain the active change, but the effect is weaker than we found when we treated all risky assets as a homogeneous asset class. Instead of a rebalancing coefficient of one-half, we obtain coefficients of about one-sixth, which are only slightly greater for stocks than for mutual funds. Thus the difference in household decision making with respect to stocks and mutual funds shows up primarily in full sales rather than in partial rebalancing decisions.

Finally, we investigate the relation between asset-level trading decisions and portfolio rebalancing. Households primarily rebalance by using a small number of trading strategies. When a household is unlucky, in the sense that its risky portfolio performs worse than average, rebalancing is mostly driven by adjustments in purchases of risky assets. Conversely, when the household is lucky, in the sense that its risky portfolio performs better than average, the household rebalances primarily by adjusting full sales of stocks and purchases of mutual funds.

Both our entry and exit results and our results on asset-level trading decisions are consistent with two branches of the literature. The disposition effect, that investors hold losing stocks and sell winning stocks, has been documented using account data on direct stockholdings by Odean (1998) and many others; Grinblatt and Han (2005), Frazzini (2006), and Goetzmann and Massa (2008) present evidence that this behavior may contribute to momentum in stock returns. The literature on mutual fund flows, on the other hand, finds evidence of performance chasing by individual investors (Ippolito 1992; Gruber 1996; Chevalier and Ellison 1997; Sirri and Tufano 1998; Frazzini and Lamont 2008; Ivkovic and Weisbenner 2007). We find similar patterns using different data and a different approach for classifying stocks and funds as losers or winners. Dhar and Zhu (2006) have recently found that households with higher self-reported income are less prone to the disposition effect in stock trading; our results are broadly consistent with this, although we find that wealth and portfolio diversification are more relevant than income in predicting the strength of the disposition effect.

The organization of the paper is as follows. In Section II we present some basic facts about the evolution of risk taking among Swedish households in the period 1999–2002. In Section III, we assess the magnitude of active rebalancing by decomposing household-level portfolio variations into their passive and active components. In Section IV, we estimate a partial adjustment

model of portfolio risk and use it to ask which types of households adjust their portfolios more rapidly. This section also asks whether increases in financial wealth increase households' desired risk exposure. Section V explores entry and exit decisions and asset-level rebalancing in relation to the disposition effect. In Section VI, we link households' asset-level decisions to their rebalancing strategies. Section VII concludes. An Appendix available online presents details of data construction and estimation methodology.

II. How Has Risk Taking Changed over Time?

II.A. Data Description and Definitions

Swedish households pay taxes on both income and wealth. For this reason, the national Statistics Central Bureau (SCB), also known as Statistics Sweden, has a parliamentary mandate to collect highly detailed information on the finances of every household in the country. We compiled the data supplied by SCB into a panel covering four years (1999–2002) and the entire population of Sweden (about 4.8 million households). The information available on each resident can be grouped into three main categories: demographic characteristics, income, and disaggregated wealth.

Demographic information includes age, gender, marital status, nationality, birthplace, education, and place of residence. The household head is defined as the individual with the highest income. The education variable includes high-school and post-high-school dummies for the household head.

Income is reported by individual source. For capital income, the database reports the income (interest, dividends) that has been earned on each bank account or each security. For labor income, the database reports gross labor income and business sector.

The panel's distinguishing feature is that it contains highly disaggregated wealth information. We observe the worldwide assets owned by each resident on December 31 of each year, including bank accounts, mutual funds, and stocks. The information is provided for each individual account or each security referenced by its International Security Identification Number (ISIN). The database also records contributions made during the year to private pension savings, as well as debt outstanding at year end and interest paid during the year.

We will refer to the following asset classes throughout the paper. Cash consists of bank account balances and money market funds. Stocks refer to direct holdings only. Risky mutual funds are classified as either bond funds or equity funds. The latter category is broadly defined to include any fund that invests a fraction of its assets in stocks; that is, balanced funds are counted as equity funds.[1] Risky assets include stocks and risky mutual funds.

Following CCS 2007, we measure a household's total financial wealth as the sum of its holdings in these asset classes, excluding from consideration illiquid assets such as real estate or consumer durables, defined contribution retirement accounts, capital insurance products that combine return guarantees with risky asset holdings, and directly held bonds. Also, our measure of wealth is gross wealth and does not subtract mortgage or other household debt. CCS 2007 summarizes the relative magnitudes of all these components of Swedish household balance sheets.

A *participant* is a household whose financial wealth includes risky assets. In Table I, Panel A, we report summary statistics on the assets held by participating households. To facilitate international comparisons, we convert all financial quantities into U.S. dollars. Specifically, the Swedish krona traded at $0.1127 at the end of 2002, and this fixed conversion factor is used throughout the paper. The aggregate value of risky holdings declined by about one-half during the bear market. Between 1999 and 2002, household stockholdings fell from $62 to $30 billion, and fund holdings from $53 to $29 billion. Cash, on the other hand, increased from $49 to $57 billion over the same period.

In the same panel we also report aggregate statistics on stock and fund holdings compiled by the SCB and by the Swedish mutual fund association, Fondbolagens Förening (FF).[2] The official statistics are incomplete because the SCB does not specifically report the aggregate cash holdings of participants and the FF series only start in 2000. The aggregate estimates obtained with our data set closely match available official statistics. In the Appendix, we also match official aggregate statistics on flows into stocks and mutual funds quite closely. The aggregate flow into an asset class is generally quite modest and never exceeds a few

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1. The managers of balanced funds periodically rebalance their holdings of cash and risky assets to maintain a stable risky share. We do not try to measure this form of rebalancing, but treat balanced funds like any other mutual funds, assuming that they have stable risk characteristics.
2. These statistics can be downloaded at www.scb.se and www.fondbolagen.se.

TABLE I
SUMMARY STATISTICS

	1999		2000		2001		2002	
	Micro data	Official statistics	Micro data	Official statistics	Micro data	Official statistics	Micro data	Official statistics
	A. Aggregate holdings of participants (billion dollars)							
Stocks	61.7	64.3	54.6	54.6	45.3	47.1	29.8	32.2
Risky mutual funds	53.4		50.4	52.7	44.0	45.4	29.4	29.5
Equity funds	49.5		46.6	48.8	39.7	40.9	24.8	25.2
Bond funds	3.9		3.8	3.9	4.3	4.5	4.5	4.3
Cash	48.7		47.5		54.3		56.7	
Total financial wealth	163.9		152.5		143.7		115.9	
	B. Participation and average risky share							
Fraction of households holding:								
Risky assets	61.6%		66.4%		66.0%		64.9%	
Individual stocks	30.0%		37.2%		37.3%		38.5%	
Risky mutual funds	54.6%		58.7%		58.2%		56.4%	
Both individual stocks and risky funds	23.0%		29.5%		29.5%		29.9%	
Average risky share (equal-weighted)	56.5%		56.6%		52.3%		45.2%	
Average risky share (wealth-weighted)	74.9%		73.7%		66.1%		54.7%	
	C. Asset returns							
Interest rate	3.1%		3.9%		4.1%		4.1%	
MSCI Sweden index	79.2%		−18.0%		−26.8%		−48.6%	
Pooled index (equal-weighted)	NA		−4.3%		−11.1%		−32.1%	
Pooled index (value-weighted)	NA		−6.1%		−11.6%		−32.2%	
MSCI world index (in Swedish kronor)	27.2%		−7.1%		−11.3%		−37.9%	
MSCI World index (in U.S. dollars)	19.0%		−18.5%		−20.7%		−22.4%	

Notes. The table reports summary statistics of aggregate holdings of participants (Panel A), participation rates and the risky share (Panel B), and asset returns (Panel C). Panel A also includes the official statistics reported by Statistics Sweden (stocks) and Fondbolagens Förening (funds) when they are available. The participation rates in Panel B are computed on the random subsample of 100,000 households considered throughout the text, whereas the average risky share (Panel B) and pooled index (Panel C) are based on the subset of participants at the end of each year in the random subsample.

percentage points of the total household wealth invested in the class. Thus, the strong reduction in aggregate risky holdings reported in Table I, Panel A, primarily results from price movements and not from large outflows from the household sector.

Following CCS 2007, we define the following variables for each household h. The *complete* portfolio contains all the stocks, mutual funds, and cash owned by the household. The *risky* portfolio contains stocks and mutual funds but excludes cash. The *risky share* $w_{h,t}$ at date t is the weight of the risky portfolio in the complete portfolio. Because the risky share is model-free, we use it extensively throughout the paper. The household's risky portfolio is also characterized by its standard deviation $\sigma_{h,t}$ and by its systematic exposure $\beta_{h,t}$ and Sharpe ratio $S_{h,t}$ relative to a global equity benchmark, the MSCI World Index. The definition and estimation of these quantities are discussed in the Appendix.

The results presented in this paper are based on households that exist throughout the 1999–2002 period. We impose no constraint on the participation status of these households, but require that they satisfy the following financial requirements at the end of each year. First, disposable income must be strictly positive and the three-year rolling average must be at least 1,000 Swedish kronor ($113). Second, financial wealth must be no smaller than 3,000 kronor ($339). For computational convenience, we have selected a random panel of 100,000 households from the filtered population. Unless stated otherwise, all the results in the paper are based on this fixed subsample, and unreported work confirms the strong robustness of the reported estimates to the choice of alternative subsamples.

II.B. Cross-Sectional Dynamics of Participation and Risk Taking

Household participation in risky asset markets increased from 62% to 65% between 1999 and 2002, as is reported in Table I, Panel B. The inflow is equal to 20% of nonparticipating households, or about 8% of the entire population. The outflow is 7% of participants, or about 4% of the entire household population. These patterns are consistent with the "participation turnover" documented for U.S. data (Hurst, Luoh, and Stafford 1998; Vissing-Jorgensen 2002). In Section V, we will further investigate the microeconomic and portfolio determinants of entry and exit.

In studying rebalancing in the next two sections, we focus in each year on the large group of households that maintain participation in risky asset markets throughout the year. Between

1999 and 2002, the equal-weighted average risky share $w_{h,t}$ of these households fell from 57% to 45% (Table I, Panel B). As illustrated in Figure IA, this lower mean reflects a downward shift in the cross-sectional distribution of $w_{h,t}$, which is most pronounced in the tails.

The downward shift in the risky share translates into a downward shift in complete portfolio risk. We illustrate in Figure IB how the standard deviation of the complete portfolio, $w_{h,t}\sigma_{h,t}$, varies with the risky share, $w_{h,t}$. The relation is almost linear and has similar slopes in all years. Consistent with this finding, we verify in the Appendix that the standard deviation of the risky portfolio, $\sigma_{h,t}$, has a stable cross-sectional distribution over time and is almost a flat function of the risky share.[3]

These results imply that Swedish households adjust their overall risk exposure primarily by scaling up or down their risky portfolios, passively or actively, rather by altering their composition. This justifies our emphasis on modeling $w_{h,t}$ in the next two sections.

III. PASSIVE AND ACTIVE REBALANCING OF THE RISKY SHARE

III.A. Decomposition of the Risky Share

The change in a household's risky share is partly determined by the household's active trades and partly by the returns on its risky securities. For instance, the risky share tends to fall mechanically in a severe bear market. For this reason, we now decompose the change in the risky share between year t and year $t+1$, $w_{h,t+1} - w_{h,t}$, into a passive change driven by the returns on risky assets and an active change resulting from household rebalancing decisions. This decomposition is empirically meaningful because of the comprehensive individual asset information available in our data set.

The *passive risky return* $1 + r_{t+1}$ is the proportional change in value of a household's risky portfolio if the household does not trade risky assets during the year. It is easily computed from the initial risky portfolio and asset returns. Let $w_{h,j,t}^*$ denote the share of asset j $(1 \leq j \leq J)$ in the risky portfolio. If the investor does not trade between date t and date $t+1$, the risky

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3. Of course, the stability of average $\sigma_{h,t}$ across risky share bins does not imply that all households own the same risky portfolio. We will indeed show in Section III that there is substantial heterogeneity in individual portfolio returns.
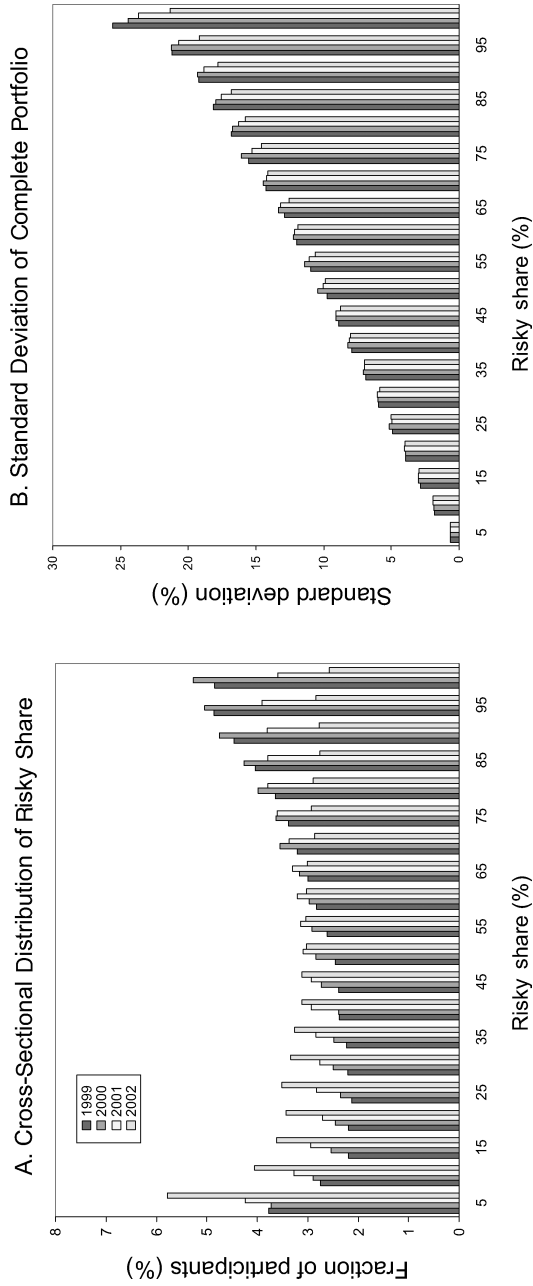
FIGURE I

Portfolio Characteristics of Participants

Notes. Panel A illustrates the cross-sectional distribution of the risky share $w_{h,t}$ at the end of years 1999 to 2002. Panel B reports the relation between the standard deviation of the complete portfolio $w_{h,t}\sigma_{h,t}$ and the risky share $w_{h,t}$.

portfolio value at $t+1$ is its value at t times its gross return $1 + r_{h,t+1} = \sum_{j=1}^{J} w_{h,j,t}^*(1 + r_{j,t+1})$. We compute returns $r_{j,t+1}$ excluding dividends, as is appropriate if households consume dividends rather than reinvesting them, but we verify in the Appendix that our empirical results are essentially unchanged when dividends are included in returns.

The *passive risky share* is the risky share at the end of the year if the household does not trade risky assets during the year. It is a function of the initial risky share and the passive risky return,

$$w_{h,t+1}^p = \omega^p(w_{h,t}; r_{h,t+1}),$$

where

$$\omega^p(w; r) \equiv \frac{w(1+r)}{w(1+r) + (1-w)(1+r_f)}.$$

The *passive change* is the change in the risky share during the year if the household trades no risky assets during the year:

$$P_{h,t+1} = w_{h,t+1}^p - w_{h,t}.$$

It is equal to zero if the investor is initially invested exclusively in cash $(w_{h,t} = 0)$ or exclusively in risky assets $(w_{h,t} = 1)$. The passive change is a hump-shaped function of the initial share if $r > r_f$, as investors presumably expect, but a U-shaped function of the initial share if $r < r_f$, as in our data from the bear market of 2000–2002.

The *active change* in the risky share, $A_{h,t+1} = w_{h,t+1} - w_{h,t+1}^p$, is the movement in the risky share that does not result mechanically from realized returns and thus reflects portfolio rebalancing. The total change in the risky share can be written as the sum of the active and passive changes:

$$w_{h,t+1} - w_{h,t} = P_{h,t+1} + A_{h,t+1}.$$

We will also use the analogous decomposition in logs,

$$\ln(w_{h,t+1}) - \ln(w_{h,t}) = p_{h,t+1} + a_{h,t+1},$$

where $p_{h,t+1} = \ln(w_{h,t+1}^p) - \ln(w_{h,t})$ and $a_{h,t+1} = \ln(w_{h,t+1}) - \ln(w_{h,t+1}^p)$ respectively denote the passive and active changes in logs.

These decompositions treat changes in riskless asset holdings, caused by saving, dissaving, or dividends received on risky assets, as active rebalancing. An alternative approach would be to

calculate the passive risky share that would result from household saving or dissaving, assumed to take place through accumulation or decumulation of riskless assets, in the absence of any trades in risky assets. This alternative decomposition is attractive to the extent that households build up and run down their riskless balances for liquidity reasons that are unrelated to their investment policies. We do not pursue this alternative decomposition further here, but in our structural model of active rebalancing we do allow for a white noise error that may capture high-frequency savings effects.

III.B. Rebalancing Regressions

Changes in a household's risky share tend to be strongly affected by the initial level of the risky share. One reason for this is purely mechanical: the total change $w_{h,t+1} - w_{h,t}$ is bounded between $-w_{h,t}$ and $1 - w_{h,t}$ in the presence of short sales and leverage constraints. In addition, there may be behavioral reasons, including sluggish rebalancing and high-frequency variation in riskless balances, that the risky share may be subject to transitory shocks and gradual reversion to a long-term mean.

The scatterplots in Figure II show the passive, active, and total changes in levels between 2001 and 2002 versus the initial risky share for a subsample of 10,000 households. In Panel A, the passive change is a U-shaped function of the initial share, as one expects in a bear market. Panel B reveals that the active change is close to zero for a sizeable group of households, who trade very little or not at all during the year. This observation is consistent with the inertia documented on other data sets. There is, however, considerable heterogeneity, and substantially positive or negative values of the active change are observed for many households. Moreover, the active change appears to decrease with the initial share, which suggests that the risky share tends to revert toward its cross-sectional mean. In Panel C, the total change is contained in the band defined by $-w_{h,t}$ and $1 - w_{h,t}$. The U-shaped influence of passive change is apparent, consistent with the inertia of some households. Overall, the scatterplots reveal substantial heterogeneity and strong dependence with respect to the initial risky share $w_{h,t}$.

The effects of passive change and initial portfolio weight on active change are clearly visible when we group households into bins according to their initial portfolio weight and plot the

A. Passive Change

B. Active Change
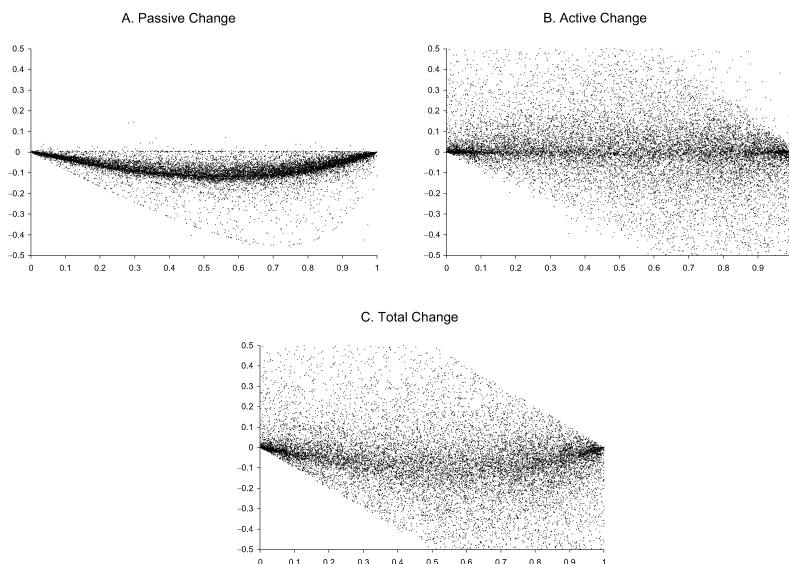
C. Total Change

FIGURE II
Scatterplots of Risky Share
Notes. The scatterplots illustrate the passive change (Panel A), active change (Panel B), and total change (Panel C) versus the initial risky share for a random sample of 10,000 households. All changes are computed in levels between 2001 and 2002 and are expressed in natural units.

equal-weighted average within each bin of the total change, the passive change and the active change. Figure III shows the results for the entire period 2000–2002 (Panel A) and for each year separately (Panels B–D). Because of the bear market during our sample period, the passive change is a U-shaped function of the initial exposure $w_{h,t}$. Active rebalancing is hump-shaped and overall decreasing with the initial share, which is consistent with both mean reversion in the risky share and a tendency to offset passive changes.

In Table II, we investigate the household-level relation between active and passive changes by estimating a rebalancing regression. We compare results in levels and in logs, but write the rebalancing regression here in logs,

$$(1) \quad a_{h,t+1} = \gamma_{0,t+1} + \gamma_1 p_{h,t+1} + \gamma_2 (\ln w_{h,t} - \overline{\ln w_{h,t}}) + u_{h,t+1},$$

where $\overline{\ln w_{h,t}}$ denotes the equal-weighted average of the log risky share. The regressor $(\ln w_{h,t} - \overline{\ln w_{h,t}})$ is included to capture the dependence of the active change on the initial risky share that
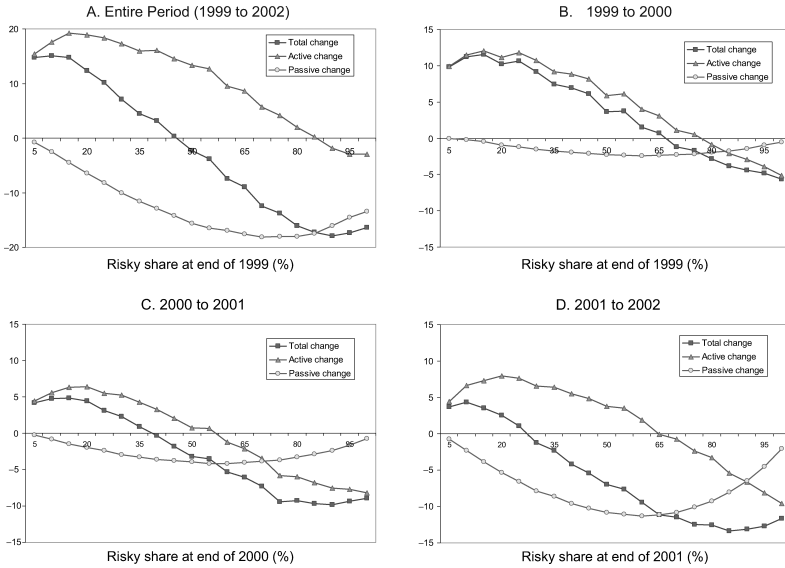
FIGURE III

Risky Share Decomposition

Notes. The figure illustrates the equal-weighted average of the total change, active change, and passive change in bins of the initial risky share. The changes are reported in percentages and computed in levels over the entire period (Panel A) and over each year of the sample (Panels B–D).

was illustrated in Figure II. We estimate (1) by OLS, both for pooled data, with year fixed effects, and for each separate cross section. We include in the regression only households that participate both in year t and in year $t + 1$. This allows us to disentangle inframarginal rebalancing from entry and exit decisions.

A fully passive household would be characterized by zero regression coefficients: $\gamma_{0,t+1} = \gamma_1 = \gamma_2 = 0$. The estimates of γ_1 are in fact close to -0.5 in the pooled regressions, and range between -0.8 and -0.4 in yearly cross sections. Thus we find that households offset about one-half of the passive change through active rebalancing. We obtain negative estimates of γ_2, implying that households with a large initial risky share have reduced their risk exposure more aggressively than other investors.

To understand the parameter estimates in Table II we now examine a few numerical examples. Consider a household invested in the value-weighted average household portfolio, with an initial share equal to the average equal-weighted share at the end of 2001: $w_{h,t} = 52.3\%$. In 2002, the average household portfolio

TABLE II
REGRESSION OF ACTIVE CHANGE ON PASSIVE CHANGE

	All years		2000		2001		2002	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
A. In levels								
Passive change	−0.504	−53.10	−0.640	−27.90	−0.608	−28.70	−0.443	−35.50
Initial risky share (demeaned)	−0.186	−144.00	−0.194	−88.10	−0.176	−82.40	−0.189	−78.70
Intercept			0.026	33.40	−0.030	−34.10	−0.022	−18.20
1999 dummy	0.028	40.40						
2000 dummy	−0.027	−38.10						
2001 dummy	−0.027	−26.70						
Number of observations	187,780		60,341		64,119		63,320	
Adjusted R^2	0.12		0.12		0.10		0.10	
B. In logs								
Passive change in logs	−0.442	−45.40	−0.745	−35.80	−0.534	−24.30	−0.423	−30.40
Log initial risky share (demeaned)	−0.199	−137.00	−0.275	−123.00	−0.152	−62.90	−0.161	−56.40
Intercept			0.098	37.50	−0.067	−22.50	−0.066	−15.00
1999 dummy	0.112	42.80						
2000 dummy	−0.060	−22.70						
2001 dummy	−0.071	−20.30						
Number of observations	187,780		60,341		64,119		63,320	
Adjusted R^2	0.14		0.24		0.09		0.10	

Notes. This table reports the pooled and yearly regressions of the active change on the passive change, both in levels (Panel A) and in logs (Panel B). Year t regressions include households that participate in risky asset markets both at the end of year $t − 1$ and at the end of year t. Pooled regressions are based on all the data points used in the yearly regressions, that is, on households that participate in two consecutive years.

yields -32.1%, and the household's corresponding passive share is 41.7%. We infer from the pooled regression reported in Table II, Panel A, that the predicted active change equals 2.4%.

Now consider an unlucky household with the same initial share but with a realized risky return of -55.1%. Among all participants, the household is in the 5th percentile of the risky return distribution. The corresponding passive change is -20.0% and the predicted active change then equals 7.1%. Alternatively, consider a lucky household with the same initial share but a realized risky return in the 95th percentile ($r_{h,t} = -7.3\%$). The active change is then -1.4%. Agents with returns below the cross-sectional average buy risky assets from agents with higher returns. An agent with an average share and an average return, on the other hand, makes fewer trades. The intuition that extreme agents trade more than average agents is familiar in equilibrium models.[4]

The rebalancing regression also predicts the effect of the initial share. For instance, a household that has an initial share in the 5th percentile ($w_{h,t} = 3.9\%$) and owns the value-weighted average household portfolio will select an active change of 6.2%. Similarly, a household with an initial share in the 95th percentile ($w_{h,t} = 95.5\%$) with an average portfolio will select an active change of -10.8%. Thus, the initial share and the realized return both have substantial quantitative effects on the active change.

In the online Appendix, we verify the robustness of the rebalancing regression by classifying households into initial risky share bins and regressing the active change onto the passive change within each bin. The estimate of the slope coefficient γ_1 is strongly and significantly negative in each risky share bin, so households with high and low involvement in risky financial markets all appear to be rebalancing actively.

The rebalancing coefficient is unusually large and negative in the lowest risky share bin, particularly when we run the regression in levels. This likely results in part from a boundary effect. During the bear market, most households with low initial exposure ($w_{h,t} \approx 0$) incur small passive losses in levels, which bring them closer to the short sales constraint $w_{h,t+1} \geq 0$. Such households may substantially increase their risky shares, which will be associated with strongly positive active changes. Very negative

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4. See Calvet, Gonzalez-Eiras, and Sodini (2004) for an example based on idiosyncratic nontradable risk.

active changes, on the other hand, are infeasible in levels (but are still in principle feasible in logs). The levels regression in the lowest risky share bin is therefore driven by observations with small negative passive and large positive active changes, resulting in a very negative slope coefficient γ_1. The coefficient in the lowest risky share bin is somewhat less anomalous when we run the regression in logs, which encourages us to use a log specification in our subsequent analysis.

III.C. Robustness Checks

Churning. One might worry that households do not deliberately rebalance the risky share, but instead randomly buy and sell risky assets—that is, churn their portfolios. Portfolio turnover causes measurement error in the passive share, so churning biases the regression coefficient of the active change on the passive change toward −1. In this case, our results tell us that there is active trading, but are not informative about deliberate rebalancing. A simple robustness check consists of confining attention to households that do not purchase new risky assets during the year. In other words, we exclude any household that has strictly positive holdings in period $t + 1$ of a risky security that it did not own at all in period t. In the Appendix, we report that the corresponding rebalancing propensity is about −0.3, which is weaker than the estimates in Table II but still substantial.[5] These estimates are conservative because they exclude households that purchase new assets as part of an active rebalancing strategy. This analysis suggests that churning alone cannot explain the strongly negative estimates of the passive change coefficient reported in our rebalancing regressions.

Automatic Investment Plans. Automatic investment plans are another source of apparent rebalancing. Consider a household that invests a fixed monetary amount in a basket of risky assets every year and makes no other trades. The active change is then a decreasing function of the risky portfolio's performance, while the passive change increases with performance. Automatic investment schemes can therefore generate a negative correlation between active and passive changes.

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5. The Appendix also estimates the adjustment model of the next section for households that purchase no new assets. The estimated adjustment speed is actually slightly higher for these households.

Automatic investment plans typically imply the purchase of the same assets every year. We have already found, in our robustness check for churning, that households that purchase no new assets have a weaker rebalancing propensity, suggesting that automatic investment plans cannot be driving our results. Further, a household that only trades automatically will neither buy nor sell assets and will therefore own the same set of assets at the end of years t and $t + 1$. We show in the Appendix that such households also have rebalancing propensities that are slightly lower than those reported in Table II. It is thus very unlikely that automatic investments account for our results.

We complement this analysis with a regression on a simulated data set of automatic savers. The automatic investment is assumed to be an exogenous percentage s of initial financial wealth. We set s equal to the average ratio in each year of savings to financial wealth for households purchasing no new assets during the year. In the Appendix, we regress the implied active change on the passive change and obtain only modest rebalancing propensities. Results are similar when we set s equal to a constant 3%, close to the time-series average of the yearly s ratios used in our main approach.

Cash Balances. Random fluctuations in cash balances are another concern. In the next section we develop a partial adjustment model that allows high-frequency shocks to affect the target risky share. In the Appendix, we instead use a bootstrap simulation to investigate this issue. Specifically, we assume that households do not rebalance or trade risky assets during the year and that their cash balances $cb_{h,t}$ follow the process $cb_{h,t+1} = R^{cb}_{h,t+1} cb_{h,t}$. The shocks $R^{cb}_{h,t+1}$ are i.i.d. across households and sampled from the empirical cross-sectional distribution of the growth rates of cash balances. The simulation generates only modest rebalancing propensities, which shows that random fluctuations in cash balances cannot explain the rebalancing results of this section.

IV. An Adjustment Model of the Risky Share

IV.A. *Specification*

The regressions of Section III have shown that rebalancing is influenced by both the initial share and the passive change. This motivates us to specify a model in which households sluggishly

adjust their portfolios toward a desired risky share $w^d_{h,t+1}$. Our approach is based on three main assumptions.

First, the natural log of the observed risky share $w_{h,t+1}$ is a weighted average of the log desired share $w^d_{h,t+1}$ and the log passive share $w^p_{h,t+1}$:

$$(2) \quad \ln(w_{h,t+1}) = \phi_h \ln\left(w^d_{h,t+1}\right) + (1 - \phi_h)\ln\left(w^p_{h,t+1}\right) + \varepsilon_{h,t+1}.$$

The error $\varepsilon_{h,t+1}$ is assumed to be i.i.d., resulting from measurement error, high-frequency variations in riskless balances, and any other idiosyncratic factors influencing portfolio composition. The coefficient ϕ_h controls the household's speed of adjustment. It can take any real value, but values between zero and one are economically most sensible. If $\phi_h = 1$, the household adjusts instantaneously, and the observed share is equal to the desired share plus an error: $\ln(w_{h,t+1}) = \ln(w^d_{h,t+1}) + \varepsilon_{h,t+1}$. A sluggish household ($\phi_h < 1$), on the other hand, is also sensitive to the passive share.

Second, the speed of adjustment coefficient ϕ_h is a linear function of observable characteristics,

$$(3) \qquad\qquad \phi_h = \varphi_0 + \varphi' x_{h,t},$$

where the vector $x_{h,t}$ is independent of the errors $\varepsilon_{h,t}$ and $\varepsilon_{h,t+1}$. This specification captures the empirical relation between speed of adjustment and measures of financial sophistication such as wealth and education.

Third, the level of the log desired risky share can vary in an arbitrary manner across households, but the change in the log desired risky share is related to household characteristics by

$$(4) \qquad\qquad \Delta \ln\left(w^d_{h,t+1}\right) = \delta_{0,t+1} + \delta'_{t+1} x_{h,t}.$$

This equation has a convenient interpretation when households have constant relative risk aversion γ_h and returns on the risky asset are i.i.d. The desired risky share of household h is then $w^d_{h,t+1} = S_{h,t+1}/(\gamma_h \sigma_{h,t+1})$, and changes in the log of the desired risky share, $\Delta \ln(w^d_{h,t+1}) = \Delta \ln(S_{h,t+1}/\sigma_{h,t+1})$, are driven only by perceived variations in investment opportunities and not by risk aversion. Equation (4) can then be viewed as expressing changes in perceived investment opportunities as a time-specific function of an intercept and household characteristics. This convenient property does not hold in levels, which supports our choice of a

log specification. In practice, many other factors can, of course, alter the desired risky share, including changes in real estate holdings, human capital, background risk, or wealth if the agent has decreasing relative risk aversion.

IV.B. *Estimation*

We now turn to the estimation of the adjustment model. In our specification, a household's target share $\ln(w^d_{h,t+1})$ is not observed, but its change $\Delta \ln(w^d_{h,t+1})$ is a parametric function of characteristics (4). The first step is therefore to difference the portfolio share (2):

$$\Delta \ln\left(w_{h,t+1}\right) = \phi_h \Delta \ln\left(w^d_{h,t+1}\right) + (1 - \phi_h)\Delta \ln(w^p_{h,t+1}) + \varepsilon_{h,t+1} - \varepsilon_{h,t}.$$

We then substitute out ϕ_h and $\Delta \ln(w^d_{h,t+1})$, using (3) and (4), and obtain the reduced-form specification

$$\Delta \ln(w_{h,t+1}) = a_{t+1} + b_0 \Delta \ln\left(w^p_{h,t+1}\right) + b' x_{h,t} \Delta \ln\left(w^p_{h,t+1}\right)$$
$$(5) \qquad\qquad + c'_{t+1} x_{h,t} + x'_{h,t} D_{t+1} x_{h,t} + \varepsilon_{h,t+1} - \varepsilon_{h,t}.$$

The reduced-form coefficients relate as follows to the structural parameters of the adjustment model: $a_{t+1} = \varphi_0 \delta_{0,t+1}$, $b_0 = 1 - \varphi_0$, $b = -\varphi$, $c_{t+1} = \delta_{t+1}\varphi_0 + \delta_{0,t+1}\varphi$, and $D_{t+1} = \varphi \delta'_{t+1}$.

The error term of the reduced-form specification (5), $\varepsilon_{h,t+1} - \varepsilon_{h,t}$, follows a first-order moving average process. A high realization of $\varepsilon_{h,t}$ feeds into a high share $w_{h,t}$ and a high passive share $w^p_{h,t+1}$, which implies that the error $\varepsilon_{h,t+1} - \varepsilon_{h,t}$ and the regressor $\Delta \ln(w^p_{h,t+1}) = \ln \omega^p(w_{h,t}; r_{h,t+1}) - \ln(w^p_{h,t})$ are negatively correlated. Because of this problem, (5) cannot be consistently estimated by ordinary least squares (OLS). We handle this by finding a set of instruments that are correlated with the explanatory variables in (5) but uncorrelated with the error term. The *period-$(t + 1)$ zero-rebalancing passive change*,

$$\ln \omega^p\left(w^p_{h,t}; r_{h,t+1}\right) - \ln\left(w^p_{h,t}\right),$$

is the passive change that would be observed at $t + 1$ if the household did not rebalance at t. Because rebalancing is limited, this variable should be positively correlated with the actual change in the passive share. At the same time, if the return $r_{h,t+1}$ is independent of the errors, the period-$(t + 1)$ zero-rebalancing passive change is uncorrelated with $\varepsilon_{h,t}$ and can therefore be used in a set of instruments.

TABLE III
ADJUSTMENT MODEL WITHOUT CHARACTERISTICS

	OLS		IV	
	Estimate	*t*-stat	Estimate	*t*-stat
Reduced-form parameters				
Change in log passive share	−0.121	−44.20	0.363	39.30
Intercept 2001	−0.111	−42.00	−0.139	−46.30
Intercept 2002	−0.246	−92.10	−0.119	−31.50
Structural parameters				
Adjustment speed φ_0	1.121	410.00	0.637	68.90
Target change $\delta_{0,2001}$	−0.099	−41.50	−0.219	−35.60
Target change $\delta_{0,2002}$	−0.219	−95.60	−0.186	−39.90
Number of observations	120,067		120,067	
Adjusted R^2	0.08			

Notes. This table reports the IV and OLS estimates of the adjustment model without characteristics. The estimation is based on households that participate in risky asset markets at the end of two consecutive years.

In Table III we estimate the adjustment model for the special case where all households have the same adjustment speed and target change, which corresponds to the restriction $\varphi = \delta = 0$. The OLS regression of the total log change in the risky share on the passive log change and a time fixed effect,

$$\Delta \ln(w_{h,t+1}) = a_{t+1} + b_0 \Delta \ln\left(w_{h,t+1}^p\right) + u_{h,t+1},$$

gives an estimate for b_0 of −0.12. This estimate is negatively biased, because the regressor $\Delta \ln(w_{h,t+1}^p)$ and the residual $u_{h,t+1}$ are negatively correlated. When we correct the bias by running an instrumental variables (IV) estimation with an intercept, the log of the initial passive share, and the zero-rebalancing passive change as instruments, we obtain a considerably higher b_0 estimate of 0.36. The difference is economically meaningful. The OLS estimate implies an adjustment speed $\varphi_0 = 1 - b_0$ that is larger than unity, whereas the IV estimate implies an adjustment speed $\varphi_0 = 0.64$, which is broadly consistent with the rebalancing regressions in Section III.

The next step is to estimate the adjustment model, allowing observable household characteristics to affect the adjustment speed and the change in the desired log risky share. The set of characteristics includes demographic, financial, and portfolio characteristics. The first category includes age, household size, and dummies for households that have high-school education,

post-high-school education, or missing education data (most common among older and immigrant households) or are immigrants. The second category includes disposable income, contributions to private pension plans as a fraction of a three-year average of disposable income, log financial wealth, log real estate wealth, log of total debt liabilities, and dummies for households that are retired, unemployed, self-employed ("entrepreneurs"), and students. The third category, which is unique to our data set, includes the standard deviation of the risky portfolio and the Sharpe ratio of the risky portfolio.

The inclusion of financial wealth F_{ht} as a household characteristic creates a new difficulty. Financial wealth depends on the random cash balance observed at the end of year t, and is therefore correlated with the measurement error $\varepsilon_{h,t}$. A natural solution is to use as an instrument passive financial wealth $F_{h,t-1}(1+r_{h,t}^c)$, where $1+r_{h,t}^c \equiv w_{h,t-1}(1+r_{h,t})+(1-w_{h,t-1})(1+r_f)$ denotes the gross passive return on the complete portfolio. This leads us to define the following set of instruments: (1) an intercept; (2) the period-t log passive share; (3) the period-$(t+1)$ zero-rebalancing passive change; (4) the period-t passive financial wealth; (5) a vector of characteristics uncorrelated with the measurement error; and (6) the log passive share, zero-rebalancing passive change, passive financial wealth, and characteristics interacted with the vector of characteristics.

To simplify the estimation of the full model (5), given that we have a short panel with only two years of data after differencing, we estimate the reduced form assuming constant coefficients over time on the household characteristics: $c_{t+1} = c$, and $D_{t+1} = D$. The structural restrictions of the model then imply that the time fixed effects a_{t+1} are also constant, as are the structural coefficients in the equation for the change in the desired risky share, (4): $\delta_{0,t+1} = \delta_0$ and $\delta_{t+1} = \delta$. We do not impose constant time fixed effects but find them to be almost identical in 2001 and 2002.

IV estimates of this model are reported in the first set of columns of Table IV. Each characteristic is standardized to have zero cross-sectional mean. We also normalize to unity the cross-sectional standard deviation of each continuous characteristic, so the reported regression coefficient reveals the effect of a one-standard-deviation change in the characteristic. To keep the table at a manageable size, we only report the structural vectors φ and δ of the full regression. The median value of the speed parameter is 0.73 and the average log target change is -0.18 in 2002.

TABLE IV
ADJUSTMENT MODEL WITH CHARACTERISTICS

	Speed		Target change		Speed		Target change	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
A. Parameter estimates								
Intercepts								
Adjustment speed φ_0	0.718	69.80			0.741	68.60		
Target change $\delta_{0,2001}$			−0.154	−8.30			−0.121	−6.21
Target change $\delta_{0,2002}$			−0.159	−8.59			−0.136	−6.96
Portfolio characteristics								
Standard deviation of risky portfolio	0.075	2.29	−0.379	−8.88	0.080	2.29	−0.259	−5.25
Sharpe ratio of risky portfolio	1.147	9.23	−0.538	−6.18	1.213	9.23	−0.510	−5.75
Financial characteristics								
Disposable income	0.010	2.18	0.012	0.67	0.007	1.36	−0.024	−1.27
Private pension premia/income	−0.009	−1.61	−0.008	−1.34	−0.010	−1.63	−0.012	−1.95
Log financial wealth	0.040	3.37	0.052	10.70	0.052	4.12	0.093	10.60
Change in log financial wealth							0.277	5.76
Log real estate wealth	0.007	0.83	−0.081	−6.37	0.009	0.96	−0.125	−8.13
Log total liability	0.031	2.64	0.023	2.38	0.032	2.60	0.041	3.99
Retired dummy	−0.078	−2.16	0.019	0.43	−0.087	−2.29	0.017	0.37
Unemployment dummy	−0.055	−2.00	0.051	1.00	−0.066	−2.27	0.058	1.12
Entrepreneur dummy	−0.069	−1.81	0.001	0.04	−0.077	−1.91	−0.005	−0.23
Student dummy	−0.051	−0.96	0.077	0.60	−0.045	−0.81	0.055	0.42

TABLE IV
(CONTINUED)

	Speed		Target change		Speed		Target change	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Demographic characteristics								
Age	0.001	1.75	−0.002	−4.49	0.002	2.21	−0.002	−3.99
Household size	−0.014	−2.37	−0.017	−3.59	−0.017	−2.70	−0.013	−2.77
High-school dummy	0.086	3.80	−0.003	−0.29	0.088	3.68	−0.009	−0.96
Post-high-school dummy	0.042	2.48	−0.002	−0.26	0.047	2.66	−0.008	−0.93
Dummy for unavailable education data	0.093	1.98	0.111	1.84	0.107	2.17	0.115	1.87
Immigration dummy	0.000	0.02	−0.021	−2.14	0.002	0.08	−0.024	−2.37
			B. Cross-sectional distribution (2001)					
5th percentile	0.532		−0.286		0.538		−0.368	
25th percentile	0.662		−0.226		0.679		−0.230	
50th percentile	0.729		−0.178		0.753		−0.145	
75th percentile	0.787		−0.092		0.818		−0.025	
95th percentile	0.862		0.046		0.902		0.197	

Notes. This table reports the estimates of the adjustment model (Panel A) and the implied cross-sectional distribution of the speed parameter and target change in 2001 (Panel B). The estimation is based on households that participate in risky asset markets at the end of two consecutive years and for which the immigration dummy is available. Disposable income is averaged over the previous three years. All characteristics are demeaned year by year, and continuous financial characteristics other than the change in financial wealth are normalized to have unit standard deviation in each cross section. Portfolio characteristics are in natural units.

These numbers are consistent with the rebalancing regressions in Section III and imply a modest revision in the target share. The estimates of φ and δ are robust to the inclusion or exclusion of the nonlinear interacted term $x'_{h,t}Dx_{h,t}$.

The most striking result in Table IV is that the speed of adjustment tends to increase with variables associated with financial sophistication, such as education, disposable income, debt, and financial and real estate wealth. In addition, households with well-diversified portfolios (high Sharpe ratios) have higher adjustment speeds. Entrepreneurial activity, retirement, unemployment, and household size, on the other hand, reduce the adjustment speed.

Changes in the target risky share are less consistently related to household characteristics. Households with greater financial wealth reduce their target less. Real estate wealth, on the other hand, works in the opposite direction, perhaps because the booming Swedish real estate market reduced the attractiveness of stocks to real-estate-oriented investors in 2001 and 2002. Well-diversified and aggressive households, with higher Sharpe ratios and riskier portfolios, reduce their target share more; but so do larger, older, and immigrant households, which normally invest cautiously (CCS 2007).

The estimates in Table IV can be used to compute the predicted speed parameter and target change of every household. The cross-sectional distribution of the speed ϕ_h has a median value of 0.73, a 5th percentile of 0.53, and a 95th percentile of 0.86, numbers that seem quite reasonable. Similarly, the target change $\Delta \ln(w^d_{h,t+1})$ has a 5th percentile of -29%, a median value of -18%, and a 95th percentile of 5%, which again seem quite reasonable in a severe bear market.

In the Appendix, we report the average characteristic values for households at different percentiles of the predicted adjustment speed and target change distributions. The average household at the 5th percentile of adjustment speed has disposable income of about $20,700 and wealth of $10,500, 47% of which is invested in risky assets with a Sharpe ratio of 0.22. Of these slowly adjusting households, 35% have a high school education, and 6% have a college education. At the 95th percentile of adjustment speed, by contrast, the average household has disposable income of $42,800 and wealth of $56,200, 70% of which is invested in risky assets with a Sharpe ratio of 0.31. Of these rapidly adjusting households, 95% have a high school education, and 71% have a college

education. In short, rapidly adjusting households appear to be more financially sophisticated than slowly adjusting households.

The Appendix also reports results when we estimate the adjustment model separately for the years 2001 and 2002, allowing both adjustment speeds and target changes to vary across years. The results are qualitatively similar to those reported in Table IV, although adjustment speeds appear to be higher in 2001 than in 2002, and some of the individual characteristics have coefficients that are unstable over time.

IV.C. Impact of Wealth Changes on Risk Taking

In the first set of columns of Table IV, we have used slowly evolving demographic and financial variables as household characteristics that may influence portfolio adjustment. We now explore the possibility that portfolio decisions are also affected by high-frequency variation in financial wealth. Several branches of financial theory suggest that an increase in financial wealth might increase the propensity to take risk. In the presence of borrowing constraints, individuals become less risk-averse as they become richer and thus less likely to face a binding constraint in the future. Even in the absence of such frictions, investors with decreasing relative risk aversion tend to hold a higher risky share as their wealth goes up. Carroll (2000, 2002) builds such a utility function and documents a positive empirical relation between household wealth and the risky share. Models of portfolio insurance (Brennan and Schwartz 1988) and habit formation (Constantinides 1990; Dybvig 1995; Campbell and Cochrane 1999) also imply a positive relation between wealth and the risky share, because richer agents are more willing to take risk as their wealth moves further above the minimum level required by the portfolio insurance policy or the present value of the future habit.

In the second set of columns of Table IV, we reestimate the adjustment model using the contemporaneous change in log financial wealth as an additional household characteristic that can affect the change in the target. We add one instrument to the previous set, the zero-rebalancing return on the complete portfolio, that is, the return that each household would earn at $t + 1$ if it did not rebalance at t. We find that an increase in log financial wealth leads to a higher target risky share, while the impact of other characteristics is largely unchanged.

In the Appendix, we show that results are similar when we estimate the model separately for the years 2001 and 2002, although the effect of the change in log financial wealth on the target risky share is stronger in 2002. The Appendix also reports similar results when we allow the change in log financial wealth to affect the adjustment speed as well as the desired risky share. We find little variation in the change in log financial wealth across rapidly adjusting and slowly adjusting households, but large variation across households with high and low predicted changes in the target risky share. Households at the 5th percentile of the target change experience average financial wealth declines of 44%, whereas households at the 95th percentile of the target change experience average financial wealth increases of 31%.

In a recent study, Brunnermeier and Nagel (2008) assess the empirical relation between wealth and the risky share using U.S. data from the Panel Study of Income Dynamics (PSID). They regress the change in the risky share (in levels) on the change in financial wealth (in logs) and control variables and obtain a small and slightly negative wealth coefficient. They attribute this result to inertia. When a household saves in the form of cash during the year and only partially rebalances its financial portfolio, its risky share tends to fall mechanically.

In the Appendix, we estimate the Brunnermeier–Nagel regression on our Swedish data set. The OLS estimate of the regression coefficient is slightly negative, consistent with Brunnermeier and Nagel's finding; but it becomes positive when we estimate the regression by instrumental variables. Similarly, we find a positive relation between the change in the risky share and the *lagged* change in financial wealth. These results are robust to separate estimation of the regression in the years 2001 and 2002. Thus, controlling for endogeneity problems and household inertia, the Swedish data do show some evidence for a positive link between wealth changes and risk taking.

IV.D. Connection with Rebalancing Regressions

The adjustment model of this section is intimately related to the rebalancing regressions we estimated in Section III. When the adjustment speed and target changes are the same for all households, the adjustment model implies

$$(6) \qquad a_{h,t+1} = \phi \delta_{0,t+1} - \phi p_{h,t+1} - \phi \left(\ln w_{h,t} - \ln w_{h,t}^d \right) + \varepsilon_{h,t+1},$$

which is analogous but not exactly identical to the rebalancing regression (1). The similarity suggests that the adjustment speed should be close to the regression coefficients reported in Table II, Panel B; this is indeed the case in our empirical results because the median speed ϕ_h and the linear regression coefficient $-\gamma_1$ are both about one-half. The distance to the target, $\ln w_{h,t} - \ln w_{h,t}^d$, represents the only difference between (1) and (6). We can therefore view (1) as a reduced-form specification in which all households have the same speed of adjustment and the distance to the target, $\ln w_{h,t} - \ln w_{h,t}^d$, is proxied by a rescaled distance to the cross-sectional mean, $\lambda(\ln w_{h,t} - \overline{\ln w_{h,t}})$.

We show in the Appendix that the adjustment model with heterogeneous agents leads to additional terms in the rebalancing regressions. Section IV thus improves on the specification in Section III by (1) providing more precise micro foundations; (2) correctly estimating the structural parameters even though the target is unobserved; and (3) allowing for heterogeneity in the adjustment speed and the target change.

In the Appendix, we investigate the role of household characteristics in the rebalancing regression (1). The reduction in the risky share is in all years less pronounced for households with higher financial wealth or debt. These households were more willing to maintain their proportional investments in risky assets than were other Swedish households. We interact demographic variables with passive changes and find that wealthier and more sophisticated households tend to have more negative regression coefficients of active changes on passive changes; that is, they rebalance more actively. These findings confirm the results of the adjustment model. They are limited, however, in that they do not allow us to disentangle household inertia from changes in the target risky share, as the adjustment model can do.

V. ASSET-CLASS PARTICIPATION, ASSET-LEVEL REBALANCING, AND THE DISPOSITION EFFECT

We now study household decisions to participate in asset classes (risky assets, mutual funds, and direct stockholding) and to rebalance positions in individual assets. We relate these decisions to the disposition effect, the tendency to realize gains and hold on to losses, where gains and losses are measured relative to the asset's purchase price. The disposition effect was identified

by Shefrin and Statman (1985) and has been widely documented (e.g., Odean [1998]).

The Swedish data set unfortunately does not provide the dates or prices of individual asset trades. For this reason, we use an asset's return during the year as an alternative measure of performance. This implies that we are assessing the robustness of the disposition effect to this alternative benchmark. The Swedish data set has an important compensating advantage: we can relate the disposition effect to demographic and financial characteristics of households, as well as the characteristics of the portfolios they hold. This allows us to extend the recent finding of Dhar and Zhu (2006) that households with higher self-reported income are less prone to the disposition effect.

V.A. *Entry and Exit at the Risky Portfolio and Asset Class Levels*

We begin by investigating the probability that a household enters or exits risky asset markets. In Table V, we run pooled probit regressions of the form $y_{h,t} = \Phi(x'_{h,t}\gamma + \gamma_{0,t})$, where $y_{h,t}$ denotes participation status, $x_{h,t}$ is the vector of characteristics, and $\gamma_{0,t}$ is a time-dependent intercept. The time interval is annual, and we pool data from 2000, 2001, and 2002. To facilitate comparison, we report in the last three rows the rates of entry to and exit from risky asset markets in each year.

In the first set of three columns, we analyze the probability that a nonparticipant in year t holds risky assets in year $t + 1$. The first two columns report coefficients and t-statistics, whereas the third column assesses the economic magnitude of the coefficient estimates by reporting the impact on the entry probability of increasing a nondummy regressor by one standard deviation, or setting a dummy variable equal to one. This impact depends on the base rate of entry; we report it for the year 2001, in which the overall entry rate was 5.7%, much lower than the rate in 2000 and slightly higher than the rate in 2002.

The probability of entry increases with standard measures of financial sophistication such as education, financial and real estate wealth, and the private pension savings rate. Conversely, the exit probability decreases with variables associated with investor sophistication, as shown in the middle three columns of Table V. The entry and exit regressions are thus remarkably symmetric and consistent with earlier research on cross-sectional data. Household characteristics that predict participation in a

TABLE V
ENTRY AND EXIT PROBABILITIES

	Entry			Exit		
	Estimate	t-stat	Change	Estimate	t-stat	Change
Portfolio characteristics						
Initial risky share				−0.571	−24.70	−0.81%
Standard deviation of risky portfolio				−0.278	−5.20	−0.20%
Dummy for risky share >95%				0.066	1.82	0.09%
Sharpe ratio of risky portfolio				−0.461	−4.64	−0.16%
Gain of risky portfolio				0.476	6.27	0.16%
Loss of risky portfolio				0.396	6.40	0.37%
Financial characteristics						
Disposable income	0.093	13.70	0.88%	0.015	3.33	0.09%
Private pension premia/income	0.029	5.86	0.26%	−0.077	−6.38	−0.42%
Log financial wealth	0.221	29.40	2.33%	−0.356	−46.60	−1.47%
Log real estate wealth	0.104	15.70	1.00%	−0.069	−10.70	−0.38%
Log total liability	0.071	8.48	0.66%	−0.026	−3.09	−0.15%
Retirement dummy	0.000	−0.01	0.00%	0.019	0.74	0.11%
Unemployment dummy	−0.039	−2.31	−0.33%	0.093	4.70	0.60%
Entrepreneur dummy	0.036	1.00	0.33%	−0.031	−0.86	−0.18%
Student dummy	−0.130	−4.36	−1.01%	0.164	4.72	1.12%

TABLE V
(CONTINUED)

	Entry				Exit			
	Estimate	t-stat	Change	Estimate	t-stat	Change	Estimate	t-stat	Change

	Estimate	t-stat	Change	Estimate	t-stat	Change
	Demographic characteristics					
Age	−0.018	−28.50	−2.18%	0.005	7.53	0.52%	0.005	6.99	0.46%
Household size	−0.054	−9.24	−0.51%	0.015	2.74	0.12%	−0.012	−2.04	−0.08%
High school dummy	0.115	7.27	1.11%	−0.058	−3.47	−0.32%	−0.049	−2.90	−0.26%
Post-high school dummy	0.138	8.90	1.36%	−0.062	−4.01	−0.34%	−0.050	−3.17	−0.26%
Dummy for unavailable education data	−0.090	−3.12	−0.72%	−0.001	−0.02	0.00%	0.002	0.06	0.01%
Immigration dummy	−0.095	−6.03	−0.76%	0.201	11.80	1.43%	0.197	11.40	1.33%
Rate of entry/exit in 2000			15.8%			1.9%			1.9%
Rate of entry/exit in 2001			5.7%			3.4%			3.4%
Rate of entry/exit in 2002			4.4%			3.9%			3.9%

Notes. The table reports the pooled probit regression of a household's entry to and exit from risky asset markets. Explanatory variables include yearly fixed effects and portfolio, financial, and demographic characteristics. Disposable income is averaged over the previous three years. For each regression, we report the linear coefficient, *t*-statistic, and marginal effect of each predicting variable. All characteristics are demeaned year by year, and continuous financial characteristics are normalized to have unit standard deviation in each cross section. Portfolio characteristics are in natural units. The marginal effect is assessed by computing the impact on the dependent variable (in levels) of increasing a nondummy regressor by one standard deviation, or setting a dummy variable equal to one, in year 2001. We exclude households for which the immigration dummy is unavailable.

cross section (e.g., Guiso, Haliassos, and Jappelli [2002]; CCS [2007]) also help to explain entry and exit in the panel.

In the last three columns of Table V, we investigate how the exit probability is affected by portfolio characteristics. The exit probability decreases with the initial risky share and the standard deviation of the risky portfolio. More aggressive agents have higher risk tolerance and are less likely to give up the benefits of financial risk taking entirely. A complementary explanation is that households sluggishly adjust their portfolios, as in Section IV; more aggressive investors are then more reluctant to dispose of all their risky assets. The exit probability, however, increases with extreme risk taking, as measured by a dummy equal to unity if the risky share exceeds 95%. Extreme risk takers presumably have limited understanding of financial risk and may be prone to panic selling in a bear market.

A household is also more likely to exit if it is undiversified (low Sharpe ratio $S_{h,t}$). Finally, we consider the performance of the risky portfolio during the year and distinguish between positive returns (winning portfolios) and negative returns (losing portfolios). Large absolute returns tend to increase the probability of exit, and the effect is slightly more pronounced for winners than for losers.

We next investigate the separate roles of direct stock and mutual fund holdings. It is useful to decompose the overall Sharpe ratio into its stock and fund components. Let $D_{h,t}$ denote the share of direct stockholdings in the risky portfolio, $S_{D,h,t}$ and $S_{F,h,t}$ the Sharpe ratios of the stock and fund portfolios, and $\sigma_{D,h,t}$ and $\sigma_{F,h,t}$ their standard deviations. The Sharpe ratio of the risky portfolio satisfies

$$S_{h,t} = C_{D,h,t} + C_{F,h,t},$$

where the components of the Sharpe ratio attributable to each asset class are given by

$$C_{D,h,t} = S_{D,h,t} \frac{D_{h,t}\sigma_{D,h,t}}{\sigma_{h,t}},$$

$$C_{F,h,t} = S_{F,h,t} \frac{(1 - D_{h,t})\sigma_{F,h,t}}{\sigma_{h,t}}.$$

The contribution of an asset class to the overall Sharpe ratio is large if the household holds a diversified portfolio of assets in the class, which represents a large fraction of its risk exposure.

In Table VI, we investigate exit decisions by asset class for a subset of households that initially own both stocks and mutual funds. As in the previous tables, we include financial and demographic variables and the risky portfolio's standard deviation. We also consider the contributions of stocks and funds to the overall Sharpe ratio and the performance during the year of the household's stocks and funds. These variables are used to explain the probability that a participating household disposes of all its risky assets (first three columns), all its directly held stocks (next three columns), or all its mutual funds (last three columns).

Most of the patterns in Table VI are consistent with those already shown in Table V. The striking new result in Table VI is that the exit probability from risky asset markets increases strongly with the performance of winning stock portfolios. Winning stock portfolio performance has an even greater impact on the probability of exiting direct stockholding, as shown in the second column of the table. These findings are consistent with the disposition effect on direct stockholdings: the owner of a winning stock portfolio is more likely to sell it and leave financial markets. There is little evidence in the table of a comparable disposition effect for mutual funds. The owner of a winning mutual fund portfolio is slightly more likely to liquidate it, but the effect is small and statistically insignificant; losses have a larger effect on the mutual fund sales probability, consistent with the literature on performance sensitivity of mutual fund holdings (Ippolito 1992; Gruber 1996; Chevalier and Ellison 1997; Sirri and Tufano 1998; Frazzini and Lamont 2008; Ivkovic and Weisbenner 2007).

V.B. Dynamics of Individual Asset Shares

We now investigate how a household adjusts during year $t + 1$ the asset positions that it holds at the end of year t. Because exit decisions have been addressed in Section V.A, we consider only households that own risky assets in both years. Also, we confine attention to assets that are held at the end of year t and do not attempt to model household decisions to purchase new assets.

A household owning a stock at the end of 2000 had, by the end of 2001, partially sold it with probability 27%, fully sold it with probability 16%, held on to it with probability 22%, and bought additional units of the same stock with probability 35%. Partial sales and partial purchases are thus more frequent than full sales or continued holdings. As reported in the Appendix, this property holds in all years and is even more pronounced for mutual funds:

TABLE VI

IMPACT OF STOCK AND MUTUAL FUND HOLDINGS ON EXIT PROBABILITY

	Risky assets			Stocks			Mutual funds		
	Estimate	t-stat	Change	Estimate	t-stat	Change	Estimate	t-stat	Change
Portfolio characteristics									
Initial risky share	−0.292	−4.11	−0.08%	−0.178	−4.70	−0.25%	−0.368	−10.20	−0.48%
Standard deviation of risky portfolio	0.170	1.15	0.02%	0.373	4.62	0.26%	0.382	4.83	0.25%
Stock component of Sharpe ratio	−1.276	−2.88	−0.10%	−3.302	−13.40	−1.17%	−0.279	−1.23	−0.12%
Fund component of Sharpe ratio	−1.190	−3.42	−0.12%	−0.762	−4.08	−0.43%	−1.754	−9.53	−0.85%
Gain of stock portfolio	0.268	2.57	0.04%	0.694	13.20	0.56%	−0.106	−1.20	−0.07%
Loss of stock portfolio	0.080	0.80	0.02%	0.015	0.29	0.02%	−0.046	−0.84	−0.05%
Gain of mutual fund portfolio	0.157	0.26	0.00%	−0.338	−0.85	−0.05%	0.444	1.67	0.07%
Loss of mutual fund portfolio	0.436	1.84	0.07%	−0.091	−0.67	−0.07%	0.263	2.24	0.20%
Financial characteristics									
Disposable income	0.014	1.78	0.02%	0.012	1.62	0.07%	−0.046	−0.84	0.08%
Private pension premia/income	−0.136	−3.59	−0.13%	−0.033	−2.35	−0.19%	0.444	1.67	−0.39%
Log financial wealth	−0.169	−7.78	−0.15%	−0.208	−17.80	−0.98%	0.263	2.24	−0.75%
Log real estate wealth	−0.060	−3.31	−0.06%	−0.033	−3.26	−0.18%	0.014	2.30	−0.24%
Log total liability	−0.026	−1.01	−0.03%	0.017	1.30	0.10%	−0.076	−5.06	−0.04%
Retirement dummy	0.043	0.56	0.05%	0.130	3.28	0.85%	−0.157	−14.60	0.16%
Unemployment dummy	0.196	3.05	0.29%	0.003	0.07	0.02%	−0.044	−4.61	0.77%
Entrepreneur dummy	−0.033	−0.33	−0.04%	−0.105	−2.05	−0.55%	−0.008	−0.61	−0.01%
Student dummy	0.155	1.33	0.22%	0.077	1.15	0.48%	0.028	0.77	1.77%

TABLE VI
(CONTINUED)

	Risky assets			Stocks			Mutual funds		
	Estimate	t-stat	Change	Estimate	t-stat	Change	Estimate	t-stat	Change
Demographic characteristics									
Age	0.002	0.97	0.04%	−0.003	−2.59	−0.23%	0.122	3.39	0.27%
Household size	0.027	1.58	0.04%	0.040	4.72	0.31%	−0.003	−0.06	−0.43%
High school dummy	−0.012	−0.22	−0.01%	0.005	0.18	0.03%	0.249	3.96	−0.19%
Post-high school dummy	0.014	0.30	0.02%	0.005	0.23	0.03%	0.003	2.87	−0.26%
Dummy for unavailable education data	0.122	1.52	0.16%	0.143	3.24	0.95%	−0.066	−7.27	−0.22%
Immigration dummy	0.149	2.76	0.21%	0.112	3.73	0.72%	−0.036	−1.31	0.91%
Rate of exit in 2000			0.3%			2.9%			2.2%
Rate of exit in 2001			0.5%			3.2%			3.0%
Rate of exit in 2002			0.6%			2.6%			3.3%

Notes. The table reports a pooled probit regression that a household sells all its risky assets (first set of three columns), and all its risky mutual funds (last set of three columns). We include yearly fixed effects, and average out disposable income over the previous three years. For each regression we report the linear coefficient, *t*-statistic, and marginal effect of each predicting variable. All characteristics are demeaned year by year, and continuous financial characteristics are normalized to have unit standard deviation in each cross section. Portfolio characteristics are in natural units. The marginal effect is assessed by computing the impact on the dependent variable (in levels) of increasing a nondummy regressor by one standard deviation, or setting a dummy variable equal to one, in year 2001. The regressions are based on the set of households that hold both stocks and funds. We exclude households for which the immigration dummy is unavailable.

the probability of a fund's full sale is less than 10% whereas the probability of a partial purchase is about 60%. The high probability of partial purchases for funds is attributable in part to the dividend reinvestment plans offered by most investment companies. Even though full sales are a relatively limited phenomenon, we begin by studying them separately given their importance in the disposition effect literature.

Full Sales. In Table VII, we analyze the probability that a household owning a risky asset j at date t has fully disposed of it by the end of year $t + 1$. The regression distinguishes between stocks and funds, and between assets with positive returns (winners) and negative returns (losers) during the year. We include household demographic and financial characteristics, and portfolio characteristics, both directly and interacted with the return on the asset during the year.[6] The table reports the coefficients on the characteristics interacted with return but omits the direct coefficients; the full regression is reported in the Appendix.

The probability of fully selling an asset increases with the absolute value of its performance during the year. Households are more likely to fully sell extreme losers or extreme winners than stocks and funds that have close to zero returns. For stocks, this effect is much more pronounced for winners than for losers, which seems consistent with a disposition effect on direct stock-holdings. For funds, performance also impacts the probability of a full sale, but there is substantially less asymmetry between losers and winners. The tendency to sell losing funds is consistent with the literature on performance sensitivity. For winning funds, however, household behavior is both driven by the tendency to hold on to winners, for instance because they are run by skilled managers, but also a tendency to sell winning assets in order to rebalance the risky portfolio. The connection between asset trades and portfolio rebalancing will be further investigated in Section VI.

Financial and portfolio characteristics have a substantial impact on the probability of a full sale of stock. Wealthier households with riskier overall portfolios and better diversified stock portfolios are less likely to sell a winning stock but more likely to sell a losing stock. These effects reduce the asymmetry between winners and losers and therefore weaken the disposition effect on direct

6. In Table VII, we assign a value of zero to the characteristic of an asset class if the household has no investments in this class. A similar convention is used in the remainder of the section.

TABLE VII
PROBABILITY OF FULLY SELLING AN ASSET

	Stocks				Funds			
	Winners		Losers		Winners		Losers	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Gain/loss of asset j	0.928	46.80	0.112	7.00	0.359	8.87	0.364	13.70
Portfolio characteristics interacted with gain/loss								
Initial risky share	−0.394	−4.12	−0.053	−0.84	−0.320	−1.98	−0.160	−1.77
Standard deviation of risky portfolio	−0.656	−4.13	0.241	1.88	0.061	0.13	0.647	2.49
Stock component of Sharpe ratio	−1.690	−3.40	1.686	4.28	−1.703	−1.41	−1.281	−1.82
Fund component of Sharpe ratio	0.359	0.78	0.842	2.32	−1.496	−1.46	0.387	0.67
Financial characteristics interacted with gain/loss								
Disposable income	−0.007	−0.52	−0.024	−2.83	−0.018	−0.31	−0.066	−2.48
Private pension premia/income	0.003	0.19	−0.028	−1.65	0.057	1.19	0.004	0.07
Log financial wealth	−0.083	−3.55	0.072	4.09	0.096	1.87	0.149	4.61
Log real estate wealth	−0.038	−1.80	−0.007	−0.41	−0.029	−0.72	0.012	0.50
Log total liability	−0.094	−4.12	0.046	2.57	−0.015	−0.30	−0.021	−0.69
Retirement dummy	−0.060	−0.83	0.009	0.16	0.101	0.61	0.207	2.19
Unemployment dummy	0.069	1.02	−0.020	−0.34	0.016	0.11	0.003	0.03
Entrepreneur dummy	0.030	0.39	0.013	0.20	−0.121	−0.67	0.260	2.28
Student dummy	0.148	1.13	0.055	0.51	−0.573	−2.35	−0.194	−1.27

TABLE VII
(CONTINUED)

| | Stocks | | | | Funds | | | |
| | Winners | | Losers | | Winners | | Losers | |
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Demographic characteristics interacted with gain / loss								
Age	0.010	5.35	0.002	1.61	−0.008	−1.97	0.014	5.35
Household size	0.005	0.32	0.003	0.21	0.054	1.75	−0.045	−2.22
High school dummy	−0.014	−0.23	0.044	0.94	−0.147	−1.27	−0.161	−2.41
Post-high school dummy	0.016	0.36	−0.048	−1.53	−0.096	−1.14	−0.029	−0.57
Dummy for unavailable education data	0.040	0.39	0.126	1.57	−0.099	−0.43	−0.168	−1.51
Immigration dummy	−0.116	−1.74	0.010	0.22	0.042	0.38	−0.105	−1.43
Noninteracted control								
Share of asset j in risky portfolio	−0.816	−39.20			−0.847	−57.40		
Number of observations	139,155		285,223		67,623		478,659	

Notes. This table reports a pooled probit regression that a household fully sells an asset. We distinguish between stocks and funds and classify a security as a winner (loser) if it yields a positive (negative) return during the year. Each regression includes the following set of explanatory variables: yearly fixed effects (unreported), gain/loss of asset j, share of asset j in the risky portfolio, noninteracted characteristics (unreported), and interacted characteristics. The gain/loss of asset j is the absolute value of the asset's performance during the year, and disposable income is averaged over the previous three years. The estimation is based on households that participate in risky asset markets at the end of two consecutive years and for which the immigration dummy is available. The share of asset j in the risky portfolio is a stand-alone regressor that is not interacted with performance. All characteristics are demeaned year by year, and continuous financial characteristics are normalized to have unit standard deviation in each cross section. Portfolio characteristics are in natural units. Standard errors are robust and clustered by household.

stockholdings. Losing funds are also more likely to be sold by wealthier households, but we otherwise find little significance of characteristics in the regressions that predict full sales of mutual funds.

Overall, the table reveals that more sophisticated and aggressive households, with larger portfolios of directly held stocks, appear to be less prone to the disposition effect.

Partial Sales, Continued Holdings, and Partial Purchases. We have shown in previous sections that households fight idiosyncratic passive variations in the risky share. We now investigate whether they also rebalance individual security positions in the risky portfolio. The analysis excludes full sales, but considers partial sales, continued holdings, and partial purchases. In the Appendix, we check that the evidence of asset-level rebalancing is even stronger when we include full sales.

For each household h, we define $w_{h,j,t}^*$ as the share of asset j in the *risky* (not the complete) portfolio at the end of period t, $r_{h,t+1}$ as the net return on the risky portfolio between t and $t+1$, and $r_{j,t+1}$ as the net return on asset j. If the household does not trade risky assets in the next period, the asset's *passive share* at the end of $t+1$ is

$$w_{h,j,t+1}^{*p} = w_{h,j,t}^* \frac{1+r_{j,t+1}}{1+r_{h,t+1}}.$$

Let $A_{h,j,t+1}^* = w_{h,j,t+1}^* - w_{h,j,t+1}^{*p}$ and $P_{h,j,t+1}^* = w_{h,j,t+1}^{*p} - w_{h,j,t}^*$ denote the corresponding active and passive changes in levels, and $a_{h,j,t+1}^*$ and $p_{h,j,t+1}^*$ their equivalents in logs.

We estimate a rebalancing model for individual assets. In Table VIII, we report the pooled and yearly regressions of the log active change $a_{h,j,t+1}^*$ on the initial share and the log passive change $p_{h,j,t+1}^*$, both for stocks (Panel A) and funds (Panel B). The rebalancing coefficient is only slightly more negative for stocks than for funds, and approximately equal to one-sixth. Thus, when we focus on partial sales, the rebalancing coefficient is roughly constant across funds and stocks. In the Appendix, we report the rebalancing regressions in levels and also find evidence of active rebalancing at the asset level. The rebalancing coefficients in levels are somewhat larger in absolute value but also more variable across regressions.

The interpretation of Table VIII is complicated by the ambiguous predictions of financial theory. In a mean-variance

TABLE VIII
ASSET-LEVEL ACTIVE CHANGE IN THE RISKY PORTFOLIO

	All years		2000		2001		2002	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
				A. Stocks				
Passive change of stock j in logs	−0.179	−61.10	−0.069	−9.87	−0.162	−32.20	−0.220	−56.70
Log initial risky share of stock j	−0.038	−46.10	−0.058	−34.60	−0.041	−26.40	−0.023	−16.70
Intercept			−0.271	−44.60	−0.127	−25.70	−0.068	−15.20
2000 dummy	−0.204	−49.10						
2001 dummy	−0.118	−35.60						
2002 dummy	−0.117	−36.00						
Number of observations	354,294		90,951		126,769		136,574	
Adjusted R^2	0.05		0.03		0.04		0.06	
				B. Mutual funds				
Passive change of fund j in logs	−0.165	−22.70	−0.189	−10.40	−0.153	−11.50	−0.162	−18.60
Log initial risky share of fund j	−0.091	−93.90	−0.109	−64.50	−0.104	−71.00	−0.062	−49.10
Intercept			−0.268	−82.70	−0.183	−66.80	−0.126	−50.50
2000 dummy	−0.230	−95.60						
2001 dummy	−0.155	−69.40						
2002 dummy	−0.191	−83.90						
Number of observations	498,502		147,930		175,692		174,880	
Adjusted R^2	0.07		0.08		0.08		0.04	

Notes. This table reports the regression of asset j's active change in logs on the asset's passive change and initial share in the risky portfolio, both for stocks (Panel A) and for mutual funds (Panel B). We include partial sales, continued holdings, and partial purchases, but exclude full sales and purchases of securities that are not held at all at the beginning of the period. The estimation is based on households that participate in risky asset markets at the end of two consecutive years. Standard errors are robust and clustered by household.

portfolio choice problem with constant investment opportuni-
ties, the optimal weights of individual assets in the risky port-
folio are time-invariant, which implies complete rebalancing with
$a^*_{h,j,t+1} = -p^*_{h,j,t+1}$; but partial rebalancing might be justified by
a variety of factors such as changes in risk and return expec-
tations, taxes, transactions costs, or Bayesian updating of beliefs
about mutual fund management. In the Appendix, we ask how the
propensity to rebalance individual assets varies with household
and portfolio characteristics, but do not find any strong effects.

In this section we have shown that households are much more
likely to fully sell a stock when it has performed well, and slightly
more likely to sell a losing fund. This finding is consistent with the
literature on the disposition effect. If a household continues to own
a stock or mutual fund, however, its behavior is well described by
a rebalancing model with a rebalancing coefficient of about one-
sixth, and the rebalancing propensity is almost the same for stocks
and for mutual funds.

VI. Trading Decisions and Risky Portfolio Rebalancing

We now investigate how rebalancing of the complete portfo-
lio, which was documented in Sections III and IV, relates to the
dynamics of individual asset holdings discussed in Section V. We
focus on the contributions of different asset classes and transac-
tion types to the overall active change of the risky share.

The active change of the risky share between dates t and $t + 1$
can be decomposed as

$$(7) \qquad A_{h,t+1} = \sum_j \left(w_{h,j,t+1} - w^p_{h,j,t+1} \right),$$

where $w_{h,j,t+1}$ denotes the share of asset j in the *complete* portfolio
at the end of year $t + 1$, and $w^p_{h,j,t+1}$ is the passive share of asset j in
the complete portfolio if the agent does not trade during the year:

$$w^p_{h,j,t+1} = \frac{w_{h,j,t}(1 + r_{j,t+1})}{w_{h,t}(1 + r_{h,t}) + (1 - w_{h,t})(1 + r_f)}.$$

The individual terms on the right-hand side of (7) can be
grouped into specific asset classes c (fund or stock) and transaction
types θ (purchase or sale):

$$A_{h,t+1} = \sum_{c,\theta} A_{h,c,\theta,t+1}.$$

				Purchases	0.001 / 0.1	Partial purchases	−0.045 / −6.9

Lucky households

Rebalancing coefficient	−0.581 / −29.6	STOCKS	−0.349 / −27.5	Purchases	0.001 / 0.1	Partial purchases	−0.045 / −6.9
						Full purchases	0.046 / 4.2
				Sales	−0.350 / −32.2	Partial sales	−0.059 / −10.2
						Full sales	−0.291 / −31.3
		FUNDS	−0.231 / −13.1	Purchases	−0.254 / −16.7	Partial purchases	−0.240 / −18.7
						Full purchases	−0.014 / −1.5
				Sales	0.023 / 1.8	Partial sales	−0.032 / −3.7
						Full sales	0.055 / 5.3

Unlucky households

Rebalancing coefficient	−0.504 / −53.1	STOCKS	−0.334 / −54.4	Purchases	−0.304 / −49.2	Partial purchases	−0.143 / −45.3
						Full purchases	−0.160 / −30.0
				Sales	−0.030 / −5.8	Partial sales	0.009 / 3.2
						Full sales	−0.039 / −8.7
		FUNDS	−0.170 / −19.9	Purchases	−0.127 / −17.2	Partial purchases	−0.076 / −12.3
						Full purchases	−0.051 / −10.9
				Sales	−0.043 / −6.7	Partial sales	−0.034 / −7.9
						Full sales	−0.009 / −1.9

FIGURE IV

Contribution of Sales and Purchases to Portfolio Rebalancing

Notes. The figure decomposes the portfolio rebalancing coefficient into its various components: (partial or full) purchases or sales of stocks and funds by lucky and unlucky households. For each transaction type and household group, we report the rebalancing coefficient and *t*-statistic of the corresponding rebalancing regression in levels, with yearly fixed effects and the risky share included as controls. A household is defined as lucky (unlucky) if the passive return on its risky portfolio during the year is higher (lower) than the cross-sectional average.

We can also distinguish between partial sales, full sales, partial purchases (assets already held by the household), and full purchases (new types of assets).

Each component of the active change $A_{h,c,\theta,t+1}$ can be regressed on the passive change of the risky portfolio $P_{h,t+1}$, the demeaned initial risky share $w_{h,t} - \bar{w}_{h,t}$, and a time-dependent intercept. The corresponding rebalancing coefficients $\gamma_{1,c,\theta,t+1}$ add up to the overall rebalancing coefficient: $\sum_{c,\theta} \gamma_{1,c,\theta,t+1} = \gamma_1$. This decomposition allows us to identify how various asset classes and transaction types contribute to portfolio rebalancing.

Given our findings in Section V on the disposition effect, it is also useful to distinguish between transactions carried out by *lucky* and *unlucky* households. Specifically, a household is classified as lucky if the return on its risky portfolio exceeds the population average during the same year. In Figure IV, we report the

rebalancing coefficients $\gamma_{1,c,\theta,t+1}$ and their t-statistics, and refer the reader to the Appendix for the full regression results. Lucky and unlucky households both have a rebalancing coefficient of about -0.5, which is slightly larger in absolute value for lucky households. Stocks and funds play an important role in rebalancing for both groups of investors. We have verified that our results are almost identical when the median return is used as an alternative cutoff, or when we consider households in the top third and bottom third of risky portfolio performance.

When we disaggregate sales and purchases, however, we do see important differences between lucky and unlucky households. Lucky households rebalance primarily by adjusting their stock sales and fund purchases. The rebalancing coefficient of -0.58 is almost entirely explained by the coefficients of full sales (-0.29) and partial purchases (-0.24). That is, lucky households, which need to reduce their holdings of risky assets, achieve this objective by fully selling more stocks and buying less mutual funds than they would otherwise.

Unlucky households, on the other hand, mainly rebalance by adjusting their purchases of new assets. The rebalancing coefficient (equal to -0.50) is primarily driven by stock purchases (-0.30) and fund purchases (-0.13). The impact of asset sales is marginal.

Households thus primarily rebalance by increasing their (full) stock sales and reducing their fund purchases when they are lucky, and increasing their purchases of risky assets (primarily stocks) when they are unlucky. These common strategies minimize transaction costs. The exception is the full sale of stocks by lucky households, which may be caused by the disposition effect.

In the Appendix, we investigate how these common rebalancing strategies are influenced by household characteristics. We find that wealthier households with more diversified portfolios tend to rebalance more strongly through purchases of risky assets but less through stock sales. Thus, it appears that more sophisticated households are less prone to the disposition effect and make greater use of rebalancing strategies that minimize transaction costs. In addition, we find possible substitution effects between purchasing strategies. Households with substantial and diversified portfolios of funds rebalance more strongly through fund purchases and less through stock purchases.

VII. Conclusions

The burgeoning field of household finance asks how households manage their financial affairs, and whether they act in a way that is consistent with the normative literature on portfolio choice. Our previous paper (CCS 2007) studied household diversification at a point in time, whereas this paper looks at changes in household behavior over time, specifically decisions to scale up or down the share of risky assets in the total portfolio, to enter or exit risky financial markets, to fully sell individual risky assets, and to scale up or down the share of individual assets in the risky portfolio. These decisions are important in themselves and are also particularly revealing because households rarely delegate these decisions to financial intermediaries.

Although other papers have looked at the dynamics of household risk taking, our data set gives us the unique ability to relate household decisions to the properties of the initial portfolio. When studying movements in the risky asset share, we find that households overall have a surprisingly large propensity to rebalance, offsetting about half the passive changes in the risky share with active changes.

We can identify the propensity to rebalance, distinguishing it from mean-reversion in the risky share and aggregate shifts in the desired risky share, because households have heterogeneous portfolios which generate cross-sectional variation in passive changes in the risky share. This implies that households can rebalance actively even in a closed economy general equilibrium; households with lower than average returns can buy stocks from households with higher than average returns. The microeconomic nature of our results means that we have little to say about rebalancing by the Swedish household sector as a whole in response to aggregate shocks, but such rebalancing appears to be quite limited in our short data set.

We develop an adjustment model with different target risky shares across households. We find that more educated and wealthier households, holding better diversified portfolios, tend to rebalance more actively. Wealthier households also reduced their target risky shares less during the bear market of the early 2000s.

Some financial theories imply that as a household becomes richer, its target risky share should increase. This will be the case, for example, if households have declining risk aversion, follow portfolio insurance policies, or derive utility from consumption

that is surplus to a slowly evolving habit level. We find evidence consistent with this view once we control for sluggish portfolio adjustment.

Our results on decisions to exit risky financial markets and to fully sell individual risky positions are intriguingly consistent with previous research on the disposition effect among stockholders and performance sensitivity among mutual fund investors. We find that high returns on directly held stock portfolios strongly increase the probability that households will exit direct stockholding, whereas this effect is almost absent for mutual fund portfolios. At the level of individual assets, a household is considerably more likely to fully sell a stock during a year if it is a "winner" that has performed well during the year, but this tendency is again much weaker for mutual funds. One possible explanation for these patterns is that individual investors buy stocks that they perceive to be undervalued and maintain fixed beliefs about fundamental value in the face of market price movements; but they buy mutual funds that they perceive to be well managed and update their beliefs about manager skill in response to mutual fund performance.

These asymmetries between winners and losers, and between stocks and mutual funds, disappear when households adjust the shares of individual risky assets within their risky portfolios, without fully selling them. Rebalancing for assets that households continue to own is close to symmetric, and it actively offsets about one-sixth of the passive changes in individual asset shares caused by individual asset performance.

We ask how households use partial and full sales and purchases of stocks and mutual funds to alter their overall risky shares. We find that households primarily rebalance by increasing their full sales of stock and reducing their fund purchases when they have higher than average portfolio returns, and by increasing their purchases of risky assets when they have lower than average returns.

Finally, we examine how household characteristics affect decisions to trade individual assets. We find that wealthy investors with high risky shares and diversified portfolios of individual stocks are less likely to fully sell winning stocks and more likely to fully sell losing stocks. Dhar and Zhu (2006) have documented a similar pattern for U.S. investors with high self-reported income. Any model of the disposition effect must explain this finding that it is not uniform across the population.

Many papers in the household finance literature, including Campbell (2006) and CCS 2007, have reported that educated, better-off households conform more closely to the predictions of standard finance theory. Rebalancing behavior and decisions to fully sell stock positions are two more examples of this phenomenon.

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