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What do mutual fund managers' private portfolios tell us about their skills?

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ABSTRACT

I study a registry-based dataset of Swedish mutual fund managers' personal portfolios. The majority of managers do not invest personal wealth into the very same funds they professionally manage. The managers who do invest personal money into their funds subsequently outperform the managers who do not. The results suggest that fund managers, in contrast to regular investors, are certain about their ability to generate an abnormal return, or lack thereof, and invest their personal wealth accordingly.

1. Introduction

Investing in actively managed mutual funds comes with large uncertainties about managerial skill. Most mutual funds earn returns close to zero relative to a passive benchmark and detecting outperforming managers is a formidable challenge (see, e.g., Fama and French, 2010). Consistently, investor uncertainty about managerial skill is a key input to equilibrium models of active management (see, e.g., Berk and Green, 2004; Pástor and Stambaugh, 2012). A natural question is whether fund managers are as uninformed about their skill as regular investors or whether managers have private information. After all, a fund manager's job is to collect and process information.

To test whether managers have private information about their skills, I test whether managers who make personal investments into the very same funds they professionally manage (that is, have "skin in the game") subsequently outperform. The argument is simple: if a manager invests personal money in her own fund and subsequently outperforms, she was rightly confident a priori about her fund's ability to outperform. Vice versa, if a manager does not invest in her own fund and subsequently underperforms, she was rightly confident a priori about her fund's lack of ability to outperform.

I construct a dataset containing detailed personal, non-public (that is, private) wealth data of 363 Swedish mutual fund managers from 1999 to 2007. Sweden has a highly developed mutual fund industry with similar ratios of mutual fund assets under management (AUM) to GDP and equity mutual fund AUM to stock market capitalization compared to the U.S. (Ibert et al., 2018).

Only 24% of managers personally invest in their own funds. Conditional on investment, the average investment is 270 002 SEK (≈ \$40 000) and accounts for 21.77% of a manager's total stock and fund investments.[2] The managers who do invest in their funds earn a 0.91 percentage points larger average abnormal return (that is, "alpha") per year relative to the managers who do not and earn a 0.45 percent alpha relative to the passive benchmark. These results suggest that fund managers, in contrast to regular investors, are certain about their ability to generate an abnormal return, or most often lack thereof, and invest their personal wealth accordingly.

Just as CEOs can have ownership in the firms they are managing, mutual fund managers can invest personal money in the funds they are managing. The SEC as of 2005 requires mutual fund managers to publicly file such personal investments and to the best of my knowledge

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[2] All Swedish Krona (SEK) amounts in this paper are expressed in 2005 SEK. The exchange rate between the U.S. dollar and the Swedish krona was 1 to 6.71 at the beginning of 2005.

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the U.S. is the only country that requires managers to do so.[3] Khorana et al. (2007) and Evans (2008) use these data and document a positive relationship between manager ownership and fund performance for a cross-section of U.S. mutual funds.

I extensively document the positive relationship between managers' personal investments and fund performance in the Swedish data. To compare to previous work, I first report coefficient estimates on the personal amount invested scaled by fund size. In addition, I document a positive relationship between abnormal fund returns and personal investments based on the amount a manager invests in her fund (while controlling for size and wealth separately) and based on the amount scaled by personal wealth. The results of the three specifications are generally similar, albeit weaker for the amount scaled by wealth in some tests. The positive relationship between personal investments and fund returns is driven by the incremental performance of managers who invest more than others (the intensive margin), and is to some extent a cross-sectional result as some of the variation is driven by fund and fund family fixed effects. Consistently, the literature on the role of the fund family has highlighted a fund family's impact on individual fund returns (see, e.g., Massa, 2003; Gaspar et al., 2006; Ferreira et al., 2018).

A simple asymmetric information model that can rationalize the positive relationship between personal investments and fund returns builds on the equilibrium model of Berk and Green (2004) and works as follows. In Berk and Green (2004), both investors and managers are uncertain about managerial skill, which in Berk and Green (2004) is measured as the before-fee return on the first dollar invested in the fund. Let us assume that managers, in contrast to investors, are certain about their skill and that managers cannot credibly signal their skill to investors. In Berk and Green (2004), investors determine a fund's size such that expected abnormal returns, which decrease with fund size, are zero conditional on investors' information sets. When investors perceive that a manager is more skilled than he actually is, the size of the fund will be too large and the expected abnormal return from the perspective of an informed investor who knows true managerial skill will be negative. Similarly, when investors underestimate a manager's skill, the fund will be too small and the expected abnormal return from the perspective of an informed investor will be positive. Since managers are informed by assumption, they invest in their funds if and only if their funds are too small and in that case earn positive expected abnormal returns.

My paper contributes to the literature on mutual funds and manager ownership using novel Swedish data.[4] Khorana et al. (2007) and Evans (2008) study a cross-section of U.S. funds, whereas Hornstein and Hounsell (2016) study panel data. Despite the potential importance of ownership data to guide both investors' and policy makers' decisions, research outside the U.S. has been limited so far.[5] Kumlin and Puttonen (2009) use Finnish data and find no evidence for a positive relationship between ownership and fund alphas, which highlights the need study this relationship outside of the U.S. Ma and Tang (2019) show that manager ownership reduces risk-taking and argue that manager ownership serves as an incentive alignment mechanism. Kaniel et al. (2019) investigate theoretically the effects of policies that force managers to commit parts of their wealth to the funds they are managing. Chen et al. (2008) and Cremers et al. (2009) analyze the investments of U.S. mutual fund directors.

By demonstrating under which assumptions the positive relationship between managers' personal investments and abnormal fund returns can be rationalized, I also contribute to the literature that extends the equilibrium arguments of Berk and Green (2004) (see, e.g., Berk and Stanton, 2007; Choi et al., 2016; Berk and van Binsbergen, 2016; Franzoni and Schmalz, 2017; Roussanov et al., 2021). Using equilibrium arguments, Berk et al. (2017) provide evidence that the fund family, too, has superior information about the skill of its managers. Through the lens of a simple asymmetric information model, managers who do not invest in their funds generally manage funds that are too large, which has various further implications. For instance, these managers are likely overcompensated relative to their skills (see, e.g., Ibert et al., 2018) and more likely to be subject to liquidity considerations during times of stress (see, e.g., Ben-Raphael, 2017).

Most broadly, my paper relates to the vast literature that uses fund managers' professional – as opposed to their personal – investment decisions to study the information managers possess (see, e.g., Cohen et al., 2005; Kacperczyk and Seru, 2007; Kacperczyk et al., 2008; Baker et al., 2010). Kacperczyk et al. (2005) show that some managers deviate from well-diversified benchmarks and tilt their funds towards industries where they have an informational advantage. Similarly, a manager may personally invest in her fund even though it is correlated with her human capital because she has an informational advantage that her fund is going to outperform. Van Nieuwerburgh and Veldkamp (2010) provide a theoretical rationale for such concentrated portfolios. While Altıet al. (2012) show that differences in information precision across fund managers can help understand differences in mutual fund managers' tendencies to chase return trends, my results suggest that a fund manager in general has a high precision about her information.

The rest of this paper is organized as follows. Section 2 describes the data and methodology. Section 3 shows that managers who invest in their own funds subsequently outperform. Section 4 interprets the results through the lens of asymmetric information. Section 5 provides robustness tests. Section 6 summarizes and briefly discusses policy implications.

2. Data

2.1. Fund data

From Morningstar Direct, I retrieve a survivorship bias-free dataset of open-ended mutual funds for sale in Sweden or the Nordic region for the period 1990 to 2015. The sample is then restricted to funds that were present at some point during 1999 to 2007 due to the availability of manager wealth data. The data are on the share class level and include AUM and return series, annual total expense ratio (TER) series, an investment category indicator, and the name of the prospectus benchmark index. The AUM and TER time series from Morningstar Direct are complemented by two additional sources, Bloomberg and some hand-collected data from AMF Fonder. The different share classes of a fund are aggregated into a single fund observation by summing up AUM across share classes and taking AUM-weighted averages for all other variables.

I eliminate money market mutual funds, index funds (identified by Morningstar as such or by the word "index" in their name), and the four government pension funds that invest public pension money. The funds' remaining investment categories are: Equity, Allocation, Alternative, Fixed Income, and a Rest category in which commodity funds, miscellaneous funds, and funds where the category variable is missing are grouped. The funds invest their assets in various international markets, but by far the two most common investment areas are "Sweden" and "Global".

[3] The SEC requires managers to report whether the dollar investment in their own funds falls in one of the following ranges: \$0, \$1–\$10,000, \$10,001–\$50,000, \$50,001–\$100,000, \$100,001–\$500,000, \$500,001–\$1,000,000, or above \$1,000,000.

[4] Bodnaruk and Simonov (2015) use similar data to study the performance of Swedish fund managers in their personal portfolios. However, they do not mention evidence of managers investing in their own funds. They find that the average manager does not outperform in her personal portfolio relative to a group of peer investors. Instead, I focus on the performance of fund managers in their professionally managed funds.

[5] Dahlquist et al. (2022) show that professional analysts rely on ownership data to form their expectations about the future performance of U.S. funds.

2.2. Manager data

Morningstar provides a manager history for each fund. The history contains the first and last name of each manager with a start and end date. Using publicly available sources, the manager names are hand-matched to social security numbers, which are then matched with tax records from Statistics Sweden, the government's statistical agency. The data from Statistics Sweden include demographic information such as age, gender, and education as well as income variables such as labor and capital income.

The dataset is similar to the one used in Ibert et al. (2018). Unique to this paper is the use of highly disaggregated wealth information available from 1999 until 2007 when Sweden levied a wealth tax. On December 31 of each year, the data show a snapshot of the portfolio holdings at the individual security level (identified by an ISIN) as well as cash in bank accounts, real estate ownership, and outstanding debt. In particular, the data show how much a fund manager personally invests in the very same fund that she manages. Appendix A discusses various additional data details.

2.3. Aggregation and performance measurement

The data consist of a panel of fund-month observations for high frequency fund-level variables such as returns and fund sizes and a panel of manager-year observations for the personal wealth data. The distinction between a manager and a fund arises because a manager can manage multiple funds, a fund can have multiple managers at the same time, and a fund can turn over its managers over time.[6] The combined panel is aggregated to the fund level (indexed by i) by taking equal-weighted averages of manager (m) level variables. Specifically, in cases of team management, which constitute around 27% of fund-year observations in the final sample, the amount the $N_{i,t}$ managers of a given fund i in a given year t directly invest in their fund and the fund's "personal wealth" are defined as

$$Amount\ in\ MF_{i,t} = 1/N_{i,t} \sum_{m=1}^{N_{i,t}} Amount\ in\ MF_{m,i,t} \tag{1}$$

$$Wealth_{i,t} = 1/N_{i,t} \sum_{m=1}^{N_{i,t}} Wealth_{m,t}. \tag{2}$$

To assess yearly fund performance, as in Ibert et al. (2018) and Roussanov et al. (2021) I first estimate a standard factor regression using the entire time-series of monthly returns for each fund:

$$R_{i,s} - R_{f,s} = \alpha_i + \beta_i(R^{BM}_{i,s} - R_{f,s}) + \epsilon_{i,s}, \tag{3}$$

where $R_{i,s}$ is the fund's net-of-fee return, $R_{f,s}$ is the risk-free rate as approximated by the one-month STIBOR rate, and $R^{BM}_{i,s}$ is the fund's prospectus benchmark return adjusted for costs as described below.

Berk and van Binsbergen (2015) point out the importance of choosing investable net-of-fee benchmark returns when estimating net alphas and use a combination of Vanguard index funds as benchmarks. Unfortunately, the number of index funds that could be used as investable benchmarks is very limited over the Swedish sample period.[7] To still account for some cost of achieving the benchmark return, I subtract the average expense ratio of all index funds that are available in a given year from the prospectus benchmark return. The average index fund expense ratio has declined from 0.74% in 1999 to 0.63% in 2007. I believe that adjusting the prospectus benchmark return by this cost gives a better estimate of the net alpha investors could have earned than assuming no cost at all.[8] This cost assumption is innocent for most of my results as it merely represents a shift in levels for the alpha estimates, but it of course does matter whenever the object of interest is performance relative to the benchmark as opposed to relative performance differences between funds.

Using the estimated coefficients, I then calculate the abnormal return in each month and annualize to form the annual alpha.[9] In the robustness section, I estimate alphas year-by-year, relative to a Swedish four-factor model, and relative to a global eight-factor model that adds four global factors to the Swedish four-factor model.

2.4. Descriptive statistics

Panel (a) of Fig. 1 visualizes the personal portfolio composition of fund managers over time. To directly compare to the Swedish population, the manager level variables are not aggregated to the fund level in Fig. 1. The vast majority of financial wealth is invested either in cash, funds, or directly in stocks. Panel (b) contrasts this with the evolution of the average portfolio composition for the Swedish population. The average Swede invests a smaller fraction of her financial wealth in risky assets and invests less in individual stocks. Consistently, Calvet et al. (2007) find that financially sophisticated investors invest more aggressively. Panel (c) considers the cross-section of managers in 2007 and decomposes managers' risky financial wealth (that is, their stock and fund investments) further into investments in own funds, funds from the same fund family, other funds, and stocks.

Table 1 shows summary statistics for the 2449 fund-years, corresponding to 556 funds and 9 years, that enter the final sample. The average alpha relative to the prospectus benchmark is −0.21% after costs and not statistically different from zero. The majority of funds do not feature any investments by their managers. The amount invested in own funds only turns positive at the 76th percentile of its distribution (untabulated). Similarly, Khorana et al. (2007) report that only 47% of U.S. managers invest personally in their funds. Unconditionally, the average investment is 66 811 SEK (≈ $10 000). Conditional on a positive investment, the average amount invested is 270 002 SEK (≈ $40 000) and accounts for 21.77% of managers' risky financial wealth (untabulated).

Swedish managers only face loose regulatory trading restrictions in their personal accounts mostly related to insider trading laws. In short, managers can invest fairly unrestricted in their personal accounts. Appendix B summarizes the evidence. Kaniel et al. (2019) discuss in detail the regulations that apply to U.S. fund managers who trade in their personal accounts. Although the economist can observe managers' personal investments in their own funds ex post, contrary to the U.S. there exists no requirement for Swedish fund managers to file their investments publicly.

[6] With a slight abuse of language, in the text I assume a one-to-one relationship between managers and funds. For example, "a manager invests in her fund" should really read "at least one of the managers at the fund invests in the fund" because funds can be team managed.

[7] Most of the available index funds invest in Swedish equities. For instance, an emerging market equity index fund only became available in 2010. Index fund returns for funds other than equity funds are even harder to obtain.

[8] A further complication in measuring the after cost performance of managers who invest in their funds is that it is unclear whether managers pay the same fee as regular investors when investing in their own funds. Typically, U.S. funds offer separate share classes with lower fees that are only available to employees. Absent detailed data on such fees, I assume that managers pay the same fee as regular investors when investing in their funds.

[9] To estimate the coefficients in Eq. (3), at least 12 monthly observations are required. To mitigate the impact of outliers the annualized alphas are winsorized at the 5th and 95th percentiles. See Dahlquist et al. (2000) and Flam and Vestman (2014) for earlier studies of Swedish fund performance.

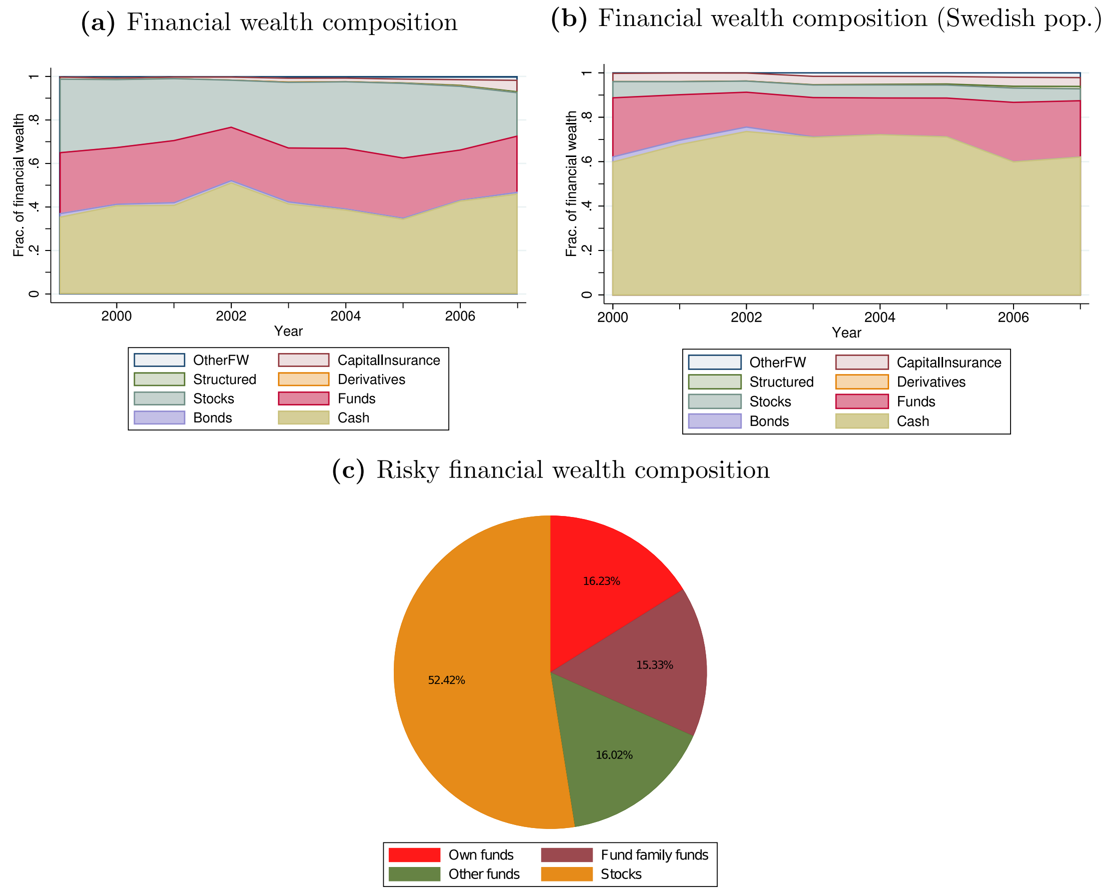

Fig. 1. Portfolio compositions.
Panel (a) shows the average composition of personal managerial financial wealth over time. Panel (b) is similar to Panel (a) but shows the average composition of financial wealth for the whole Swedish population. Panel (c) shows the average composition of managers' risky financial wealth (that is, stock and fund investments) at the end of 2007. Own funds are professionally managed funds by the manager that are also in the manager's personal portfolio. Funds from the same family are funds from the manager's fund family (her employer). Other funds are funds in the personal portfolio that are not own funds and not from the same family.

3. Fund performance and personal investments

3.1. Main empirical results

In this section, I estimate predictive regressions of fund alphas, measured during year t, on personal investments and various observables, measured at the beginning of year t (technically, the end of year $t-1$).

The previous literature typically scales the amount a manager invests in her fund by fund size (see, e.g., Khorana et al., 2007). To compare to the literature, I first estimate a regression of fund alphas on managers' personal investments scaled by fund size. I then also investigate the relationship between fund alphas and the unscaled investment and the investment scaled by wealth, respectively. To compare coefficient estimates across specifications, I standardize the variables capturing managers' personal investments to zero mean and unit standard deviation. The resulting coefficient estimates across the three specifications are similar.

Column (1) of Table 2 shows that a one-standard-deviation increase in personal investments scaled by size, that is, percentage ownership in the fund, is associated with a 0.46 percentage points larger annual alpha.[10] In unstandardized terms, a one-percentage-point increase is associated with a 0.60 larger annual alpha (untabulated). This 0.60 estimate is economically smaller than the corresponding 2.36 percentage points increase reported in Khorana et al. (2007).

Column (2) adds several control variables. The controls include net worth ($Wealth$), fund size, age (Age), experience in years as a fund manager ($Exper$), labor income ($Income$), gender ($Female$), TER, the number of categories a manager manages ($NumCategories$), the number of funds a manager manages ($NumFunds$), and the number of managers on a fund ($NumManagers$). In addition, I also include investment category fixed effects. The coefficient estimate on investments scaled by size remains virtually unaffected.

Column (3) of Table 2 investigates the relationship between the amount a manager invests in her fund and alphas. A one-standard-deviation increase in the amount a manager invests in her fund is associated with a 0.75 percentage points larger alpha. Column (4) adds controls and again the positive relationship remains unaffected. Columns (5) and (6) show that a one-standard-deviation increase in the percentage of a manager's risky financial wealth invested in the fund is associated with a 0.50 to 0.57 percentage points larger alpha, respectively.[11]

While in the end the results for the specifications which use personal investments scaled by fund size are similar to the results of the

[10] Standard errors are clustered by funds. The results are similar if standard errors are clustered by fund family.

[11] The sample is reduced by 158 funds whose managers do not own any risky financial wealth at all. I scale by risky financial wealth instead of net worth because net worth can be negative (see Table 1). Note that all measures of wealth in this paper do not include human capital, retirement accounts, or ownership in private firms. Omitting these substantial sources of wealth can lead to large investments as a percentage of risky financial wealth that are at the same time small in absolute terms and small in relation to omitted wealth determinants.

Table 1
Summary statistics at the fund level.

	10%	25%	50%	75%	90%	Mean	Sd	N
A. AUM, TER and no. of managers								
$AUM_{i,t}$ (mio. SEK)	56.53	177.22	586.25	2118.87	6634.30	2154.79	3923.75	2449
$TER_{i,t}$ (%)	0.49	0.74	1.40	1.55	1.80	1.26	0.68	2449
$NumManagers_{i,t}$	1.00	1.00	1.00	2.00	3.00	1.44	0.86	2449
B. Performance								
$12 \times \hat{\alpha}_{i,t}^{BM}$ (%)	−8.95	−3.73	−0.28	2.42	9.02	−0.21	6.91	2449
$12 \times \hat{\alpha}_{i,t}^{BM,gross}$ (%)	−7.56	−2.40	0.59	3.63	10.68	1.00	7.02	2449
$12 \times \hat{\alpha}_{i,t}^{FF4,swe}$ (%)	−11.91	−6.01	−1.20	2.91	8.81	−1.44	7.62	2449
$12 \times \hat{\alpha}_{i,t}^{FF8,glob}$ (%)	−6.95	−2.98	−0.14	3.74	9.91	0.79	6.22	2449
C. Managerial commitment and controls								
$AUM\ in\ MF_{i,t}$ (%)	0.00	0.00	0.00	0.00	0.01	0.05	0.76	2449
$Amount\ in\ MF_{i,t}$ (TSEK)	0.00	0.00	0.00	0.00	59.36	66.81	440.68	2449
$RiskyFW\ in\ MF_{i,t}$ (%)	0.00	0.00	0.00	0.06	15.70	5.76	17.33	2291
$RiskyFW_{i,t}$ (TSEK)	2.93	48.51	310.06	1338.91	2903.30	1754.69	6399.33	2449
$Wealth_{i,t}$ (TSEK)	−385.64	518.54	1943.75	3990.03	7938.93	3711.05	7758.73	2449
$Income_{i,t}$ (TSEK)	606.00	916.23	1317.97	1849.92	2588.90	1563.61	1285.72	2449
$Age_{i,t}$	34.00	37.00	41.00	44.00	49.00	41.39	5.94	2449
$Exper_{i,t}$	1.00	2.33	4.33	7.25	12.17	5.65	4.73	2449
$NumCategories_{i,t}$	1.00	1.00	1.00	2.00	2.00	1.44	0.63	2449
$NumFunds_{i,t}$	1.00	2.00	3.00	6.80	11.00	4.87	4.14	2449

The table shows summary statistics for fund-year observations. In Panel A AUM is fund size, TER is a fund's total expense ratio, and $NumManagers$ is the number of managers working for the fund. Panel B shows performance measures relative to the prospectus benchmark return in excess of the one-month STIBOR rate (both before and after subtracting the TER), a Swedish Fama and French four-factor model (swe), and a Global Fama and French eight-factor model (glob). Fund alphas are estimated according to Eq. (3) and the description in the text. All alphas are winsorized at the 5th and 95th percentiles. Panel C shows the main independent variables and controls. $\%AUM\ in\ MF$ is managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds in thousands of SEK. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. $RisykFW$ is the average risky financial wealth, that is, stock and fund investments, of managers at a fund in thousands of SEK. $Wealth$ is the average net wealth (worth) of managers at a fund. $Income$ is labor income, Age is managerial age, $Exper$ is manager experience in years, $NumCategories$ is the number of investment categories managers manage, and $NumFunds$ the number of funds managers manage.

other specifications, caution is in order for future research. Inferring a positive relationship between the amount scaled by size and abnormal fund returns could be misleading whenever fund size is correlated with performance. Whenever the correlation is negative, small fund size means both a large scaled variable and large returns and vice versa. Hence, a positive estimate on the amount scaled by size could emerge mechanically in a regression of returns on the amount scaled by size.[12]

In conclusion, all specifications show that managers who invest in their funds outperform the managers who do not. The managers who invest in their funds also outperform the passive benchmark. Unconditionally, the average alpha for managers who invest in their funds is 45 basis points per year, whereas the average alpha for managers who do not invest in their funds is −42 basis points. Overall, the results are consistent with the hypothesis that managers are informed about the fund's ability to earn an abnormal return, or lack thereof, and personally invest whenever they deem it profitable.

3.2. Intensive and extensive margin

Column (1) of Table 3 estimates a specification that is independent of the scaling discussion by including a dummy variable for positive investment. In Column (1), managers who invest personal money in their funds on average earn a 0.9 percentage points larger alpha. Evans (2008) reports a 2.6 percentage points larger alpha for managers who invest in their funds for a sample of U.S. funds in a differences-in-means test, which is again economically larger than the estimate for the Swedish data.

Columns (2)–(4) estimate piecewise linear specifications with the three continuous variables and dummy out the managers who do not invest in their funds. The dummy is not or only borderline statistically different from zero in Columns (2)–(4), whereas the linear terms are positive and highly significant. This suggests that the positive relationship between abnormal fund returns and personal investments is driven by the incremental returns of managers who invest more than others (the intensive margin) rather than driven by the difference in returns between managers who invest and managers who do not (the extensive margin).

3.3. Variation within funds and within fund families

Columns (1)–(3) of Table 4 add fund fixed effects to the specifications with the amount scaled by size, the amount, and the amount scaled by wealth, respectively. The estimates become weaker both statistically and economically but they remain positive throughout. Relative to Table 2 the R^2s almost triple with fund fixed effects, whereas they double with fund family fixed effects. Hence, some of the relationship between abnormal fund returns and personal investments is driven by systematic differences across funds and fund families. Such systematic differences could relate to differences in distribution channels across fund families (see, e.g., Bergstresser et al., 2009; Del Guercio and Reuter, 2014) or differences in incentives across fund

[12] There is reason to believe that fund size is negatively correlated with performance a priori, both from a theoretical and an empirical standpoint. In Berk and Green (2004), a negative correlation between returns and size arises naturally because of decreasing returns to scale. Even though in Berk and Green (2004) returns are unpredictable to the real-time Bayesian investor, returns are predictable to an econometrician that uses the full sample to estimate a regression of returns on size with fund fixed effects (see Pástor et al., 2015). Empirically, there is evidence for a negative cross-sectional and within-fund relationship of size and returns as well (see, e.g., Chen et al., 2004; Zhu, 2018).

Table 2
Regressions of alphas on managers' personal investments.

	(1) $12 \times \hat{\alpha}_{i,t}^{BM}$	(2) $12 \times \hat{\alpha}_{i,t}^{BM}$	(3) $12 \times \hat{\alpha}_{i,t}^{BM}$	(4) $12 \times \hat{\alpha}_{i,t}^{BM}$	(5) $12 \times \hat{\alpha}_{i,t}^{BM}$	(6) $12 \times \hat{\alpha}_{i,t}^{BM}$
$\%AUM\ in\ MF_{i,t-1}$	0.460***	0.441***				
	(0.136)	(0.133)				
$Amount\ in\ MF_{i,t-1}$			0.747***	0.726***		
			(0.157)	(0.191)		
$\%RiskyFW\ in\ MF_{i,t-1}$					0.504***	0.568***
					(0.194)	(0.200)
$Wealth_{i,t-1}$		0.0253		0.0100		0.0351
		(0.0460)		(0.0467)		(0.0447)
$AUM_{i,t-1}$		0.00263		−0.000115		−0.0139
		(0.0402)		(0.0407)		(0.0415)
$TER_{i,t-1}$		−0.819		−0.789		−0.886
		(0.648)		(0.642)		(0.635)
$NumManagers_{i,t-1}$		−0.202		−0.213		−0.242
		(0.198)		(0.196)		(0.197)
$Income_{i,t-1}$		−0.197		−0.201		−0.190
		(0.181)		(0.179)		(0.190)
$Age_{i,t-1}$		−0.0111		−0.00181		−0.0298
		(0.0372)		(0.0374)		(0.0375)
$Exper_{i,t-1}$		−0.0572*		−0.0645**		−0.0700**
		(0.0318)		(0.0317)		(0.0334)
$NumCategories_{i,t-1}$		−0.719**		−0.678*		−0.771**
		(0.363)		(0.359)		(0.378)
$NumFunds_{i,t-1}$		0.0522		0.0614		0.0877*
		(0.0484)		(0.0478)		(0.0491)
$Female_{i,t-1}$		−0.428		−0.397		−0.465
		(0.424)		(0.420)		(0.446)
Constant	−0.207		−0.207		−0.185	
	(0.182)		(0.180)		(0.190)	
Observations	2449	2449	2449	2449	2291	2291
Adjusted R^2	0.096	0.104	0.102	0.110	0.089	0.102
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Category FE	No	Yes	No	Yes	No	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated relative to the fund's prospectus benchmark according to Eq. (3) and the description in the text. $\%AUM\ in\ MF$ is managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

Table 3
Intensive and extensive margin.

	(1) $12 \times \hat{\alpha}_{i,t}^{BM}$	(2) $12 \times \hat{\alpha}_{i,t}^{BM}$	(3) $12 \times \hat{\alpha}_{i,t}^{BM}$	(4) $12 \times \hat{\alpha}_{i,t}^{BM}$
$Amount\ in\ MF_{i,t-1} > 0$	0.913**			
	(0.456)			
$Amount\ in\ MF_{i,t-1} = 0$		−0.812*	−0.524	−0.340
		(0.456)	(0.452)	(0.528)
$\%AUM\ in\ MF_{i,t-1}$		0.409***		
		(0.127)		
$Amount\ in\ MF_{i,t-1}$			0.673***	
			(0.184)	
$\%RiskyFW\ in\ MF_{i,t-1}$				0.491**
				(0.226)
Observations	2449	2449	2449	2291
Adjusted R^2	0.103	0.106	0.111	0.101
Year FE	Yes	Yes	Yes	Yes
Category FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated relative to the fund's prospectus benchmark according to Eq. (3) and the description in the text. $Amount\ in\ MF > 0$ is a dummy variable that takes on the value one if a manager invests in her fund. $Amount\ in\ MF = 0$ is a dummy variable that takes on the value one if a manager does not invest in her fund. $\%AUM\ in\ MF$ managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

familie (see., e.g., Ma et al., 2019; Evans et al., 2020).[13] Simultaneously, they could reflect a systematic matching of managers with high ability to particular fund families, similar to the mechanism proposed in Berk et al. (2017).

Nevertheless, the estimates show that even within funds and fund families there exists a positive relationship between fund returns and managers' personal investments. Only in Column (6), in which a one-standard-deviation in the percentage of wealth invested in the fund is associated with a 0.20 percentage points larger within fund family alpha, the coefficient estimate is actually statistically indistinguishable from zero.

4. Interpretation of results

I interpret the positive relationship between abnormal fund returns and personal investments through the lens of asymmetric information. In that case, managers self-select into their funds according to the fund's ability to earn an abnormal return and the coefficient estimate does not have a causal interpretation. An alternative interpretation would be that the positive relationship between abnormal returns and personal

[13] In fact, the Swedish fund market is dominated by four large commercial banks (Handelsbanken, Nordea, SEB, Swedbank) that manage the majority of AUM. The average alpha and amount invested of funds associated with large banks are −0.75% and 11 635 SEK, respectively, in contrast to 0.49% and 138 396 SEK, respectively, at other fund families. Ferreira et al. (2018) document the predominant role of asset management divisions of commercial banks and their underperformance in an international sample.

Table 4
Fund and fund family fixed effects.

	(1) $12\times\hat{\alpha}^{BM}_{i,t}$	(2) $12\times\hat{\alpha}^{BM}_{i,t}$	(3) $12\times\hat{\alpha}^{BM}_{i,t}$	(4) $12\times\hat{\alpha}^{BM}_{i,t}$	(5) $12\times\hat{\alpha}^{BM}_{i,t}$	(6) $12\times\hat{\alpha}^{BM}_{i,t}$
$\%AUM\ in\ MF_{i,t-1}$	0.318**			0.313**		
	(0.153)			(0.134)		
$Amount\ in\ MF_{i,t-1}$		0.531**			0.433***	
		(0.265)			(0.154)	
$\%RiskyFW\ in\ MF_{i,t-1}$			0.445*			0.198
			(0.232)			(0.195)
Observations	2339	2339	2185	2439	2439	2279
Adjusted R^2	0.287	0.288	0.296	0.200	0.201	0.200
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Category FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	No	No	No
Fund Family FE	No	No	No	Yes	Yes	Yes

The table shows regressions of alphas on managers' personal investments with fund and family fixed effects. Alphas are estimated relative to the fund's prospectus benchmark according to Eq. (3) and the description in the text. $\%AUM\ in\ MF$ managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

Table 5
Fund flows.

	(1) $Flow_{i,t}$	(2) $Flow_{i,t}$	(3) $Flow_{i,t}$	(4) $Flow_{i,t}$
$Amount\ in\ MF_{i,t-1}$	−0.244	0.572		
	(0.688)	(0.700)		
$12\times\hat{\alpha}^{BM}_{i,t-1}$	0.408**	0.416**	0.485***	0.471**
	(0.182)	(0.183)	(0.183)	(0.187)
$12\times\hat{\alpha}^{BM}_{i,t-1}\times Amount\ in\ MF_{i,t-1}$		−0.0861		
		(0.0670)		
$\%RiskyFW\ in\ MF_{i,t-1}$			0.504	0.415
			(0.923)	(0.830)
$12\times\hat{\alpha}^{BM}_{i,t-1}\times\%RiskyFW\ in\ MF_{i,t-1}$				0.0525
				(0.108)
Observations	1843	1843	1745	1745
Adjusted R^2	0.075	0.074	0.081	0.081
Year FE	Yes	Yes	Yes	Yes
Category FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

The table shows regressions of fund flows on managers' personal investments and past performance. $\%Flow_{i,t}$ is the percentage change in assets under management, that is $\%Flow_{i,t}=(AUM_{i,t}-AUM_{i,t-1}\times(1+R_{i,t}))/AUM_{i,t-1}\times 100$. Flows are winsorized at the 5th and 95th percentiles. $Amount\ in\ MF$ is the absolute amount managers invest in their funds standardized to zero mean and unit standard deviation. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds standardized to zero mean and unit standard deviation. Fund alphas are estimated according to Eq. (3) and the description in the text. Standard errors are clustered by funds.

investments arises because of reduced agency frictions. Reduced agency frictions could align incentives, improve a manager's effort, and thereby returns. However, self-selection likely matters: the regulator indicated no requirement or recommendation for fund managers to invest in their own funds. European mutual funds, including the vast majority of Swedish funds, are commonly regulated under the UCITS directives, which over the sample period in this study did not require managers to invest in their funds in any form.[14] Moreover, as shown in the previous section potential requirements by the fund family for its managers to personally invest cannot fully explain the positive relationship either.

A simple asymmetric information model that builds on the rational expectations equilibrium model of Berk and Green (2004) can rationalize the positive relationship between abnormal returns and personal investments. Berk and Green (2004)'s investors are uncertain about managerial skill, update their beliefs about managerial skill from observed fund returns, which decrease with fund size, and allocate capital to funds competitively such that every fund's expected abnormal return from the investor's perspective is zero at every point in time. Note that in Berk and Green (2004) the distinction between "managerial skill" and the "ability to earn an abnormal return" is important. The latter measures a fund's ability to pay out abnormal returns to investors, whereas the former measures the before-cost abnormal return, where costs include management fees and costs arising from capacity constraints. Both in the original model and under asymmetric information, a manager may be highly skilled but not be able to earn an abnormal return. This happens whenever skill as perceived by investors is above true skill.

When a manager, in contrast to investors, is certain about her skill, she invests in her funds whenever skill as perceived by investors is lower than a manager's true skill or, equivalently, whenever actual fund size is below efficient fund size (that is, the size if all parameters of the model were known). A manager who invests in her fund then earns an alpha. Since mutual funds cannot be shorted, if perceived skill by investors is above true skill, the manager simply does not invest. Under this view, the fact that most managers do not invest in their own funds implies that most managers believe that their funds are too large. Appendix C lays out such an asymmetric information model more formally and estimates the Berk and Green (2004) model on Swedish data following Roussanov et al. (2021).

The key assumption for this simple model to work is the assumption that managers cannot credibly signal their investments to investors. If a manager could credibly signal, she would face a complicated tradeoff. On the one hand, sending the signal by personally investing in the fund could increase AUM which ultimately affect compensation (Ibert et al., 2018; Ma et al., 2019). On the other hand, increasing AUM deteriorate the fund's return, which leads to a decrease in both the return on the personally invested capital and the pay-for-performance compensation. The assumption that managers cannot signal includes the assumption that managers' investments are "small" in relation to fund size such that investors cannot learn about managers' personal investments by observing fund size before allocating their capital.

In practice, the data on managers' personal investments are private and difficult to observe without significant effort, and managers' investments in relation to fund size are trivial. Even at the 90th percentile of the distribution, percentage ownership in the fund is only one basis point (see Table 1).[15] A simple test whether managers successfully

[14] Only with the introduction of UCITS V in June 2016, remuneration structures need to include rules on variable and fixed compensation, including a requirement that at least 50% of variable remuneration be in the form of units of the fund.

[15] If managers' personal investments were "large", then they would also have an effect on returns via decreasing returns to scale. In that case, a

Table 6
Team management and busy managers.

	(1) $12\times\hat{\alpha}_{i,t}^{BM}$	(2) $12\times\hat{\alpha}_{i,t}^{BM}$	(3) $12\times\hat{\alpha}_{i,t}^{BM}$	(4) $12\times\hat{\alpha}_{i,t}^{BM}$	(5) $12\times\hat{\alpha}_{i,t}^{BM}$	(6) $12\times\hat{\alpha}_{i,t}^{BM}$
$\%AUM\ in\ MF_{i,t-1}$	0.429***			0.409**		
	(0.111)			(0.168)		
$Amount\ in\ MF_{i,t-1}$		0.483***			0.333*	
		(0.122)			(0.200)	
$\%RiskyFW\ in\ MF_{i,t-1}$			0.414**			0.436*
			(0.202)			(0.248)
Observations	1780	1780	1634	1726	1726	1583
Adjusted R^2	0.097	0.098	0.092	0.236	0.235	0.224
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Category FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Manager FE	No	No	No	Yes	Yes	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated relative to the fund's prospectus benchmark according to Eq. (3) and the description in the text. $\%AUM\ in\ MF$ is managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. The sample is restricted to funds managed by one manager, that is excluding team-managed funds. Standard errors are clustered by funds.

Table 7
Regressions of year-by-year alphas on managers' personal investments.

	(1) $12\times\hat{\alpha}_{i,t}^{BM}$	(2) $12\times\hat{\alpha}_{i,t}^{BM}$	(3) $12\times\hat{\alpha}_{i,t}^{BM}$
$\%AUM\ in\ MF_{i,t-1}$	0.417***		
	(0.112)		
$Amount\ in\ MF_{i,t-1}$		0.479***	
		(0.147)	
$\%RiskyFW\ in\ MF_{i,t-1}$			0.113
			(0.174)
Observations	2449	2449	2291
Adjusted R^2	0.061	0.062	0.058
Year FE	Yes	Yes	Yes
Category FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated year-by-year using 12 monthly observations relative to the fund's prospectus benchmark according to Eq. (3). $\%AUM\ in\ MF$ is managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

signal their investments to investors is to test for a significant relationship between fund flows and managers' personal investments. Table 5 reports standard flow-performance regressions and additionally includes managers' investments in their own funds as an independent variable.[16] The point estimates on the amount invested or the amount invested scaled by wealth are statistically zero. All in all, there is no evidence that managers who invest in their funds attract larger flows and, hence, no evidence that managers successfully signal their personal investments to investors.

manager deciding *how much* to invest her fund would trade-off the size of personal investment versus deteriorating the return on that investments. Gupta and Sachdeva (2022) argue that this is the case for hedge funds, which typically feature much larger personal investments in relation to fund size than mutual funds.

[16] Flows are winsorized at the 5th and 95th percentiles. The results are similar if flows are defined as $\%Flow_{i,t} = (AUM_{i,t} - AUM_{i,t-1}\times(1+R_{i,t}))/(AUM_{i,t-1}\times(1+R_{i,t}))$ instead of $\%Flow_{i,t} = (AUM_{i,t} - AUM_{i,t-1}\times(1+R_{i,t}))/AUM_{i,t-1}$, and similar if flows are defined as changes in market shares (Spiegel and Zhang, 2013).

5. Robustness tests

5.1. Team management and busy managers

Columns (1)–(3) of Table 6 exclude team-managed funds from the main specifications in Table 2 and show that the results are robust.

An interesting question is whether in cases of team management, managers' personal investments tend to cluster. Consistent with the notion that managers at a given fund are informed about the fund's ability to earn abnormal returns, the most common pattern is that managers agree on their personal investment strategy. For 65% of the team-managed funds in the sample, none of the managers invest in a given year, and for 10% of the funds, all managers at a fund invest. In the remaining 25% of cases, some managers invest but others do not.

Some managers manage multiple funds – they are "busy". Columns (4)–(6) of Table 6 identify the effect of managers' personal investments on fund performance controlling for unobserved manager – as opposed to fund – characteristics. The coefficient estimates are similar to the ones in Columns (1)–(3).

5.2. Year-by-year alphas

I have measured fund performance using alphas obtained from a constant coefficients model. The advantage of estimating a constant coefficients model is more precise estimates; the disadvantages are a look-ahead bias in finite samples when predicting performance and a misspecification in case coefficients are time varying.

Table 7 re-estimates Columns (2), (4), and (6) of Table 2 using year-by-year alpha estimated with twelve monthly observations. The coefficient estimate on investments scaled by size is similar and the coefficient on the amount invested is smaller but still highly significant. The coefficient estimate on the percentage of wealth invested remains positive but is not statistically distinguishable from zero.

5.3. Alternative benchmarks

Table 8 re-estimates Table 2 using alternative models to estimate alphas. Columns (1)–(3) use before-fee alphas, Columns (4)–(6) use a Swedish four-factor model with market, size, value, and momentum factors, and Columns (7)–(9) complement the Swedish four-factor model with global market, size, value, and momentum factors obtained from Kenneth French's website.

All coefficient estimates remain positive and most remain highly statistically significant. The exception is again the coefficient estimate on the percentage of wealth invested which is statistically indistinguishable from zero at conventional significance levels in Columns (6) and (9).

Table 8
Alternative benchmarks.

	(1) $12 \times \hat{\alpha}^{BM,gross}_{i,t}$	(2) $12 \times \hat{\alpha}^{BM,gross}_{i,t}$	(3) $12 \times \hat{\alpha}^{BM,gross}_{i,t}$	(4) $12 \times \hat{\alpha}^{FF4,swe}_{i,t}$	(5) $12 \times \hat{\alpha}^{FF4,swe}_{i,t}$	(6) $12 \times \hat{\alpha}^{FF4,swe}_{i,t}$	(7) $12 \times \hat{\alpha}^{FF8,glob}_{i,t}$	(8) $12 \times \hat{\alpha}^{FF8,glob}_{i,t}$	(9) $12 \times \hat{\alpha}^{FF8,glob}_{i,t}$
$\%AUM\ in\ MF_{i,t-1}$	0.454***			0.321***			0.235***		
	(0.137)			(0.0722)			(0.0759)		
$Amount\ in\ MF_{i,t-1}$		0.750***			0.252**			0.226**	
		(0.196)			(0.121)			(0.112)	
$\%RiskyFW\ in\ MF_{i,t-1}$			0.585***			0.159			0.130
			(0.204)			(0.205)			(0.177)
Observations	2449	2449	2291	2449	2449	2291	2449	2449	2291
Adjusted R^2	0.099	0.105	0.095	0.200	0.200	0.202	0.131	0.131	0.129
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Category FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated as in Eq. (3) and the description in the text but with alternative benchmarks. Columns (1) to (3) use the prospectus benchmark and add back total expense ratios to the fund's return. Columns (4) to (6) use a Swedish four-factor model. Columns (7) to (9) add four global factors to the Swedish four-factor model. The different benchmark models are described in detail in Appendix A. $\%AUM\ in\ MF$ is managers' percentage ownership in their funds. $Amount\ in\ MF$ is the absolute amount managers invest in their funds. $\%RiskyFW\ in\ MF$ is the percentage of risky financial wealth managers invest in their funds. Percentage ownership, amount, and percentage of risky financial wealth are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

Table 9
Winsorizing the amount invested.

	(1) $12 \times \hat{\alpha}^{BM}_{i,t}$	(2) $12 \times \hat{\alpha}^{BM}_{i,t}$
$Amount\ in\ MF^{99\%}_{i,t-1}$	1.143***	
	(0.310)	
$Amount\ in\ MF^{95\%}_{i,t-1}$		0.976***
		(0.269)
Observations	2449	2449
Adjusted R^2	0.081	0.073
Year FE	Yes	Yes
Category FE	Yes	Yes
Controls	Yes	Yes

The table shows regressions of alphas on manager and fund characteristics. Alphas are estimated relative to the fund's prospectus benchmark according to Eq. (3) and the description in the text. $Amount\ in\ MF^{99\%}$ is the absolute amount managers invest in their funds winsorized at the 99th percentile. $Amount\ in\ MF^{95\%}$ is the absolute amount managers invest in their funds winsorized at the 95th percentile. The amounts are normalized to zero mean and unit standard deviation. Standard errors are clustered by funds.

5.4. Outliers

The amount invested is highly skewed and one may be worried that outliers in this variable drive some of the results for the corresponding specifications. The specification with a dummy for positive investment already mitigates the impact of outliers in the continuous variables. Alternatively, I winsorize the amount invested at the 99th and 95th percentiles, respectively, and re-estimate Column (4) of Table 2. Table 9 shows that with the winsorizations the coefficient estimates on the amount invested are even larger.

6. Conclusion

I collect a dataset of Swedish fund managers' personal portfolio holdings and find large amounts of cross-sectional dispersion in the composition of these portfolios. While some managers invest in their own funds, the majority of managers do not. The managers who do invest in their own funds subsequently perform better with their funds. The results suggest that fund managers, in contrast to fund investors, are certain about the fund's ability to earn an abnormal return, or most often lack thereof, and invest their personal wealth accordingly.

The results are relevant for policy makers in evaluating the benefits and costs of disclosure policies. If Swedish fund managers have to publicly file the investments in their own funds, it may be costly for the managers who lack ability to generate an abnormal return to feign ability to investors. Ultimately, the cost of signaling could drive some of the managers who lack ability out of the market. Thus, making managers' personal investments in their funds publicly available could decrease the size of the active fund industry. Whether this effect is desirable, and from which perspective, is an interesting question for future research.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix A. Data

A.1. AUM and TER imputation algorithms

As in Ibert et al. (2018), missing AUM and TER values for a given fund are imputed using the following algorithms.

A.1.1. Imputing AUM at the share-class level

Only missing values in the middle of AUM series are imputed by using their past values, fund share class returns, and a factor adjusted for flow rates. Specifically, let $[t_0, t]$ and $[t+n, T]$ be periods when a share class has data on AUM. The missing values are filled as follows:

$$AUM_k = F \times AUM_{k-1}(1 + r_k), \quad \text{for } k \in [t+1, t+n-1], \tag{A.4}$$

$$F \equiv \left(\frac{1}{\prod_{k=t+1}^{t+n}(1+r_k)} \frac{AUM_{t+n}}{AUM_t} \right)^{\frac{1}{n}} \tag{A.5}$$

where F is the factor adjusted for flow rate, and r_k is share class net return.

A.1.2. Imputing TER at the fund level

Missing TER values are imputed for every period funds have a return, using the following steps. First, for funds whose TER series are almost constant (the ratio of the smallest to the largest TER values larger than 0.95), the missing TER values are filled with the mean of the observed values. However, the number of imputations must be less than or equal to the number of periods when a fund has TER data.

Second, I use a fund's management fee (MNG) information to impute for missing TER as follows. For funds that have missing TER at time t but have data on MNG at this time, as well as other times when TER is available, I replace a missing TER with the product of MNG and the mean of the TER-to-MNG ratio. This step is used only if these ratios are not too volatile, meaning the mean of the TER-to-MNG ratio over the standard deviation of the TER-to-MNG ratio should be larger than 0.13.

For funds that do not have TER at all but have data on MNG, I rely on other funds that belong to the same Morningstar investment category to fill the missing values as follows:

$$imputed\_TER_{ijt} = MNG_{ijt}\left(\frac{1}{N_{jt}}\sum_{h\in\Omega_{jt}^{-i}}\frac{TER_{hjt}}{MNG_{hjt}}\right) \tag{A.6}$$

where TER_{hjt} is the TER of fund h in Morningstar category j, Ω_{jt}^{-i} is the set of funds (excluding fund i) belonging to category j in year t, and $N_{jt} = |\Omega_{jt}|$. If Ω_{jt}^{-i} is empty, I use this imputation:

$$imputed\_TER_{ijt} = MNG_{ijt}\left(\frac{1}{T}\sum_{\substack{k\in\Gamma\\k\neq t}}\frac{1}{N_{jk}}\sum_{h\in\Omega_{jk}^{-i}}\frac{TER_{hjk}}{MNG_{hjk}}\right) \tag{A.7}$$

where Γ is the set of periods other funds in category j have data on both TER and MNG, and $T = |\Gamma|$.

These first two steps account for 44% of the total number of imputations.

Third, for funds that have missing values in the middle of the TER series, the missing numbers are imputed by using their lag values and the TER growth rates. Precisely, let $0 \leq H_1, H_2 \leq 2$ such that funds have TER at any periods in $[t-H_1, t]$ and $[t+n, t+n+H_2]$. The missing TERs are imputed for each fund as follows:

$$\begin{aligned} imputed\_TER_k &= \left(\frac{\overline{TER}_{[t+n,t+n+H_2]}}{\overline{TER}_{[t-H_1,t]}}\right)^{\frac{1}{n}} \times TER_{k-1}, \\ &\text{for } k \in [t+1, t+n-1], \end{aligned} \tag{A.8}$$

where

$$\overline{TER}_{[t-H_1,t]} = \frac{1}{H_1+1}\sum_{k=t-H_1}^{t} TER_k \tag{A.9}$$

$$\overline{TER}_{[t+n,t+n+H_2]} = \frac{1}{H_2+1}\sum_{k=t+n}^{t+n+H_2} TER_k \tag{A.10}$$

Fourth, for funds that have missing TER at the tails of the series, I test whether TER series follow the linear time trend. If they do, I replace the missing TER with the forecast values from the model. To be specific, let $[t_0, t]$ and $[t+n, T]$ be periods when TER are missing, and let TER of fund i have the specification:

$$\log TER_{ik} = a_i + b_i k + \varepsilon_{ik}, \quad \forall k \in [t_0, T] \tag{A.11}$$

The missing TERs are filled as follows:

$$imputed\_TER_{ik} = \exp(\hat{a}_i + \hat{b}_i k), \quad \forall k \in [t_0, t] \cup [t+n, T] \tag{A.12}$$

only if the p-value of $\hat{b}_i$ is less than or equal to 5% and $n \geq 6$. If these conditions are violated, I replace all of the missing TER at the left (right) tail of the series with the mean values of the first (last) three TER values.

A.2. Finding social security numbers

Whenever possible, I first confirm the spelling of first and last names in the Morningstar data by comparing them with the fund company's annual report or the fund company's website. From the same sources, I try to find the fund manager's age or year of birth. If this is not possible, I narrow down the age range by using information about the person's career from Morningstar. I assume that active fund managers are between 25 and 67 years old. For example, if the fund manager has been active as a fund manager for ten years and is active to this date, I adjust the age range to 35 to 67 years. I search the internet for information on recruitment, fund performance, career history, LinkedIn profiles, pictures, comments in annual reports, and so on. This search may provide additional information about year of graduation and earlier jobs. For example, information about an earlier job can make it possible to further increase the minimum age of the fund manager. I flag managers with inconsistent spelling, for example between the fund report and Morningstar. When there are obvious spelling mistakes or erroneous data entry of manager names, I correct for it. Sometimes there is also confusion regarding which is the last name and which the first name, which I sort out using secondary sources, such as websites.

Based on the first name and last name, and if available the year of birth, I collect social security numbers using the websites www.upplysning.se and www.ratsit.se In the best-case scenario, I find exactly one social security number that fits the first name, last name, and age bracket. For some first and last name pairs, I cannot find any social security number using our data source. I send these names as well as those with spelling inconsistencies to the Swedish Tax Authority. The tax authority investigates whether a person with that first and last name lives in Sweden at any time between 1995 and 2013 and reports back to us one of four possibilities: (i) tax and income information is present, (ii) the person has a social security number but is not paying taxes, (iii) there are more than 100 matches, or (iv) there is no match. In case (i), I receive the social security number. In cases (ii) and (iv), I am now certain that this manager was not a Swedish taxpayer at any point between 1995 and 2013, and therefore has had no labor income in Sweden. In case (3), I assign the manager as being "unidentified".

For many names and age ranges, I obtain multiple social security numbers. For some common names, I may get more than 50 matches on first name, last name, and age range. In such cases, if the manager is still active and I know her or her fund company's office is located in Stockholm, I refine the search to include only the greater Stockholm area. This may allow me to narrow down the number of socials to just one, in which case I get a perfect match, or it may leave me with multiple but fewer matches. If I still get more than 50 hits after including the area information, I classify the fund manager as "unidentified". Based on this procedure, 84 managers remain unidentified.

For these 84 managers I try to find information about which university they attended. If I find such information, I request the manager's transcript from the university in question. This transcript usually contains the social security number as well as the person's address. This allows me to obtain another 32 matches, reducing the unidentified ones to 52.

For managers with multiple candidate social security numbers, I rate each social security number in terms of how likely it is to belong to the fund manager in question. Any available information from websites or other places is used. The rating scale goes from 0 to 3, where 0 means no match at all and 3 represents the most reliable category. Along with this rating, I ask Statistics Sweden to provide information about occupation and industry of employment for each candidate social. I rank all observed occupations and industries based on their appropriateness on a scale from 1 to 3. I then construct an algorithm that picks the most appropriate social based on our rating, the occupation, and the industry. In most cases, it is evident which the best match is. In the few cases where there are ties, I ask Statistics Sweden to internally check whether the registered employer name matches with the fund complex registered in Morningstar Direct.

Table A.1 shows how I arrive at the final sample used for the main regressions. The raw data include 832 managers but the final sample contains only 363 managers. The reason is that many of the manager names in the Morningstar raw data are Finnish, Danish, or Norwegian and stem from the inclusion of Nordic cross-borders funds.

Table A.1
Sample selection criteria.

Panel A: Sample selection	Managers	Funds
Morningstar sample 1990–2015		1744
Drop “Team Management” and “Not Disclosed”	1324	1600
Present at some point during 1999–2007	862	1103
Drop index, money market and pension funds	832	1019
Assign social security number candidate	535	838
Uniquely identify social security number	383	664
Final sample		
Require nonmissing controls and fund alphas	363	556

The table shows how I arrive at the final sample. A fund is included in the sample if at least one of its managers is identified. In case of missing fund holding data, a manager is included in the sample if at least one of her funds has holdings data.

A.3. Wealth variable definition

I define a manager’s personal risky financial wealth to be the sum of non-money market fund and direct stock investments. Cash is the sum of money market funds and bank account holdings. Financial wealth is the sum of risky financial wealth, cash, bonds, capital insurance, structured products, derivatives, and other financial wealth. (Net) Wealth is the sum of financial wealth, commercial, and noncommercial real estate net of debt. These definitions closely follow Betermier et al. (2017).

A.4. Benchmark and factor models

A.4.1. Morningstar prospectus benchmark

The main performance measure in this paper is the average abnormal return in excess of the benchmark. Morningstar reports a Primary Prospectus Benchmark for 74% of the funds. Some funds have linear combinations of indices as their benchmark. There are more than 300 different benchmark indices present in the sample. I find monthly return information for most of them on Morningstar, Bloomberg, and Datastream. For funds with no assigned benchmark or an irretrievable benchmark, I assign a benchmark by hand.[17] To account for the fact that investing in the benchmark features a non-negligible cost, I subtract the average expense ratio of Swedish the index funds that are available in a given year from the prospectus benchmark return.

A.4.2. Swedish FF4

The Swedish Fama and French four-factor model (Fama and French, 1993; Carhart, 1997) has the stock market factor, the size factor (SMB), the value factor (HML), and the momentum factor (MOM). These are constructed from all Swedish stocks and are the same as in Betermier et al. (2017).

A.4.3. Global FF8

The Global eight-factor model adds global market, size, value, and momentum factors obtained from Kenneth French’s website to the Swedish four-factor model.

All returns are converted into Swedish krona.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jfi.2022.100999.

[17] In those cases, I use the Morningstar variable “Category”, assigning the most common benchmark for that category to the remaining funds. When the benchmark is a linear combination of indices, and I lack return information on some of the component indices, I assign an alternative only to that component, keeping the other components and the index weighting.

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