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ORIGINAL ARTICLE

Fraternal twins—Should investors be careful?*

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Abstract

After analyzing portfolio differences between separate account-mutual fund twins, we find that dissimilar "fraternal twins" show significantly lower joint performance than "identical twins." This finding is consistent with fraternal twins competing for the limited attention of a manager while identical twins mutually profit. Furthermore, the effect is stronger for separate accounts, which is probably due to investors having the opportunity to influence managers' investment decisions according to their preferences. These results are independent of differences in known investment constraints. However, the findings may be driven by separate account investors' preferences for higher liquidity and lower idiosyncratic risk.

KEYWORDS

mutual funds, performance, portfolio holdings, separate accounts

JEL CLASSIFICATION

G11; G23

1 | INTRODUCTION

In large asset management companies, it has become common practice to offer developed investment strategies (e.g., "large cap value" or "small cap growth") to different types of investors in parallel through different investment vehicles. Specifically, mutual funds (MFs) with low or no minimum investment thresholds are primarily offered to retail investors. Separate accounts (SAs) with high minimum investment thresholds mainly focus on institutional investors and wealthy individual investors. Moreover, MFs and SAs pursuing the same broad-based investment strategy are often managed side-by-side, meaning that they are managed by the same portfolio manager or management team. In fact, more than 40% of all MFs and SAs in our initial sample are part of such a "twin" arrangement. As these twins are managed by the same manager with the same strategy, one would expect that their portfolios are automatically very similar, that is, that they are "identical twins". However, we demonstrate that their portfolios can indeed be quite different, that is, that "fraternal twins" exist and that this has a significant negative impact on the fraternal twins' performance. Furthermore, we show that the effect is stronger in SAs and present additional analysis regarding why this could be the case.

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Despite the importance of twin arrangements within the asset management industry, respective academic research is surprisingly sparse. Evans and Fahlenbrach (2012) show that retail MFs with an institutional twin SA outperform retail MFs without a twin by 1.5% per year due to a reduction of agency problems from greater monitoring. After the implementation of an institutional twin, expenses for retail MFs decrease, while different proxies show that managerial effort increases. In a performance comparison, Chen et al. (2017) analyze managers that concurrently manage at least one SA and one MF. Their results show significantly better performance for SAs compared with MFs.

Our study contributes to this line of research to enhance the general understanding of how portfolio deviations between twins affect the risk-adjusted performance of both vehicles. In this context, Evans, Gil-Bazo, and Lipson (2020) show that investment managers managing multiple MFs deliver lower performance because they devote less time and attention to each of the individual portfolios. Their results indicate that the attention effect is mainly driven by nonoverlapping holdings. Furthermore, studies such as Wermers (2000), Chen et al. (2004), Hu and Chang (2008), and Amihud and Goyenko (2013) show that more sophisticated and varied holdings increase demands on manager attention and that this can reduce the quality of manager decisions.

In our view, such a negative performance effect from divided managerial attention should be smaller for identical twins with very similar portfolios because greater attention to one portfolio also benefits the other. Conversely, the negative effect should be larger for fraternal twins with dissimilar portfolios because they compete for attention.[1] Therefore, why should the twin portfolios be different in the first place? Assuming that a rational portfolio manager would like to establish the same optimal strategy in both vehicles to minimize adverse effects from limited attention, material differences in portfolio compositions might still arise due to different investment constraints between the vehicles. These may include differences in portfolio characteristics (e.g., size or volatility of flows), which have been shown to drive portfolio performance in general (e.g., Chen et al., 2004 or Rakowski, 2010). Moreover, vehicles' organizational structures and institutional conditions are different. SAs face a lower level of regulation and fewer reporting requirements. Furthermore, within an SA, each investor owns an individual account in which she directly holds the respective assets.[2] This allows SA investors to customize their portfolios within the boundaries of the overall strategy, such as by setting style or risk preferences or by banning on specific stocks or industries. MFs do not offer such individualization because investors own assets only indirectly via fund shares. Consequently, MFs are managed as one homogeneous portfolio. Considering such differences in vehicle structures and institutional conditions, we can expect material deviations in the portfolio composition even if a manager would like to implement the same strategy in both portfolios. In addition, the manager may want to install different strategies in twin portfolios.

Using a comprehensive dataset of US domestic equity MFs and SAs, we identify a large sample of twins and compare their portfolio compositions using a new holdings-based "portfolio distance measure" (PDM). Specifically, we follow the twin identification methodology proposed by Evans and Fahlenbrach (2012), which requires a common fund family, a common manager (team), and a common investment objective. Our final sample comes from Morningstar and consists of 907 twin pairs with 22,916 twin-quarter observations in the period from 1997 to 2016 with contemporaneous holdings reports available for both portfolios.

To calculate the PDM, we apply a modification of Cremers and Petajisto's (2009) "active share," which originally measured investment activity as portfolio deviation from a passive benchmark. In contrast, the PDM compares SA holding weights to those of the corresponding MF twins. The calculation yields a quarterly time series of portfolio differences for each twin pair. In our sample, the mean PDM was approximately 22%,[3] and the median was approximately 8%. These statistics suggest that the twins are rather similar on average, as we would expect from side-by-side managed portfolios. However, since a manager would manage both an MF and SA in the same optimal way under exactly equal conditions, we consider such portfolio differences to be noteworthy. Furthermore, the cross-sectional variation in the PDM between the twin pairs is sufficiently strong to analyze the impact of dispersing portfolio compositions on twin performance.

We applied several univariate and multivariate analysis methods. Using univariate quintile sorting based on the PDM, we find the first evidence that larger portfolio differences between twins are associated with a lower risk-adjusted performance in both SAs and MFs. The effect seems to be stronger in SAs, as SAs show a larger performance decline, which might indicate a strong influence of the customization wishes of SA investors. Overall, the results are in line with the notion that portfolio management suffers when multiple portfolios compete for attention. However, the MF literature offers a wide variety of papers analyzing how investment restrictions and fund characteristics affect performance.[4] Most recently, Pastor, Stambaugh and Taylor (2020) show that managers face trade-offs between several economic constraints, such as skill, fund size, expenses, portfolio turnover and portfolio liquidity, which limit funds' performance. To control for such characteristics and to measure the effect of manager- and investor-driven portfolio differences, we include a large set of twin, firm, and portfolio characteristics in the subsequent multivariate regression analyses. These include

TABLE 1 Twin characteristics

		Mean			Median			SD		
	Obs	**SA**	**MF**	**Δ**	**SA**	**MF**	**Δ**	**SA**	**MF**	**Δ**
Total Net Assets (in $m)	21,829	2106 (0.00)	1433 (0.00)	673 (0.00)	554	273	282 (0.00)	3538	3608	−70 (0.00)
Min. Investment (in $m)	22,183	13.29 (0.00)	0.25 (0.00)	13.04 (0.00)	10.00	0.00	10.00 (0.00)	16.48	0.77	15.71 (0.00)
Number of Holdings	22,916	76.83 (0.00)	84.16 (0.00)	−7.33 (0.00)	66.00	68.00	−2.00 (0.00)	59.23	66.65	−7.42 (0.00)
Expense Ratio (in %)	22,916	1.11 (0.00)	1.26 (0.00)	−0.15 (0.00)	0.84	1.20	−0.36 (0.00)	0.90	0.42	0.48 (0.00)
Turnover Ratio (in %)	14,957	57.41 (0.00)	60.30 (0.00)	−2.89 (0.00)	47.82	49.00	−1.18 (0.00)	42.19	44.48	−2.29 (0.00)
Age	22,916	14.34 (0.00)	10.59 (0.00)	3.75 (0.00)	13.24	8.66	4.58 (0.00)	8.32	9.28	−0.96 (0.00)
Number of Accounts	21,734	200.06 (0.00)			22.00			558.63		

Note: This table shows means, medians, and standard deviations for fund characteristics of separate account-mutual fund twins on a quarterly basis as well as corresponding differences. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. The descriptive statistics include all twin-quarter observations with simultaneous availability of holding information and the respective characteristics for both the separate account and mutual fund. For the characteristics, we use quarterly averages of total net assets, minimum investment, number of equity holdings in the portfolio, expense ratio, turnover ratio, age, and number of institutional accounts managed through the SA. The expense ratio is based on the annualized difference between gross and net returns. Annual turnover ratio is the lesser of purchases or sales divided by average monthly net assets. Age is calculated in years using the respective SA and MF inception dates. For testing the significance of the means, this table reports *p* values of two-sided one-sample *t* tests and paired two-sample *t* tests for the respective difference between separate accounts and mutual funds using clustered standard errors at the twin level. For testing the difference in the medians, this table reports *p* values using the Wilcoxon matched-pairs signed-ranks test (Wilcoxon, 1945), and for the difference between standard deviations, a two-sample variance-comparison test is reported. *p* values are shown in parentheses.

variables for the manager overlap between the twins and the number of managed accounts in the SA, which approximates differences in the organizational structure. We find strong and robust evidence that a higher PDM between twins leads to a decrease in their joint risk-adjusted performance.

This finding raises the question of whether this negative impact equally affects both investment vehicles or if it differs in strength between SAs and MFs. The results from the univariate quintile sorting already indicate a stronger performance decrease for SAs, while MFs are also hurt but not as much. Using a piecewise linear regression model including controls for constraints and two separate PDM variables to measure the separate impacts on SA and MF performance, we document robust evidence of a stronger decline in performance for SAs than for MFs. This could be the result of SA investors affecting investment decisions such that SAs must deviate from the relatively undisturbed strategy the manager may execute for MFs. However, as SAs demand more attention due to investors' customization needs, MF performance deteriorates. For these reasons, we document that the PDM significantly affects the performance of both SAs and MFs, which seems to be driven by the customization demands of SA investors.

We run several additional analyses to ensure the robustness of the results and to provide possible explanations. First, an important type of institutional investor preference in SAs is specific risk factor targets. To test whether the negative effect of the PDM on performance comes from different risk preferences, we further add differences in investment risk and style factor exposures between SA-MF twins into our regressions. The results remain economically unchanged such that the negative correlation of the PDM and performance is not driven by differences in risk preferences between SA and MF investors. Second, to control for possible falsely identified twin matches, we further test our results by excluding twins with very high PDM values from our regressions. However, even the removal of potentially false twins with high PDM values does not change the economic interpretation of our results. We provide robust evidence that differences in portfolio composition harm twin performance. Last, we examine the characteristics of the stocks that most drive the PDM separately for each twin to find a possible explanation regarding why SA performance is adversely affected more strongly by a higher PDM. We find that SA investors prefer higher liquidity, lower idiosyncratic risk, and stronger stock return momentum compared with their MF twins. Thus, SA investors may forego the respective liquidity and risk premia, which possibly explains the larger performance decline in SAs.

2 | DATA AND METHODOLOGY

2.1 | Data

Our initial sample consists of 3152 US domestic equity MFs and 3781 US domestic equity SAs for the period from 1990 to 2016 obtained from Morningstar Direct. Morningstar provides detailed information on the names and terms of individual managers for both vehicles, the investment companies and the vehicles' positions in the Morningstar equity style box. As in Evans and Fahlenbrach (2012) and Chen et al. (2017), we aggregate different mutual fund share classes at the fund level. Variables such as returns and fees are size-weighted, and size itself is aggregated. Since mutual funds might offer retail and institutional share classes, we also include the fraction of institutional share class total net assets as a control variable in our regressions. SAs usually do not have multiple share classes because each investor holds her own portfolio and negotiates fees individually. Following Chen et al. (2017), some funds are used multiple times to form twins in case managers have an unbalanced number of SAs and MFs fulfilling the twin definition. Furthermore, we obtain quarterly holdings reports for SAs and MFs from Morningstar. Respective holdings characteristics such as stock price, market capitalization, and book-to-market ratio are obtained from Refinitiv Datastream.

To identify SA-MF twins, we apply the methodology of Evans and Fahlenbrach (2012), which requires a common investment firm, a common manager (team), and a common investment objective. The matching results in 1463 MF-SA twin pairs and 14,297 twin years.[5] Thus, more than 40% of our sample portfolios are a part of a twin arrangement. To be included in later analyses, these twins must survive the following filters: (i) We remove passively managed twins identified by fund name following Elton, Gruber and Blake (2014). (ii) We require a minimum of 36 monthly observations for net and gross returns per twin. (iii) There must be at least five contemporary holding reports for both vehicles showing at least one equity holding. Our final sample consists of 907 twin pairs with available holdings data for the period 1997 to 2016.[6] Obtaining all SA and MF holdings from Morningstar conveniently allows us to use an internal Morningstar identifier to match the holdings across both portfolios, which ensures high-quality matches.[7]

Table 1 describes and compares common twin characteristics on a quarterly basis for MFs and SAs by reporting the means, medians, standard deviations, corresponding differences and paired statistical tests. Therefore, we include all

twin-quarter observations with simultaneous availability of holding information and the respective characteristics for both vehicles. The results indicate that SAs are significantly larger on average than their MF twins. The minimum investment of roughly $13.3 M is also clearly higher for SAs than for MFs ($0.3 M), which restricts SAs factually to institutional investors and wealthy individual investors. The higher the contribution of these clients to an SA, the stronger their bargaining power becomes. MFs are therefore more expensive than SAs. While investors in MFs pay on average 1.26% per year, SA investors pay only approximately 1.11%. In addition to the negotiation of fees, SA investors might also influence the portfolio composition, for example, by putting bans on specific types of stocks. Indeed, the comparison of the average number of holdings is in line with this presumption by showing a significantly smaller portfolio for SAs. However, as expected from the nature of the data, there is only a small but still significant difference in the number of holdings according to the median. The turnover ratio seems to be slightly higher in MFs, but this might be primarily due to the higher fluctuation in cash flows caused by the higher number of retail investors in MFs. Moreover, the turnover ratio data are often missing for SAs, which might bias the statistic. With respect to age, it is surprising that the SAs at 14.3 years were on average significantly older than the MFs at 10.6 years. This may be related to fund incubation, as Evans (2010) reports that successful SA strategies are often subsequently offered to the public via MFs.

2.2 | Performance measurement

We evaluate SA-MF twins using both absolute and risk-adjusted returns from the capital asset pricing model (CAPM), the Fama and French (1993) 3-factor model, and the Carhart (1997) 4-factor model.[8] To obtain a time series of alphas, we follow Sharpe (1992) and run rolling regressions (Equation 1) to calculate the out-of-sample performance (Equation 2) for each SA and each MF in each month t+1 using style betas estimated over the 24-month window ending in t.

$$\mathrm{ER}_{i,t} = \alpha_{i,(t)} + \beta^{m}_{i,(t)} ER_{m,t} + \beta^{\mathrm{SMB}}_{i,(t)} \mathrm{SMB}_t + \beta^{\mathrm{HML}}_{i,(t)} \mathrm{HML}_t + \beta^{\mathrm{MOM}}_{i,(t)} \mathrm{MOM}_t + \varepsilon_{i,t}. \tag{1}$$

$$\alpha_{i,t+1} = \mathrm{ER}_{i,t+1} - \left(\beta^{m}_{i,(t)} \mathrm{ER}_{m,t+1} + \beta^{\mathrm{SMB}}_{i,(t)} \mathrm{SMB}_{t+1} + \beta^{\mathrm{HML}}_{i,(t)} \mathrm{HML}_{t+1} + \beta^{\mathrm{MOM}}_{i,(t)} \mathrm{MOM}_{t+1} \right). \tag{2}$$

is the monthly excess return of vehicle i in month t over the risk-free rate using the US one-month Treasury bill rate, $\mathrm{ER}_{m,t}$ is the excess return of the market, and $\varepsilon_{i,t}$ is the error term. Without further factors, $\alpha_{i,(t)}$ corresponds to the in-sample Jensen (1968) or CAPM alpha of vehicle i during the window ending in t. By adding SMB_t and HML_t, we obtain the Fama and French alpha; and by further adding MOM_t, we obtain the Carhart alpha. $\beta^{m}_{i,(t)}$, $\beta^{\mathrm{SMB}}_{i,(t)}$, $\beta^{\mathrm{HML}}_{i,(t)}$, and $\beta^{\mathrm{MOM}}_{i,(t)}$ are the style betas of vehicle i during the window ending in t. For the summary statistics and quarterly panel regressions, we sum the monthly excess returns and out-of-sample alphas during the respective quarter and multiply the results by four to obtain annualized measures. Twin alphas are calculated as the total net assets-weighted average of the out-of-sample alphas estimated separately for SAs and MFs.[9]

Table 2 repeats the analysis according to Section 2.1 by showing summary statistics for calculated SA and MF performance measures. The results indicate that the average SA and MF performance is significantly positive for gross returns (Panel A) and significantly negative for net returns (Panel B). With a difference in the means of 1 bp p.a. and a p value of 83%, the annualized gross excess returns are almost identical for both vehicles; however, after the consideration of fees, SAs exhibit a significantly higher performance of 12 bps p.a. due to their lower expense ratio. With respect to risk-adjusted returns, the differences between SAs and MFs are of similar size and are nonsignificant for gross returns but significant for net returns at the 5% level. For example, the difference in their average gross (net) Carhart alpha is 4 (13) bps per year.

Some of these statistics are in line with the existing literature. Elton, Gruber and Blake (2014) and Evans et al. (2020b) report that SAs outperform MFs on average; however, in a direct comparison of SAs and MFs offered by the same company and having the same Morningstar objective; Elton, Gruber and Blake (2014) find no significant difference in risk-adjusted performance. They conclude that smaller boutique firms that serve only large wealthy investors are responsible for the better performance of SAs. One issue of this matching approach at the firm and objective levels is that it does not correctly control for managerial skill. In a similar study, Chen et al. (2017) circumvent this problem by analyzing managers that concurrently manage at least one SA and one MF. Their results reveal significantly better performance for SAs compared with MFs. As in Chen et al. (2017), we address this issue by our implementation of twin analysis, but as seen

TABLE 2 Twin performance

		Mean			Median			SD		
	Obs	SA	MF	Δ	SA	MF	Δ	SA	MF	Δ
Panel A: Gross Returns (in %)										
Excess Returns	22,916	11.07 (0.00)	11.06 (0.00)	0.01 (0.83)	13.68	13.53	0.14 (0.00)	33.34	33.63	−0.30 (0.18)
Carhart Alpha	20,700	0.42 (0.00)	0.39 (0.00)	0.04 (0.44)	0.47	0.46	0.01 (0.31)	11.17	11.34	−0.17 (0.03)
Fama-French Alpha	20,700	0.44 (0.00)	0.42 (0.00)	0.01 (0.75)	0.47	0.43	0.04 (0.32)	10.94	11.12	−0.18 (0.02)
CAPM Alpha	20,700	0.28 (0.00)	0.26 (0.01)	0.01 (0.74)	0.16	0.22	−0.06 (0.27)	13.12	13.32	−0.21 (0.02)
Panel B: Net Returns (in %)										
Excess Returns	22,916	10.03 (0.00)	9.91 (0.00)	0.12 (0.02)	12.61	12.41	0.20 (0.00)	33.29	33.56	−0.27 (0.23)
Carhart Alpha	20,700	−0.60 (0.00)	−0.72 (0.00)	0.13 (0.02)	−0.54	−0.56	0.01 (0.00)	11.21	11.31	−0.10 (0.20)
Fama-French Alpha	20,700	−0.58 (0.00)	−0.69 (0.00)	0.11 (0.04)	−0.54	−0.59	0.04 (0.00)	10.99	11.09	−0.10 (0.18)
CAPM Alpha	20,700	−0.74 (0.00)	−0.85 (0.00)	0.10 (0.05)	−0.81	−0.80	−0.01 (0.00)	13.15	13.29	−0.14 (0.12)

Note: This table shows means, medians, and standard deviations for annualized excess returns and risk-adjusted performance measures of separate account-mutual fund twins on a quarterly basis as well as corresponding differences. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. The descriptive statistics include all twin-quarter observations with simultaneous availability of holding information and respective returns for both the separate account and mutual fund. For testing the significance of means, this table reports *p* values of two-sided one-sample *t* tests and paired two-sample *t* tests for the respective difference between separate accounts and mutual funds using clustered standard errors at the twin level. For testing the difference in medians, this table reports *p* values using the Wilcoxon matched-pairs signed-ranks test (Wilcoxon, 1945), and for the difference between standard deviations, a two-sample variance-comparison test is reported. Excess returns are returns subtracted by the US one-month Treasury bill rate. The annualized excess return is the multiplicative sum of the monthly returns of a quarter multiplied by four. Risk-adjusted returns are out-of-sample alphas calculated via factor loadings obtained from 24-month rolling window regressions from *t*–1 to *t*–24 using the CAPM, Fama-French 3-Factor model and Carhart 4-Factor model. The alpha of a quarter is the sum of its three monthly out-of-sample alphas multiplied by four to obtain annualized figures. Net returns are gross returns minus the expense ratio. *p* values are shown in parentheses.

from the results above, we can only confirm their findings for net returns and not for gross returns. However, since this study predominantly investigates the question of whether the performance of twins with similar portfolios (identical twins) differs cross-sectionally from the performance of twins with different portfolios (fraternal twins), whether MFs and SAs perform differently within the twin is not important to our analysis.

2.3 | Portfolio distance measure

To measure potential differences in portfolio management, we apply a holdings-based portfolio distance measure (PDM), which is a modification of the active share (Cremers & Petajisto, 2009). Instead of comparing the SA portfolio with a passive reference index to measure investment activity, we use the corresponding MF twin portfolio as the reference, as shown in Equation (3). In this way, we obtain a time series of portfolio differences for each twin pair:

$$\mathrm{PDM}_{\mathrm{TW},t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{\mathrm{SA},j,t} - w_{\mathrm{MF},j,t}\right| \tag{3}$$

For each quarter t and twin pair TW, $\mathrm{PDM}_{\mathrm{TW},t}$s the sum of the absolute differences between matched equity holding weights between the two portfolios divided by two to avoid double counting. $w_{\mathrm{SA},j,t}$ is the SA portfolio weight of stock j in quarter t, and $w_{\mathrm{MF},j,t}$ is the MF portfolio weight for the same stock. Stocks exclusively held in one vehicle exhibit a weight of zero in the corresponding twin, and all portfolio weights of equity holdings in a vehicle have been accordingly rescaled to ensure that they sum up to 100%. Given this definition, the PDM is identical for both twins. This procedure favors a comparison employing return-based measures such as tracking error since the comparison between the portfolios is based on actual portfolio compositions rather than solely on correlations, which may understate the differences (see Cremers & Petajisto, 2009).

Panel A of Table 3 reports descriptive statistics for the PDM, presented pooled, by quarter and by twin. The pooled mean of approximately 22% suggests that the weights of the stocks in the SA-MF portfolio overlap by an average of 78%, some stocks are overweighted by 22% and others are underweighted by 22%. The corresponding median is 7.88%, indicating that the twin portfolios are quite similar in general. Since a manager, all else being equal, can generally be expected to manage both MFs and SAs in the same way, we still consider such differences noteworthy. Furthermore, all means are highly significant and different from zero at the 1% level. This finding is in line with our expectation that investment managers encounter different restrictions in the management of these two vehicles, for example, due to investor interventions within the SA or the organizational structure, which affect the portfolio composition of one or both. Figures that are calculated by quarter and by twin support this notion. The twin standard deviation of 26.47% represents the cross-sectional variation of the PDM between twins. In contrast, Panel B shows an average within twin time-series standard deviation of 6.01%. Thus, it seems that the PDM is rather stable within twins compared with a strong cross-sectional variation between twins.

3 | EFFECTS OF DIFFERING PORTFOLIO COMPOSITIONS ON PERFORMANCE

3.1 | Univariate quintile sorting

Investment companies typically offer the same investment strategy via MFs to retail investors and via SAs to institutions. Even when the same manager manages both vehicles, we observe different portfolio compositions, as seen in Section 2 introducing the PDM. In this section, we examine whether this deviation in the portfolio management of SA-MF twins causes a significant decrease in performance.

To test this premise, we start with quarterly quintile sorting based on the PDM. In Table 4, Quintile 1 contains the 20% of twin observations with the lowest PDMs, and thus, the smallest differences in portfolio composition. Likewise, Quintile 5 contains the largest 20% of differences. Pooled means and medians are calculated across all twins and quarters. In addition to the annualized CAPM, Fama-French, and Carhart gross alphas, we also show several vehicle characteristics, such as total net assets, expense ratio, minimum investment, number of equity holdings, turnover ratio, and age. As in Tables 1 and 2, we include only twin-quarter observations with contemporaneously reported SA-MF data on holdings, characteristics, and returns. Panel A shows the means while Panel B shows the medians. We include statistical tests for the 5–1 difference to answer the primary question of whether the performance varies between twins depending on the PDM. Moreover, we include statistical tests for the difference between SAs and MFs across all quintiles to investigate whether the performance deviates significantly within twins.

Analyzing the results for the PDM, which is naturally identical for an SA-MF twin, Quintile 1 shows an average close to zero. This finding suggests that a significant number of twins hold the exact same portfolio. Conversely, we also

TABLE 3 Portfolio distance measure

					Percentile				
	Obs	**Mean**	**SD**	***T* Test**	**10**	**25**	**50**	**75**	**90**
Panel A: Descriptive Statistics									
Pooled	22,916	21.99	26.67	(0.00)	0.04	1.10	7.88	37.96	65.26
By Quarter	80	19.57	9.09	(0.00)	0.00	20.77	21.79	24.16	26.74
By Twin	907	24.89	26.47	(0.00)	0.99	2.79	12.97	42.01	67.51
Panel B: Within Twin Standard Deviation									
PDM	907	6.01	5.99	(0.00)	1.00	2.05	4.01	7.80	14.24

Note: This table shows descriptive statistics of the portfolio distance measure (PDM) for separate account-mutual fund twins on a quarterly basis. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. For each quarter t and twin TW, $\mathbf{PDM}_{\mathrm{TW},t}$. Nonincluded holdings in a portfolio exhibit a weight of zero. In Panel A, calculated statistics are pooled and for quarter as well as twin averages of the PDM. Panel B shows statistics of the within twin standard deviation of the PDM measure. For testing the significance of the means, this table reports p values of two-sided one-sample t tests. Except for quarter averages, all test statistics are calculated using clustered standard errors at the twin level. PDM is in % and p values are shown in parentheses.

TABLE 4 Quintile sorting based on PDM

		SA	MF	Δ Test	SA	MF	Δ Test	SA	MF	Δ Test	SA	MF	Δ Test	SA	MF	Δ Test
	PDM	**Excess Gross Return (in %)**			**4F Alpha Gross (in %)**			**3F Alpha Gross (in %)**			**CAPM Alpha Gross (in %)**			**Total Net Assets (in $m)**		
Panel A: Mean																
Low PDM	0.17	11.28	11.27	(0.81)	0.68	0.58	(0.05)	0.75	0.68	(0.16)	0.43	0.36	(0.18)	2344	1382	(0.00)
2	1.96	11.06	11.01	(0.14)	0.68	0.68	(0.91)	0.54	0.53	(0.89)	0.07	0.02	(0.44)	2661	1539	(0.00)
3	9.11	10.95	11.00	(0.35)	0.48	0.35	(0.05)	0.50	0.40	(0.16)	0.45	0.44	(0.96)	1946	1702	(0.25)
4	31.74	10.98	11.03	(0.60)	0.14	0.09	(0.66)	0.15	0.16	(0.94)	0.34	0.37	(0.73)	2317	1836	(0.17)
High PDM	67.54	11.09	11.00	(0.61)	0.11	0.21	(0.58)	0.22	0.32	(0.63)	0.10	0.10	(0.97)	1224	691	(0.01)
5–1 PDM	67.37 (0.00)	−0.19 (0.07)	−0.27 (0.07)		−0.57 (0.02)	−0.37 (0.07)		−0.53 (0.02)	−0.36 (0.08)		−0.33 (0.05)	−0.26 (0.17)		−1120 (0.00)	−691 (0.00)	
	PDM	**Expense Ratio (in %)**			**Min. Investment (in $m)**			**# Holdings**			**Turnover Ratio (in %)**			**Age**		
Low PDM	0.17	1.03	1.24	(0.00)	13.46	0.26	(0.00)	71.25	71.57	(0.00)	55.41	57.81	(0.00)	13.64	10.91	(0.00)
2	1.96	1.05	1.24	(0.00)	14.66	0.31	(0.00)	81.05	81.82	(0.00)	51.20	54.44	(0.00)	14.47	10.97	(0.00)
3	9.11	1.13	1.27	(0.03)	11.20	0.28	(0.00)	73.82	76.06	(0.00)	55.12	57.91	(0.00)	16.46	10.78	(0.00)
4	31.74	1.16	1.24	(0.21)	15.64	0.23	(0.00)	78.19	85.39	(0.05)	60.84	62.78	(0.06)	14.68	10.55	(0.00)
High PDM	67.54	1.17	1.29	(0.06)	11.41	0.16	(0.00)	79.88	106.22	(0.00)	65.43	69.53	(0.16)	12.45	9.73	(0.00)
5–1 PDM	67.37 (0.00)	0.15 (0.00)	0.04 (0.00)		−2.05 (0.00)	−0.10 (0.00)		8.63 (0.00)	34.66 (0.00)		10.02 (0.00)	11.72 (0.00)		−1.19 (0.00)	−1.18 (0.29)	
	PDM	**Excess Gross Return (in %)**			**4F Alpha Gross (in %)**			**3F Alpha Gross (in %)**			**CAPM Alpha Gross (in %)**			**Total Net Assets (in $m)**		
Panel B: Median																
Low PDM	0.04	13.85	13.79	(0.00)	0.72	0.61	(0.08)	0.71	0.65	(0.07)	0.32	0.23	(0.07)	816	361	(0.00)
2	1.74	13.76	13.71	(0.00)	0.62	0.69	(0.24)	0.52	0.50	(0.13)	0.04	0.00	(0.08)	832	345	(0.00)
3	7.96	13.26	13.30	(0.00)	0.63	0.60	(0.19)	0.59	0.51	(0.26)	0.27	0.34	(0.57)	543	352	(0.00)
4	31.70	13.35	13.39	(0.26)	0.32	0.33	(0.79)	0.37	0.30	(0.62)	0.14	0.41	(0.67)	655	254	(0.00)
High PDM	65.28	14.04	13.46	(0.57)	0.05	0.18	(0.56)	0.15	0.15	(0.64)	0.11	0.07	(0.88)	206	118	(0.00)

TABLE 4 (Continued)

	PDM	Excess Gross Return (in %)		4F Alpha Gross (in %)		3F Alpha Gross (in %)		CAPM Alpha Gross (in %)		Total Net Assets (in $m)	
5–1 PDM	65.24 (0.00)	0.19 (0.22)	−0.33 (0.22)	−0.67 (0.04)	−0.43 (0.15)	−0.56 (0.05)	−0.50 (0.05)	−0.21 (0.19)	−0.16 (0.39)	−610 (0.00)	−242 (0.00)

	PDM	Expense Ratio (in %)			Min. Investment (in $m)			# Holdings			Turnover Ratio (in %)			Age		
Low PDM	0.04	0.84	1.19	(0.00)	5.00	0.00	(0.00)	66.00	66.00	(0.00)	49.55	51.00	(0.00)	12.92	9.00	(0.00)
2	1.74	0.84	1.19	(0.00)	10.00	0.00	(0.00)	68.00	68.00	(0.00)	41.41	45.00	(0.00)	13.30	9.01	(0.00)
3	7.96	0.82	1.21	(0.00)	5.00	0.00	(0.00)	60.00	62.00	(0.00)	40.41	41.80	(0.00)	15.25	8.75	(0.00)
4	31.70	0.76	1.17	(0.00)	10.00	0.00	(0.00)	63.00	67.00	(0.00)	51.36	53.00	(0.00)	13.42	8.41	(0.00)
High PDM	65.28	0.84	1.22	(0.00)	5.00	0.00	(0.00)	72.00	78.00	(0.00)	57.40	58.00	(0.00)	11.34	8.00	(0.00)
5–1 PDM	65.24 (0.00)	0.00 (0.66)	0.03 (0.03)		0.00 (0.46)	0.00 (0.31)		6.00 (0.00)	12.00 (0.00)		7.85 (0.00)	7.00 (0.00)		−1.58 (0.00)	−1.00 (0.73)	

Note: This table shows the means (Panel A) and medians (Panel B) of a quarterly quintile sorting based on the portfolio distance measure (PDM). Quintile 1 contains the lowest 20% of PDM values for each quarter and Quintile 5 the highest 20%. The means and medians are calculated by pooling across all quarters. 5–1 is the difference between the top and bottom quintile. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. For each quarter t and twin TW, $\text{PDM}_{\text{TW},t}$ is the sum of the absolute differences between matched holding weights of the separate account and mutual fund equity portfolio divided by two: $\text{PDM}_{\text{TW},t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{\text{SA},j,t} - w_{\text{MF},j,t}\right|$. Nonincluded holdings in a portfolio exhibit a weight of zero. Depending on the quarterly sorting of the PDM (%), corresponding separate account and mutual fund statistics are also shown for annualized performance measures and fund characteristics including total net assets ($m), expense ratio (% p.a.), minimum investment of the vehicle ($m), number of equity holdings in the portfolio, turnover ratio (% p.a.), and age in years. Excess returns are fund gross returns subtracted by the US one-month Treasury bill rate. The annualized excess return is the multiplicative sum of the monthly returns of a quarter multiplied by four (%). Risk-adjusted returns are out-of-sample gross alphas calculated via factor loadings obtained from 24-month rolling window regressions from t–1 to t–24 using the CAPM, Fama-French 3-Factor model, and Carhart 4-Factor model. The alpha of a quarter is the sum of its three monthly out-of-sample alphas multiplied by four to obtain annualized figures (%). The descriptive statistics for returns and fund characteristics include all twin-quarter observations showing a simultaneous reporting from the separate account and mutual fund. For testing the significance of the respective quintile differences in the means between separate accounts and mutual funds, the table reports p values of paired two-sample t tests using clustered standard errors at the twin level. For testing the differences in the medians, the table reports p values using the Wilcoxon matched-pairs signed-ranks test (Wilcoxon, 1945). p values from all difference tests are shown in parentheses.

observe twins with a very high portfolio difference in Quintile 5, showing an average PDM of 68%. Accordingly, the corresponding difference between both quintiles is highly significant at the 1% level for the mean and the median.

Examining the performance measures, the significant 5–1 differences indicate that greater portfolio differences are accompanied by a lower performance for both SAs and MFs. For example, the average annualized 5–1 difference in the Carhart MF alpha equals −37 bps and is significant at the 10% level. However, the difference in the Carhart SA alpha is even larger at −57 bps, which is significant at the 5% level. The same applies to the comparison of the remaining 5–1 differences of risk-adjusted returns between SAs and MFs, with some also showing higher significance levels for SAs. Hence, the performance of MFs does not seem to be hurt as much as the performance of SAs. Considering that investors are able to influence the portfolio choice in SAs but not in MFs, this result suggests that the PDM is driven by the investor rather than the fund manager herself, which causes the performance to suffer. Since there is an increased need for attention within an SA, the manager also has less time for the MF counterpart, which is why we still observe indirect performance decreases for MFs. We will follow up on this observation more deeply in Section 3.3, where we use a piecewise linear panel regression to measure the separate influences of the PDM on the SA and MF alphas. Overall, these first results tend to confirm our expectation that larger differences in the portfolio composition negatively affect both twin vehicles, MFs and SAs. Moreover, it seems that SAs are affected more strongly.

With regard to the other fund characteristics, it is striking that Quintile 5 with the highest average PDM seems to be rather different in general.[10] For example, in terms of total net assets, it is significantly smaller than Quintiles 1 to 4. This result diverges from previous findings on diseconomies of scale, an observed investment restriction, which suggests that larger portfolios underperform smaller ones (e.g., Chen et al., 2004, for MFs and Evans et al., 2020a, for SAs). With respect to age, Quintile 5 observations are from younger portfolios than the observations of the remaining quintiles. Conversely, the average expense ratios, number of equity holdings and turnover ratios increase almost monotonically over all PDM quintiles.

Considering the differences between SA and MF quintiles, we observe similar results for the performance as in Section 2.2. Most of the quintiles in Panels A and B show no significant difference. At least for gross returns, we cannot confirm a higher performance for SAs. As already mentioned above, this is not important to our analysis since we are interested in the cross-sectional performance variation between twins that show smaller and larger portfolio deviations. In contrast, almost all of the characteristic quintiles show significant differences between SAs and MFs, supporting the reported results in Table 1. This finding emphasizes the need for the inclusion of fund characteristics in the following regressions to control for differences in observable investment constraints between SAs and MFs that are also well known to affect portfolio management and therefore risk-adjusted performance.

3.2 | Panel regressions of joint twin alphas

In the previous section, we document univariate evidence that the PDM is negatively correlated with performance. However, we also note correlations of the PDM with a number of other fund characteristics, which approximate several investment constraints. This finding is not surprising since the PDM is based on the difference in holdings between SAs and MFs and therefore reflects all differences in the portfolio management of these twins. By considering a large variety of twin and portfolio characteristics in the following regressions, we investigate the combined manager- and investor-driven effect of differing twin portfolios on the joint risk-adjusted twin performance following Equation (4):

$$\alpha_{\mathrm{TW},t+1} = b_0 + b_1 \mathrm{PDM}_{\mathrm{TW},t} + \sum_{k=2}^{7} b_k \mathrm{Level}^k_{\mathrm{TW},t} + \sum_{k=8}^{13} b_k \mathrm{Diff}^k_{\mathrm{TW},t} + \sum_{k=14}^{19} b_k \mathrm{Controls}^k_{\mathrm{TW},t} + \varepsilon_{\mathrm{TW},t}. \tag{4}$$

is the joint twin out-of-sample gross alpha in quarter t+1 using either the respective CAPM, Fama and French or Carhart model. $\mathrm{PDM}_{\mathrm{TW},t}$ is the PDM as introduced in Equation (3). $\mathrm{Level}^k_{\mathrm{TW},t}$ and $\mathrm{Diff}^k_{\mathrm{TW},t}$ correspond to several twin characteristics k, such as log total net assets, expense ratio, flow, age, cash holdings, and turnover ratio. More specifically, $\mathrm{Level}^k_{\mathrm{TW},t}$ is the average of the respective SA and MF characteristics in quarter t and is included to capture cross-sectional differences between twin pairs and therefore controls for common portfolio characteristics that are in general well known to affect risk-adjusted performance. $\mathrm{Diff}^k_{\mathrm{TW},t}$ is the difference between the SA and MF characteristics in quarter t and is included to capture differences within a twin pair, thus controlling for characteristic-driven portfolio deviations that are also expected to cause attention effects on performance. $\mathrm{Controls}^k_{\mathrm{TW},t}$ represents the levels of further control variables for

which the level-difference separation is not applicable. Those include the average bid-ask spread of holdings to capture liquidity and the log number of equity holdings to capture diversification. The SA-MF difference of both measures is by construction highly correlated with the PDM.[11] The log number of accounts within an SA captures differences in the organizational structure, while the fraction of institutional share classes in an MF may control for outside monitoring effects. Both variables are exclusive to the respective vehicle. The log firm total assets and the percentage of common managers are identical for both twins. We cluster standard errors by twin to account for the low time-series variation of the PDM within the twins compared to the strong cross-sectional variation between the twins, as shown in Table 3. Considering all these control variables, we expect coefficient $\boldsymbol{b_1}$ to measure the effects of manager- and investor-driven portfolio differences on joint twin performance.

Table 5 reports the corresponding regression results. Column 1 shows a pooled regression with a significantly negative coefficient of the PDM on the twin Carhart alpha, which confirms our expectation of a negative effect for portfolio differences on performance. Columns 2 to 4 show economically similar results for regressions, including style and/or time fixed effects. The simultaneous application of style and time fixed effects reduces the significance of the effect to the 5% level. In Columns 6 and 7, we obtain results similar to those in Column 4 using the Fama and French and CAPM alphas as the dependent variables, respectively. Only an analysis considering twin fixed effects in Column 5 produces a statistically insignificant coefficient of the PDM on performance. This suggests that within a twin pair, those differences in portfolio composition are rather stable over time. As already indicated in Table 3, the within twin standard deviation of the PDM is relatively small compared to the cross-sectional variation. Overall, we interpret these results as strong evidence for the negative effect of larger portfolio differences on the twin's risk-adjusted performance.[12]

3.3 | Panel regressions of separate twin alphas

Thus far, we show that differences in portfolio composition between twins harm their joint performance, the average twin alpha. In the next step, we want to determine whether this negative impact equally affects both investment vehicles or if it differs in strength between SAs and MFs. Assuming there should be one optimal strategy, it is unclear which of the portfolios constitutes the source for deviating investment decisions. However, SA investors receive the opportunity to influence portfolio composition, while MF investors do not. Thus, observed differences might be predominantly investor driven via SAs. As already seen in Section 3.1, the results suggest a stronger performance decrease for SAs, indicating an investor dominating effect.[13] To shed further light on this observation using controls for investment constraints, we repeat the investigation from Section 3.2, but instead of using the joint twin performance as the dependent variable, we directly explain SA and MF alphas by using each twin observation twice. Following Equation (5), we conduct a piecewise linear regression by including two separate PDM variables to measure their separated influence on the SA and MF alphas:

$$\begin{aligned}\alpha_{i,t+1} = b_0 + b_1^{\mathrm{SA}}\mathrm{PDM}_{i,t}^{\mathrm{SA}} + b_1^{\mathrm{MF}}\mathrm{PDM}_{i,t}^{\mathrm{MF}} + \sum\nolimits_{k=2}^{7} b_k \mathrm{Level}_{\mathrm{TW},t}^{k} + \sum\nolimits_{k=8}^{13} b_k \mathrm{Diff}_{\mathrm{TW},t}^{k} \\ + \sum\nolimits_{k=14}^{19} b_k \mathrm{Controls}_{\mathrm{TW},t}^{k} + b_{20} D_{i,t}^{\mathrm{SA}} + \epsilon_{i,t}.\end{aligned} \tag{5}$$

is the out-of-sample gross alpha of SA or MF i in quarter t+1.[14] $\mathrm{PDM}_{i,t}^{\mathrm{SA}}$ is the PDM of the twin pair if the alpha is from the SA and 0 otherwise. The opposite applies to $\mathrm{PDM}_{i,t}^{\mathrm{MF}}$. We maintain all control variables at the twin level and for the SA-MF difference by duplicating the observations. We add an SA dummy to capture a potential average performance difference between SAs and MFs. We cluster standard errors by vehicle.

Table 6 shows the corresponding results. In Columns 1 to 5, we explain the Carhart alphas; in Column 6, we explain the Fama and French alphas; and in Column 7, we explain the CAPM alphas. For all models, the effect of the PDM on performance is stronger for SAs than for MFs. For example, considering Column 1 and the average PDM of 22% in Table 3, the annualized risk-adjusted performance decreases by 32 bps for SAs and only by 21 bps for MFs. Considering time fixed effects, the negative impact of the PDM on the risk-adjusted performance becomes nonsignificant for MFs but remains highly significant for SAs. Thus, SAs seem to be more affected than their MF twins. A possible explanation is that SA investors influence the investment strategy according to their personal preferences, thereby driving asset allocation away from the manager's "optimal" strategy and consuming much of the manager's attention.

TABLE 5 Performance regression with joint twin alphas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	3F Alpha	CAPM Alpha
PDM	−0.0126***	−0.0122***	−0.0093***	−0.0077**	−0.0070	−0.0080**	−0.0087**
Ln(Total Net Assets)	−0.1259**	−0.1744***	−0.1010*	−0.1381**	−1.1597***	−0.1290**	−0.1124*
Diff. SA-MF	0.0538	0.0635*	0.0139	0.0144	0.2853**	0.0101	−0.0347
Expense Ratio	0.6255	0.3348	0.0216	−0.4006	4.0993***	−0.4596	−0.9730**
Diff. SA-MF	−0.5357**	−0.4150*	−0.0920	0.0817	−2.1961***	0.1030	0.3124
Flow	0.0253***	0.0259***	0.0116	0.0114	0.0032	0.0132*	0.0020
Diff. SA-MF	−0.0083**	−0.0084**	−0.0028	−0.0025	−0.0033	−0.0044	−0.0019
Age	−0.0269*	−0.0243*	−0.0082	−0.0051	−0.0809	−0.0066	−0.0188
Diff. SA-MF	−0.0090	−0.0097	−0.0003	0.0008	−0.0280	−0.0007	−0.0043
Cash	−0.0022	−0.0050	0.0088	0.0019	−0.1175**	−0.0042	0.0406
Diff. SA-MF	−0.0064	−0.0104	−0.0088	−0.0120	−0.0059	0.0030	−0.0054
Turnover	0.0062	0.0039	0.0019	−0.0006	0.0234***	0.0030	0.0059
Diff. SA-MF	−0.0023	−0.0010	−0.0026	−0.0013	−0.0017	0.0017	0.0037
Bid-Ask Spread	0.0407**	0.0444**	0.0001	−0.0059	0.0973***	−0.0107	0.0160
Ln(# of Equity Holdings)	0.7885***	0.7752***	0.7260***	0.5319***	−0.8154	0.6495***	0.4362**
Ln(#Accs)	0.0085	0.0414	−0.0828*	−0.0383	−0.1264	−0.0397	0.0297
Ln(TA Firm)	0.0308	0.0330	0.0344	0.0517	−0.1032	0.0485	0.0614
% Inst. Share Classes	0.0035	0.0028	0.0040*	0.0020	0.0014	0.0022	0.0036
% Common Managers	−0.0033	−0.0013	0.0010	0.0014	−0.0093	0.0017	0.0073*
Style Fixed Effects	No	Yes	No	Yes	No	Yes	Yes
Time Fixed Effects	No	No	Yes	Yes	No	Yes	Yes
Twin Fixed Effects	No	No	No	No	Yes	No	No
N	13,923	13,923	13,923	13,923	13,923	13,923	13,923
Adj. R^2	0.0078	0.0088	0.0928	0.0939	0.0179	0.0898	0.1360

Note: This table shows quarterly performance regressions using average gross out-of-sample twin alphas of quarter t+1 as the dependent variable. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective, and have at least one common manager. The twin alpha is the value-weighted average of the calculated separate account and mutual fund alphas using the total net assets of the vehicles. A vehicle's out-of-sample alpha is calculated via factor loadings obtained from 24-month rolling window regressions from t–1 to t–24 using the CAPM, Fama-French 3-Factor model, and Carhart 4-Factor model. The quarterly alpha is the sum of its three monthly alphas multiplied by four to obtain annualized figures (%). In addition to the portfolio distance measure (PDM, in %), the regression includes several controls for fund and firm characteristics at quarter t. For each quarter t and twin TW, $PDM_{TW,t}$ is the sum of the absolute differences between matched holding weights of the separate account and mutual fund equity portfolio divided by two: $PDM_{TW,t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{SA,j,t} - w_{MF,j,t}\right|$. Nonincluded holdings in a portfolio exhibit a weight of zero. Control variables for the logarithm of total net assets, expense ratio (% p.a.), flow (%), age (years), cash proportion in the portfolio (%), and turnover (% p.a.) are at the twin level, which is the average of the separate account and the mutual fund characteristics at quarter t. The regression also includes variables for the respective difference between the separate account and the mutual fund characteristics. Control variables for which the level-difference separation is not applicable are the holdings' average bid-ask spread and the log number of equity holdings because the difference of both measures is by construction highly correlated with PDM. Further variables are the log number of institutional accounts managed through the SA, the fraction of institutional share classes in the MF (%), the log firm total assets, and the fraction of common managers that are identical for both twins (%). ***, **, * denote significance of the estimated parameters at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered at the twin level.

3.4 | Controlling for different style and risk factor exposures

Thus far, we have shown that different portfolio compositions harm the joint performance of twin managers and that the performance for SAs seems to decrease more strongly than for MFs. An important type of investor preference in SAs is specific risk factor targets. Thus, higher PDM values might be the result of retail and institutional investors having different risk factor objectives since clients in MFs usually cannot specify individual targets. Hence, observed portfolio differences between twins and the decrease in performance might be just the consequence of different risk preferences. First,

TABLE 6 Performance regression by separating SA and MF alphas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	4F Alpha	**4F Alpha**	**4F Alpha**	**4F Alpha**	**4F Alpha**	**3F Alpha**	**CAPM Alpha**
PDM SA | SA Alpha or 0	−0.0146***	−0.0139***	−0.0116***	−0.0096***	−0.0111	−0.0096***	−0.0095**
PDM MF | MF Alpha or 0	−0.0096**	−0.0092**	−0.0059	−0.0043	−0.0059	−0.0051	−0.0070*
Ln(Total Net Assets)	−0.1329***	−0.1683***	−0.1247***	−0.1477***	−1.2119***	−0.1384***	−0.1073**
Diff. SA-MF	0.0655**	0.0759***	0.0226	0.0223	0.2594***	0.0136	−0.0290
Expense Ratio	0.5455*	0.3083	−0.0932	−0.4308	3.9357***	−0.5088*	−1.0881***
Diff. SA-MF	−0.5239***	−0.4143***	−0.1103	0.0409	−2.2705***	0.0748	0.3423**
Flow	0.0238***	0.0243***	0.0104**	0.0101**	0.0014	0.0118**	0.0010
Diff. SA-MF	−0.0075***	−0.0075***	−0.0021	−0.0017	−0.0021	−0.0036	−0.0016
Age	−0.0270***	−0.0239**	−0.0108	−0.0063	−0.0770**	−0.0083	−0.0176*
Diff. SA-MF	−0.0092	−0.0093*	−0.0025	−0.0008	−0.0271	−0.0031	−0.0056
Cash	0.0084	0.0064	0.0179	0.0122	−0.1119***	0.0085	0.0546**
Diff. SA-MF	−0.0089	−0.0123	−0.0107	−0.0135	−0.0024	−0.0005	−0.0118
Turnover	0.0055*	0.0033	0.0013	−0.0008	0.0232***	0.0032	0.0061*
Diff. SA-MF	−0.0024	−0.0011	−0.0027	−0.0015	−0.0019	0.0016	0.0040
Bid-Ask Spread	0.0466***	0.0496***	0.0089	0.0022	0.0954***	−0.0020	0.0219**
Ln(# of Equity Holdings)	0.7463***	0.7188***	0.7099***	0.5026***	−1.0151	0.6094***	0.3914***
Ln(#Accs)	0.0023	0.0253	−0.0691	−0.0362	−0.0461	−0.0386	0.0147
Ln(TA Firm)	0.0414	0.0428	0.0464	0.0613*	−0.0277	0.0574	0.0651*
% Inst. Share Classes	0.0017	0.0011	0.0019	0.0003	−0.0018	0.0010	0.0034
% Common Managers	−0.0043	−0.0026	−0.0000	0.0003	−0.0088	0.0010	0.0061*
Dummy SA	0.1523	0.0437	0.4106*	0.2176	0.1542	0.2468	0.1624
Style Fixed Effects	No	Yes	No	Yes	No	Yes	Yes
Time Fixed Effects	No	No	Yes	Yes	No	Yes	Yes
Twin Fixed Effects	No	No	No	No	Yes	No	No
N	27,846	27,846	27,846	27,846	27,846	27,846	27,846
Adj. R^2	0.0085	0.0096	0.0899	0.0912	0.0388	0.0880	0.1330

Note: This table shows quarterly performance regressions using gross out-of-sample twin alphas for separate accounts (SA) and mutual funds (MF) of quarter t+1 as the dependent variable. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. The regression includes both alphas of a twin in the same model, the alpha of the separate account, and the mutual fund. A vehicle's out-of-sample alpha is calculated via factor loadings obtained from 24-month rolling window regressions from t–1 to t–24 using the CAPM, Fama-French 3-Factor model, and Carhart 4-Factor model. The quarterly alpha is the sum of its three monthly alphas multiplied by four to obtain annualized figures (%). In addition to the portfolio distance measure (PDM, in %), the regression includes several controls for fund and firm characteristics at quarter t. For each quarter t and twin TW, $PDM_{TW,t}$ is the sum of the absolute differences between matched holding weights of the separate account and mutual fund equity portfolio divided by two: $PDM_{TW,t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{SA,j,t} - w_{MF,j,t}\right|$. Nonincluded holdings in a portfolio exhibit a weight of zero. For measuring separate effects on the out-of-sample alpha, the regression includes two PDM variables. One variable is for the separate account, which is zero if the alpha is from the mutual fund and vice versa. Control variables for the logarithm of the total net assets, expense ratio (% p.a.), flow (%), age (years), cash proportion in the portfolio (%), and turnover (% p.a.) are at the twin level, which is the average of the separate account and the mutual fund characteristics at quarter t. The regression also includes variables for the respective difference between the separate account and the mutual fund characteristics. Control variables for which the level-difference separation is not applicable are the holdings' average bid-ask spread and the log number of equity holdings because the difference of both measures is by construction highly correlated with PDM. Further variables are the log number of institutional accounts managed through the SA, the fraction of institutional share classes in the MF (%), the log firm total assets, and the fraction of common managers that are identical for both twins (%). To regress those variables on the alphas of the separate account and the mutual fund, each value is duplicated. The regression also includes a dummy variable equaling 1 if the dependent variable refers to a separate account alpha and is zero otherwise. ***, **, * denote significance of the estimated parameters at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered at the vehicle level.

taking risk-adjusted performance as the dependent variable should already account for such differences. Second, setting caps and floors for several risk factor parameters presumably restricts portfolio management in more complex ways than simply leveraging an otherwise optimal portfolio up or down to the desired factor beta. To address these concerns, we repeat our investigation from Section 3.2 by including style betas from the Carhart 4-factor model in the regression following Equation (6):[15]

$$\alpha_{TW,t+1} = b_0 + b_1 \text{PDM}_{TW,t} + \sum_{k=2}^{7} b_k \text{Level}^k_{TW,t} + \sum_{k=8}^{13} b_k \text{Diff}^k_{TW,t} + \sum_{k=14}^{19} b_k \text{Controls}^k_{TW,t} + \sum_{k=20}^{23} b_k \text{StyleLevel}^k_{TW,t} + \sum_{k=24}^{27} b_k \text{StyleDiff}^k_{TW,t} + \varepsilon_{TW,t}. \quad (6)$$

are the joint value-weighted twin betas of quarter t with respect to the market, the small market capitalization minus big (SMB) size factor, the high book-to-market ratio minus low (HML) valuation factor and the momentum (MOM) factor. Analogously, we include the beta difference between the SA and MF, $\text{StyleDiff}^k_{TW,t}$, for each twin. In this way, we are able to control directly for differences in risk factor characteristics between SA-MF twins.

Table 7 contains the regression results using Carhart alpha as the dependent variable.[16] For reasons of comparability, Columns 1 and 2 repeat Columns 2 and 4 from Table 5. Columns 3 and 4 include the market betas, Columns 5 and 6 include the SMB and HML betas, and Columns 7 and 8 include all betas from the Carhart 4-factor model. In all model specifications, we find highly significant negative coefficients at the 1% level for the joint twin market beta. Thus, twins with higher average market betas achieve systematically lower risk-adjusted performance. One reason for this finding might be the low-beta anomaly, as reported in Frazzini and Pedersen (2014), who show that portfolios of high-beta assets have lower alphas than portfolios of low-beta assets. We observe similar but less pronounced results for the SMB beta. The coefficient is significant at the 5% level in a regression that includes style fixed effects; however, when we consider time fixed effects, this significance disappears. Examining the differences, we find no evidence for an impact of style betas on risk-adjusted performance.

With regard to the PDM, we observe only slightly lower negative coefficients with the same level of significance when we compare Columns 3 to 8 with Columns 1 and 2. Hence, even when considering risk targets set by investors as further control variables, there is still a statistically highly significant effect of the portfolio difference on risk-adjusted performance.

3.5 | Exclusion of high PDM twins

The quintile sorting in Section 3.1 shows that Quintile 5 containing the highest PDM observations is very different from the remaining quintiles. While we consider our matching of SA-MF twins based on manager names, investment company and investment style to be very reliable, we do not want to ignore the possibility of "false" twins in our sample.[17] Since such false twins would end up primarily in Quintile 5, Table 8 repeats the analysis from Section 3.2 by excluding this quintile from the regression.[18]

In Columns 1 to 4, we exclude all twin observations allocated to Quintile 5 based on a quarterly rebalancing according to Table 4. In Columns 5 to 8, we exclude all twin pairs sorted into Quintile 5 using their average PDM to avoid time-varying exclusion of twins from the regressions. Overall, we obtain very similar results to the previous tables. In all models, the PDM shows a statistically significant negative coefficient. Thus, removing potentially false twins does not change the economic interpretation of our results. We provide robust evidence that differences in twin portfolios harm their joint performance.

3.6 | Stock characteristics of overweighted and underweighted separate account holdings

Examining the univariate quintile sorting and panel regressions from the previous sections, our results suggest that for larger PDM values, the performance is hurt more for SAs than MFs. As only SA investors are able to affect portfolio managers' investment decisions, they could also influence a manager's ability to invest in certain types of stocks, which could be one reason why the adverse effect on performance is stronger for SAs. As Falkenstein (1996) has shown for MFs,

TABLE 7 Performance regression with style betas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha
PDM	−0.0122***	−0.0077**	−0.0114***	−0.0073**	−0.0114***	−0.0071**	−0.0114***	−0.0071**
Ln(Total Net Assets)	−0.1744***	−0.1381**	−0.1788***	−0.1495***	−0.1925***	−0.1577***	−0.1918***	−0.1575***
Diff. SA-MF	0.0635*	0.0144	0.0603	0.0134	0.0627*	0.0174	0.0625*	0.0172
Expense Ratio	0.3348	−0.4006	0.4626	−0.2409	0.5567	−0.2186	0.5622	−0.2174
Diff. SA-MF	−0.4150*	0.0817	−0.5190**	−0.0467	−0.5597**	−0.0536	−0.5651***	−0.0559
Flow	0.0259***	0.0114	0.0236***	0.0080	0.0240***	0.0084	0.0241***	0.0084
Diff. SA-MF	−0.0084**	−0.0025	−0.0078**	−0.0013	−0.0080**	−0.0014	−0.0080**	−0.0014
Age	−0.0243*	−0.0051	−0.0235*	−0.0036	−0.0201	−0.0030	−0.0201	−0.0029
Diff. SA-MF	−0.0097	0.0008	−0.0094	0.0003	−0.0088	0.0008	−0.0088	0.0009
Cash	−0.0050	0.0019	−0.0593*	−0.0630*	−0.0638*	−0.0650*	−0.0637*	−0.0647*
Diff. SA-MF	−0.0104	−0.0120	−0.0183	−0.0155	−0.0179	−0.0151	−0.0180	−0.0152
Turnover	0.0039	−0.0006	0.0065	0.0032	0.0060	0.0028	0.0061	0.0029
Diff. SA-MF	−0.0010	−0.0013	−0.0014	−0.0018	−0.0007	−0.0014	−0.0009	−0.0015
Bid-Ask Spread	0.0444**	−0.0059	0.0434**	−0.0064	0.0426*	−0.0070	0.0423*	−0.0072
Ln(# of Equity Holdings)	0.7752***	0.5319***	0.8245***	0.5869***	0.8445***	0.6146***	0.8410***	0.6088***
Ln(#Accs)	0.0414	−0.0383	0.0424	−0.0330	0.0352	−0.0347	0.0347	−0.0348
Ln(TA Firm)	0.0330	0.0517	0.0344	0.0501	0.0229	0.0446	0.0233	0.0450
% Inst. Share Classes	0.0028	0.0020	0.0022	0.0017	0.0023	0.0018	0.0024	0.0018
% Common Managers	−0.0013	0.0014	−0.0008	0.0022	−0.0012	0.0020	−0.0011	0.0021
Market Beta 4F			−6.0110***	−6.6226***	−6.2934***	−6.7682***	−6.3017***	−6.7699***
Diff. SA-MF			−0.1374	1.9334	−0.0092	1.9459	−0.0335	1.9342
SMB Beta 4F					−1.3231**	−0.4228	−1.3318**	−0.4156
Diff. SA-MF					−0.5892	−0.4000	−0.4635	−0.3251
HML Beta 4F					−0.6610	−0.4562	−0.6616	−0.4698
Diff. SA-MF					0.1078	0.8888	−0.0044	0.8175
MOM Beta 4F							−0.0387	0.0957
Diff. SA-MF							1.2337	0.7772
Style Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
N	13,923	13,923	13,923	13,923	13,923	13,923	13,923	13,923
Adj. R^2	0.0088	0.0939	0.0121	0.0979	0.0138	0.0991	0.0136	0.0990

Note: This table shows quarterly performance regressions using average gross out-of-sample twin alphas of quarter t+1 as the dependent variable. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective, and have at least one common manager. The twin alpha is the value-weighted average of the calculated separate account and mutual fund alphas using the total net assets of the vehicles. A vehicle's out-of-sample alpha is calculated via factor loadings obtained from 24-month rolling window regressions from t–1 to t–24 using the Carhart 4-Factor model. The quarterly alpha is the sum of its three monthly alphas multiplied by four to obtain annualized figures (%). In addition to the portfolio distance measure (PDM, in %), the regression includes several controls for fund and firm characteristics at quarter t. For each quarter t and twin TW, $PDM_{TW,t}$ is the sum of the absolute differences between matched holding weights of the separate account and mutual fund equity portfolio divided by two: $PDM_{TW,t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{SA,j,t} - w_{MF,j,t}\right|$. Nonincluded holdings in a portfolio exhibit a weight of zero. To account for investment strategies, the strategy beta of a quarter is the average of its three monthly factor loadings. At the twin level, the quarterly beta is the value-weighted average of the separate account and mutual fund betas using the total net assets. ***, **, * denote significance of the estimated parameters at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered at the twin level.

there can be preferences for certain stock characteristics, such as an aversion to small and low-priced stocks or a higher demand for liquidity.

To investigate whether different preferences in stock characteristics between SAs and MFs constitute a possible explanation for the adverse effect on SA performance, we sort stocks into quintiles for each twin using their differences in the

TABLE 8 Performance regression excluding quintile 5

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha	4F Alpha
Quintile Allocation	**Quarterly**	**Quarterly**	**Quarterly**	**Quarterly**	**Twin**	**Twin**	**Twin**	**Twin**
PDM	−0.0185**	−0.0191**	−0.0216***	−0.0184**	−0.0148**	−0.0152**	−0.0172***	−0.0147**
Ln(Total Net Assets)	−0.1036	−0.1533**	−0.1202*	−0.1515**	−0.1220*	−0.1609**	−0.1324**	−0.1547**
Diff. SA-MF	0.0576	0.0662	0.0124	0.0093	0.0647	0.0733	0.0303	0.0273
Expense Ratio	0.3324	0.1765	−0.2587	−0.5743	0.3478	0.2308	−0.2148	−0.5031
Diff. SA-MF	−0.3802	−0.3229	0.0209	0.1494	−0.3869	−0.3424	0.0070	0.1237
Flow	0.0289***	0.0299***	0.0117	0.0121	0.0270***	0.0278***	0.0109	0.0111
Diff. SA-MF	−0.0118***	−0.0121***	−0.0046	−0.0046	−0.0095**	−0.0097**	−0.0029	−0.0029
Age	−0.0198	−0.0153	−0.0023	0.0035	−0.0182	−0.0150	−0.0027	0.0017
Diff. SA-MF	−0.0098	−0.0099	−0.0033	−0.0012	−0.0085	−0.0084	−0.0026	−0.0002
Cash	−0.0255	−0.0290	−0.0065	−0.0145	−0.0132	−0.0154	0.0072	−0.0002
Diff. SA-MF	−0.0163	−0.0163	−0.0210	−0.0178	−0.0345	−0.0343	−0.0437	−0.0402
Turnover	0.0043	0.0027	−0.0002	−0.0025	0.0036	0.0021	−0.0013	−0.0034
Diff. SA-MF	−0.0019	−0.0010	−0.0036	−0.0026	−0.0018	−0.0011	−0.0029	−0.0021
Bid-Ask Spread	0.0995***	0.1067***	0.0339*	0.0213	0.0973***	0.1055***	0.0310	0.0194
Ln(# of Equity Holdings)	0.6477***	0.6408***	0.6615***	0.4511**	0.6722***	0.6947***	0.6975***	0.5157**
Ln(#Accs)	0.0314	0.0593	−0.0565	−0.0232	0.0297	0.0501	−0.0556	−0.0266
Ln(TA Firm)	0.0431	0.0492	0.0366	0.0533	0.0566	0.0564	0.0446	0.0563
% Inst. Share Classes	0.0013	0.0016	0.0026	0.0015	0.0022	0.0026	0.0030	0.0020
% Common Managers	0.0019	0.0034	0.0042	0.0044	0.0008	0.0023	0.0033	0.0037
Style Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Time Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
N	11,113	11,113	11,113	11,113	11,410	11,410	11,410	11,410
Adj. R^2	0.0117	0.0123	0.0961	0.0970	0.0113	0.0117	0.0958	0.0963

Note: This table shows quarterly performance regressions using average gross out-of-sample twin alphas of quarter t+1 as the dependent variable. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. The twin alpha is the value-weighted average of the calculated separate account and mutual fund alphas using the total net assets of the vehicles. A vehicle's out-of-sample alpha is calculated via factor loadings obtained from 24-month rolling window regressions from t–1 to t–24 using the Carhart 4-Factor model. The quarterly alpha is the sum of its three monthly alphas multiplied by four to obtain annualized figures (%). In addition to the portfolio distance measure (PDM, in %), the regression includes several controls for fund and firm characteristics at quarter t. For each quarter t and twin TW, $PDM_{TW,t}$ is the sum of the absolute differences between matched holding weights of the separate account and mutual fund equity portfolio divided by two: $PDM_{TW,t} = \frac{1}{2}\sum_{j=1}^{N}\left|w_{SA,j,t} - w_{MF,j,t}\right|$. Nonincluded holdings in a portfolio exhibit a weight of zero. Control variables for the logarithm of total net assets, expense ratio (% p.a.), flow (%), age (years), cash proportion in the portfolio (%), and turnover (% p.a.) are at the twin level, which is the average of the separate account and the mutual fund characteristics at quarter t. The regression also includes variables for the respective difference between the separate account and the mutual fund characteristics. Control variables for which the level-difference separation is not applicable are the holdings' average bid-ask spread and the log number of equity holdings because the difference of both measures is by construction highly correlated with PDM. Further variables are the log number of institutional accounts managed through the SA, the fraction of institutional share classes in the MF (%), the log firm total assets, and the fraction of common managers that are identical for both twins (%). At each quarter t, observations with PDM values in Quintile 5 are excluded from the regression in Columns (1) to (4). In Columns (5) to (8), we exclude all twins showing an average PDM above the 80% percentile instead. ***, **, * denote significance of the estimated parameters at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered at the twin level.

twins' portfolio weights across all stocks and quarters. Quintile 1 comprises the stocks in which the SA has the largest underweight compared with its MF twin. Quintile 5, on the other hand, comprises all stocks in which the SA has the largest overweight. Quintiles 2 to 4 therefore contain stocks that exhibit rather similar weights. Table 9 shows the mean for each quintile using the respective twin averages as observations, taking each twin as equally important. The 5–1 difference tests the equality of the means and provides information on whether the characteristics of stocks in which the

TABLE 9 Quintile sorting of stocks based on a twin's portfolio weight differences

	Portfolio Weight Difference (in %)	Stock Price (in $)	Market Cap (in $m)	Shares Outstanding (in m)	Traded-Dollar Volume (in $m)	Bid-Ask Spread (in %)
Underweight SA	−1.0007	58.86	39,443.7	799.0	5701.7	0.0775
2	−0.3389	56.12	33,444.9	678.2	4968.8	0.0798
3	−0.0146	56.20	32,797.6	673.5	4994.3	0.0816
4	0.3406	56.82	34,252.1	693.0	5032.6	0.0773
Overweight SA	1.0200	58.18	39,788.3	790.9	5625.2	0.0736
5–1	2.0207 (0.00)	−0.68 (0.24)	344.7 (0.72)	−8.1 (0.69)	−76.4 (0.52)	−0.0040 (0.05)

	Volatility (in %)	Book-to-Market Ratio	Market Beta	SMB Beta	HML Beta	MOM Beta
Underweight SA	1.8911	0.4367	1.0227	0.2116	0.0064	0.0101
2	1.9340	0.4414	1.0273	0.2429	−0.0014	−0.0246
3	1.9601	0.4447	1.0269	0.2494	−0.0053	−0.0410
4	1.9178	0.4375	1.0249	0.2334	−0.0035	−0.0184
Overweight SA	1.8697	0.4322	1.0237	0.2118	0.0058	0.0231
5–1	−0.0214 (0.05)	−0.0045 (0.22)	0.0010 (0.75)	0.0002 (0.98)	−0.0006 (0.93)	0.0129 (0.00)

Note: In this table, stocks held by separate account-mutual fund twins are sorted into quintiles based on their difference in portfolio weightings. Nonincluded holdings in one of the twin vehicles receive a weighing of zero. The sample consists of 907 twin pairs over the period 1997–2016. A twin is defined as a separate account (SA) and a mutual fund (MF) that are both from the same investment firm, have the same investment objective and have at least one common manager. Quintile 1 comprises the stocks in which the SA has the largest underweight compared with its MF twin. Quintile 5 comprises all stocks in which the SA has the largest overweight. Quintiles 2 to 4 therefore contain stocks that exhibit a rather similar weighting. For each twin and quintile, we calculate the average using the across quarter sorted observations of portfolio weight differences and corresponding stock characteristics. We report the means of these averages to make each twin equally important. The 5–1 difference tests the equality of the means and provides information on whether the characteristics of stocks in which the SA is overweighted differ significantly from those in which the SA is underweighted instead. For stock characteristics, statistics are reported using quarterly averages of a stock's daily closing price, market capitalization, shares outstanding, traded-dollar volume on the exchange, bid-ask spread, and book-to-market ratio. For volatility, we calculate the standard deviation using daily returns of the quarter. Similarly, a stock's Carhart (1997) 4-factor loadings are obtained from regressions run in each quarter using daily returns. *p* values from paired two-sample *t* tests for the respective 5–1 differences are shown in parentheses.

SA is overweighted differ significantly from those in which the SA is underweighted. In addition to the portfolio weight differences, we report corresponding statistics on stock prices, market capitalization, shares outstanding, daily dollar trading volume, book-to-market ratio, bid-ask spread, daily return volatility, and the factor loadings from the Carhart 4-factor model.

As expected from the construction of the quintile sorting, we document a significant 5–1 difference in the portfolio weight differences of SA-MF twins. For stock characteristics, we find no significant differences between Quintiles 5 and 1 when considering stock price, market capitalization, shares outstanding, and traded-dollar volume. We note, however, that the means of the quintiles are U-shaped. It appears that the largest overweight and underweight occur in the largest stocks, while portfolio deviations in smaller companies are less pronounced. Examining the bid-ask spread, we document a negative 5–1 difference that is significant at the 5% level. This indicates that stocks that are heavily overweighted in the SA appear to be more liquid than those that are heavily underweighted. We make a similar observation when examining volatility, a measure of a stock's total risk. The volatility of Quintile 5 comprising the stocks with the largest overweight seems to be significantly lower than the stocks in Quintile 1. Thus, SA investors seem to prefer higher liquidity and lower total risk. Since there is no difference in the market beta, the preference for lower risk is primarily a preference for lower idiosyncratic risk. Due to this avoidance, SA investors might be missing out on the risk premium offered by the underweighted stocks, which may explain why the documented SA performance declines at a greater rate for larger differences in portfolio composition.

With respect to the book-to-market ratio and the factor loadings from the Carhart 4-factor model, we find no significant differences. One exception is the beta of the momentum factor, which is positive and highly significant at the 1% level. Investors in SAs thus seem to prefer stocks that are more in line with a momentum strategy, perhaps due to SA investors influencing managers in this direction. If we consider that the use of the 4-factor alphas as a performance

measure does not reward an investment in momentum, this could also contribute to lower SA performance. In summary, these findings suggest that differences in preferences for liquidity, stock risk, and momentum are possible reasons that explain why the performance of SAs is more strongly negatively affected relative to their MF twins.

4 | CONCLUSION

In an ideal world, the job of an investment manager would be easy, as she would construct an "optimal" portfolio given her individual level of skill and apply it to all vehicles and all types of investors. However, such an ideal world does not exist. Instead, we observe that different investment vehicles face different sets of economic and institutional constraints and that different types of investors have different preferences regarding their investments. This may lead to quite different portfolios, even if they are managed side-by-side by the same manager pursuing the same broad strategy.

We propose an innovative way to quantify such differences in the portfolio composition of side-by-side managed investment vehicles. As the perfect laboratory, we examine SA-MF twins, two portfolios managed by the same manager for the same company with the same style. Based on our datasets of 3781 US equity SAs and 3152 US equity MFs, we find that more than 40% of the portfolios are managed as part of an SA-MF twin arrangement. By measuring the difference in the portfolio composition using a holdings-based portfolio distance measure, we are able to analyze a time series of portfolio deviations for each twin pair, which we use to investigate the impact on risk-adjusted portfolio performance. By controlling for as many constraints as possible, we isolate the effect for manager- and investor-driven portfolio differences and find strong and robust evidence that these differences lead to a decrease in risk-adjusted performance. Even after controlling for potential differences in risk factor exposures between the two twin vehicles, our results remain economically unchanged. Furthermore, we find the performance decrease to be stronger within SAs, possibly due their preference for stocks with higher liquidity and lower idiosyncratic risk.

These novel findings have several implications. First, investors should be careful when investing in investment vehicles that show a substantial portfolio difference compared with a side-by-side managed twin since the performance tends to be lower for both the MF and SA. Second, it is not easy to explain why side-by-side managed twins exhibit significant differences in their portfolio compositions and why managers or investors should intentionally deviate from an optimal strategy since it apparently would reduce their average portfolio performance. We have included several controls for investment constraints, such as vehicle structure, size, or liquidity, in our analysis, but there might even be further constraints that also affect the portfolio performance of twin managers and are still unexplored. Hence, twin managers possibly do not truly intend to split their attention to install different portfolios, but they are forced to do so. Consequently, it is important for future research to continue searching for unknown constraints affecting portfolio management. Nevertheless, our general observation that twins with larger portfolio differences exhibit lower performance remains intact.

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ENDNOTES

[1] Similar to Evans and Fahlenbrach (2012), we find that both identical and fraternal twins on average outperform nontwins, probably due to economies of scale and shared expenses. However, because we focus only on the performance differences between identical and fraternal twins, the analysis is not reported.

[2] To be precise, an SA is owned by only one investor. However, all accounts following the same broad investment strategy (e.g., "small value") are collectively managed by the same management team. Morningstar provides SA data, including portfolio holdings, at this collective level.

[3] A PDM of 22% may be interpreted, for example, as the SA holding 100% of the MF's portfolio plus a long position of 22% in overweighted stocks minus a short position of 22% in underweighted stocks relative to the MF (cf. Cremers & Petajisto, 2009). For instance, suppose the SA holds 50% in each of two stocks, the MF holding 72% in one stock and 28% in the other stock yields a PDM of 22%.

[4] See also Berk and Green (2004), Chen et al. (2004), Pollet and Wilson (2008), Pastor, Stambaugh, and Taylor (2015), and Evans et al. (2020a) for analysis of the diseconomies of scale in portfolio management. Yan (2008) analyzes the effect of liquidity on portfolio performance. Sirri and Tufano (1998), Edelen (1999), Alexander, Cici and Gibson (2007), Rakowski (2010), Fulkerson and Riley (2017), and Rohleder, Schulte, and Wilkens (2017) investigate the impact of flows and flow risk on fund performance. Cici and Palacios (2015) and Natter et al. (2016) investigate how the restriction of certain investment practices, such as derivative use, impact fund performance. Cici, Dahm and Kempf (2018) examine the trading efficiency of mutual fund families.

[5] In unreported alternative tests, we require both management teams to be exactly identical, that is, 100% common managers. This stricter matching requirement reduces our sample significantly; however, the main results regarding PDM remain economically unchanged. To control for a different management composition in both vehicles, we include the variable *percentage of common managers* in all panel regressions.

[6] We also observe twins within the 1990 to 1996 window. However, due to the limited availability of holdings data, mainly on the part of the voluntarily reporting SAs, we are not able to include these twin observations in the following analyses. The first year with simultaneous holdings information on both SA-MF twins, which is required to measure holdings differences for the comparison of the compositions of twin portfolios, is not until 1997.

[7] We have a coverage of 99.3% for all equity holdings over time. If the Morningstar identifier was not available, we first used CUSIP9 and then the security name as an alternative. The security name was always available.

[8] We thank Kenneth French for providing the corresponding risk factors at the following: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[9] The use of equal weighting does not change later reported results economically.

[10] Section 3.5 presents a robustness analysis excluding Quintile 5 to control for potentially false twin matches.

[11] A larger difference in those variables automatically induces a stronger difference in portfolio holdings. However, their inclusion in unreported alternative regressions does not change our results economically.

[12] Table 5 contains only a selection of our regression models. In unreported results, we conduct further performance regressions using net and gross alphas of the CAPM, the Fama-French 3-factor model and the Carhart 4-factor model. In all specifications, we obtain economically similar results. They are available upon request.

[13] We examine the possibility that SAs are incubated as a laboratory twin for testing new investment ideas and observed portfolio differences are therefore manager-driven rather than investor-driven. Our results suggest no significant difference in the PDM and SA performance between early and later twin life. Hence, our observation of a high PDM and poor performance seems to persist long after SA incubation. Since poor performance will lead to an SA being closed down as a test vehicle or a rational manager harmonizing the SA-MF portfolio over time to improve performance, it is more likely that portfolio deviations between twins are predominantly investor-driven and not manager-driven. However, due to a very low number of identified twins with available holding data immediately after an SA's inception, these results are only indicative and thus inappropriate for prominently including them in the paper. The results are available upon request.

[14] We obtain economically similar results when we use net instead of gross alphas.

[15] In unreported results, we repeat Model (5) from Section 3.3 obtaining similar interpretations.

[16] The use of the CAPM or Fama and French alphas leads to economically similar results. The same applies to net returns.

[17] High reliability is indicated by an average return correlation of over 97%.

[18] Again, our results are very similar for all types of risk-adjusted performance measures.

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