Social interactions and mutual fund portfolios: the role of alumni networks in China

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Abstract

Purpose – This paper aims to investigate the influence of social interactions on mutual fund portfolios from the perspective of alumni network in China.

Design/methodology/approach – Based on a data set that consists of 162 actively managed equity funds in China during the time period of 2003–2014, this study employs multiple linear regression model to control for organization- and location-based interpersonal connections as well as other confounding factors and clarify the causality relationship between alumni networks of mutual fund managers and their portfolios.

Findings – After controlling for organization- and location-based interpersonal connections, we find that mutual fund managers who graduated from the same college/university have more similar stock holdings and are more likely to buy or sell the same stocks contemporaneously. As a result, alumni managers exhibit a higher correlation of fund returns. Moreover, the effect of alumni relationship on mutual fund investments becomes weaker when more managers are connected within the network. We also find that valuable information is shared among alumni managers: (1) the average returns for the alumni common holdings portfolios is significantly higher than those for non-alumni holdings portfolios and (2) a long-short strategy composed of stocks purchased minus sold by alumni managers yields positive and significant risk-adjusted returns.

Practical implications – The findings suggest that information dissemination among connected fund managers could be one of the driving forces for mutual fund herding behavior, and that a portfolio of funds whose managers are educationally connected could be highly exposed to certain stocks and risks.

Originality/value – This paper contributes to the growing finance literature addressing the influence of personal connections on information dissemination that specifically contributes to price formation. It corresponds more closely to Cohen *et al.* (2008), who investigate college alumni connections between fund managers and corporate board members. Since the authors simultaneously examine three potentially overlapped social networks, which are based on education, locality and fund family, the authors are able to disentangle their effects on fund managers' investment decisions. Moreover, the findings suggest that institutional investors make investment decisions based on share private information, and therefore, it also contributes to the literature on fund herding behaviors (Grinblatt *et al.*, 1995; Wermers, 1999).

Keywords Mutual fund, Alumni network, Financial market, Social interactions

Paper type Research paper

1. Introduction

There is tremendous evidence in the economics literature that interpersonal relationships affect human behaviors (e.g. Ellison and Fudenberg, 1995; Akerlof, 1997; Bala and Goyal, 1998; Bertrand *et al.*, 2000; among others). A couple of studies in the finance discipline examine the effects of social relations on corporate governance and a firm's operating

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performance (Hallock, 1997; Pérez-González, 2006). Another strand of the finance literature focuses on the influence of social networks on information dissemination, which determines prices of financial assets. For instance, Shiller and Pound (1989) show that stock investors exchange information by word-of-mouth. Hong *et al.* (2004) find that social households are more likely than others to invest in stocks, controlling for race, wealth and other factors. Ivković and Weisbenner (2007) complement that article and find that households' stock purchases are highly correlated with the stock purchases made by their neighbors. These studies on the effects of community- or locality-based networks suggest that individual/household investors share their investment ideas with others.

Along this line, several scholars focus on a particular type of social network: educational ties. Cohen *et al.* (2008) study college alumni connections between mutual fund managers and corporate board members, and they find that fund managers invest a higher percentage of assets under management in connected companies, and that those connected holdings perform significantly better than non-connected holdings. Two years later, Cohen *et al.* (2010) examine financial analysts' educational ties with corporate management teams; they find that the investments in recommended firms to which analysts have alumni connections produce higher returns. All these findings suggest that private information disseminates through alumni networks. As explained by Cohen *et al.* (2008), students form social groups with the same interests, resulting in long-term relationships and a high level of interaction. This argument from the sociology literature refers to a commonly accepted principle that, compared to dissimilar people, similar people interact with each other more frequently (McPherson *et al.*, 2001). Kalmijn and Flap (2001) also provide direct evidence that homophily is more present in school-generated connections than in any other kind of social relationships.

In addition to alumni connections, there are other types of social networks through which information can flow among portfolio managers. Managers living near each other have more chances to get to know each other and to become friends. For example, they are connected if their kids are classmates; they may join the same clubs and churches. Hong *et al.* (2005) present supporting evidence that a money manager has a higher chance of trading certain stocks if other managers living in the same city buy or sell those same stocks. Also, two managers are connected if they both work for the same investment company or fund family; they may read the same research reports and exchange investment ideas at meetings (Cici *et al.*, 2017). Pool *et al.* (2015) show that neighboring fund managers have more overlapping holdings, generating positive risk-adjusted returns, suggesting that value-related information is exchanged among neighboring fund managers. With a sample of pension funds, Rossi *et al.* (2018) find that the fund managers' network centrality is positively correlated to fund performance.

Some recent studies focus on the role of social networks in the Chinese context. Gu *et al.* (2019) find that a mutual fund manager is more likely to invest in stocks covered by analysts with whom they are socially connected, and these connected stocks generate higher returns than others. Li *et al.* (2020) present evidence that companies covered by more connected analysts have more accurate consensus forecasts and lower forecast dispersion, which suggests that the connected financial analysts likely disseminate proprietary information. Chen *et al.* (2020) show that, if fund managers are socially connected with a firm's auditor, they will invest relatively more in the firm and earn superior portfolio returns, suggesting that connected auditors and fund managers share valuable information.

Our paper extends the mutual fund literature on the role of personal connections in the investment industry; it investigates the influence of portfolio managers' educational ties on their investment behavior. In China, the alumni relationship is a very important part of *guangxi*, which refers to social connections that may consist of extended family, alumni, workmates and business partners. The closeness and strength of the alumni relationship is maintained and reinforced by the activeness of alumni associations, which organize social

activities, publish newsletters and raise funds for schools. For example, Qinghua University has 141 alumni associations scattered around mainland China and 51 such organizations in 13 foreign countries by the end of 2013. Based on these alumni associations, Qinghua's alumni have formed 17 professional organizations in investments, insurance, real estates, information technology, etc. In Chinese culture, reciprocal favors are important to maintain one's *guanxi*. Given the findings in the extant literature that information is transmitted through alumni networks, we expect that, if Chinese fund managers have valuable information or a brilliant investment idea, they are likely to share it with their closest relatives, friends and college alumni who usually are their best friends.

For the empirical analyses, we first explore the effect of alumni networks on mutual fund holdings. If alumni managers share private information and investment ideas, they will trade and hold the same stocks and, as a result, will have more common stock holdings than non-connected managers, all other things being equal. Based on a data set that consists of 162 actively managed equity funds in China during the period of 2003–2014, we find that alumni managers invest about 9.4% of the assets under management in the common holdings, while non-alumni managers invest only 8.2% in those holdings. In addition, the average number of stocks commonly held is higher among alumni managers (9.5 stocks) than non-alumni managers (8.2 stocks). For the multivariate analyses, we control for the effects of locality and fund family networks and still find supportive evidence that alumni relationships contribute significantly to asset allocation in common holdings.

Next, based on the disclosed stock holdings at the end of June and December, we further examine the changes in common holdings over the six-month period. In a pooled regression setup, the indicator of alumni networks positively predicts common holding changes. This finding suggests that a manager is more likely to buy or sell the same stock if other alumni managers are doing the same trading contemporaneously. We also find that, compared to non-alumni managers, alumni managers exhibit a higher commonality in fund performance, as measured by raw return: one-factor risk-adjusted return and three-factor risk-adjusted return, respectively.

Next, we test if the size of the alumni network matters for the relation between alumni networks and mutual fund portfolios. If it is the interpersonal communication with alumni peers that drives the relation, the information pass-through is more likely to occur between intimate alumni peers rather than among all connected members. Given that managers in a small alumni network should be more likely to interact with each other than managers in a large alumni network, we expect and find that the relation between alumni networks and mutual fund portfolios is reduced within larger alumni networks.

Finally, we conduct empirical tests to evaluate portfolio performance based on alumni managers' common stock holdings as well as their trades. If common holdings and trades are driven by an exchange of value-related information rather than personal sentiment or bias, the shared portfolio choices of alumni managers should achieve superior performance. We show that the average returns for the portfolio composed of alumni common holdings are significantly higher than those of non-alumni holdings. We also find that an investment strategy formed on alumni managers' trades generates a significant and positive abnormal return of 1.3–5.8% per quarter. Overall, our findings suggest that alumni networks are important channels for the dissemination of private information among institutional investors, contributing to mutual fund herding behavior as found in the literature (Grinblatt *et al.*, 1995; Wermers, 1999).

Our paper contributes to the burgeoning finance literature addressing the importance of social networks in information dissemination in the financial markets. It corresponds more closely to Cohen *et al.* (2008), who examine alumni connections between equity managers and corporate board members. Since we simultaneously examine three potentially overlapping social networks, which are based on education, locality and fund family, we are able to

disentangle their effects on fund managers' investment decisions. Moreover, our findings suggest that institutional investors make investment decisions based on shared private information; therefore, it also contributes to the literature on fund herding behaviors (Grinblatt *et al.*, 1995; Wermers, 1999).

The remainder of the paper is organized as follows. Section 2 describes the data source and main variables used in our empirical analyses. Section 3 examines whether alumni networks are associated with fund holding, trades and returns. Section 4 asks whether valuable information is transmitted through the alumni networks of fund managers. Section 5 concludes the paper.

2. Data and sample construction

2.1 Data sources

Our analyses are based on 162 actively managed open-end equity funds that invest in common stocks listed in the Shanghai and Shenzhen exchanges over the period of 2003–2014. We collect the mutual fund data from the China Fund Market Research Database, jointly developed by Hong Kong University and GTA Information Technology Co., China. The database provides information about fund characteristics such as net returns, total net assets and fund managers' demographic information, including names, gender, highest degree earned, college/university attended, etc. The information on the educational background of fund managers is manually collected through the funds' periodical financial reports, their homepage websites and internet search engines, such as Google, Baidu, Yahoo, etc. For each quarter, we pair all sample funds to obtain fund-pair-quarter observation. For example, if there are n sample funds in quarter t, we can form $C_n^1 C_{n-1}^1/2 = n(n-1)/2$ fund-pair-quarter observations in quarter t. We obtain a sample of 106,814 fund-pair-quarter observations over the period from the first quarter of 2003 to the fourth quarter of 2014.

2.2 Alumni networks

If any two managers managing different funds went to the same college or university, even in different years, we define them as alumni managers and use a dummy variable *Alumni* to indicate this relationship. If a fund is managed by a team, we identify the relation by pairing each team member with a manager running the other fund. In the sample, there are 527 mutual fund managers who graduated from 105 Chinese and foreign colleges/universities. Based on this information, we are able to identify 40 alumni networks, each having at least two alumni managers.

2.3 Measures of common holdings

Following Elton *et al.* (2007) and Pool *et al.* (2015), we measure the common holdings between fund i and fund j at the end of quarter t as:

$$Comhold_{i,j,t} = \sum_{k \in H_t} \min\{w_{j,k,t},\ w_{j,k,t}\} \tag{1}$$

where $w_{i,k,t}$ is the portfolio weight of stock k in fund i, and H_t is the set of all stocks held by fund i and fund j at the end of quarter t. We then aggregate the common holdings measure to the fund level. In China, mutual funds are required by law to disclose their complete portfolio holdings as of the end of June and December, and their top ten holdings as of the end of March and September. In general, a mutual fund could invest in more than ten individual stocks, and thus, examining only the top ten holdings is not enough. Therefore, we focus on the portfolio composition as of the end of June and December (*Comhold_24q*), but we also report the results on the first and the third quarters (*Comhold_13q*) for robustness purposes.

We also use the number of stocks commonly held by any two funds at the end of the quarter to measure common holdings. Specifically, *Comnum_24q* (*Comnum_13q*) is the number of stocks commonly held by paired funds as of the end of March and September (June and December).

2.4 Measures of common trades

We calculate the overlap in stock trades for paired funds. Given that limited information on holding changes is available for the first and third quarters, we focus on the holding changes between the second and fourth quarters. We measure the common trades as:

$$Comholdchg\_24q_{i,j,t} = \sum_{k\in\Psi_t}\min\left\{w^{+}_{i,k,t}, w^{+}_{j,k,t}\right\} + \sum_{k\in\Psi_t}\min\left\{\mathrm{abs}\left(w^{-}_{i,k,t}\right), \mathrm{abs}\left(w^{-}_{j,k,t}\right)\right\} \quad (2)$$

where $w^{+}_{i,k,t}$ is the increase of portfolio weight of stock k in fund i between time $t-1$ and t, with the weight calculated based on the stock prices at the end of period $t-1$. Abs ($w^{-}_{i,k,t}$) is the absolute value of the decrease of portfolio weight of stock k in fund i between time $t-1$ and t. Ψ_t is the union of all stocks traded by fund i and j. We also follow Pool *et al.* (2015) and define an alternative measure of common trades, *Comnumch_24q*, as the number of stocks that are commonly traded by fund i and j between time $t-1$ and t.

2.5 Measures of fund return correlations

We follow Elton *et al.* (2007) and employ the Pearson correlation coefficient to measure the fund return correlation. Specifically, for each quarter t, we calculate the correlation of returns between fund i and j as:

$$Corr_{i,j,t} = \frac{\sum_{\tau=1}^{n}\left(ret_{i,t,\tau} - \overline{ret}_{i,t,\tau}\right)\left(ret_{j,t,\tau} - \overline{ret}_{j,t,\tau}\right)}{\sqrt{\sum_{\tau=1}^{n}\left(ret_{i,t,\tau} - \overline{ret}_{i,t,\tau}\right)^2}\sqrt{\sum_{\tau=1}^{n}\left(ret_{j,t,\tau} - \overline{ret}_{j,t,\tau}\right)^2}} \quad (3)$$

where $ret_{i,t,\tau}$ is the raw return of fund i on day τ in quarter t, and n is the number of trading days in quarter t. For the purpose of robustness, we also calculate the return correlations with risk-adjusted returns based on the market model (*Corr_1f*) and the Fama–French three factor model (*Corr_3f*).

2.6 Control variables

We construct a set of control variables based on characteristics of the paired funds. In our setup, there are mainly three types of social networks: geography (or locality), organization (fund family) and alumni networks. The existing literature found empirical evidence that fund managers living in the same city or working for the same fund family share information. Accordingly, we develop two dummy variables, *SameCity* and *SameFamily*, to control for the potential effects of these two networks. For the geography network, we identify whether any two sample funds' headquarters are in the same city. For the organizational network, we examine whether the two funds are connected to the same fund family or investment company. *DiffSize* is defined as the difference in total asset between the paired funds, scaled by their average asset value to control for the potential effect of the difference in fund size. Likewise, *DiffAge* measures the difference in paired funds' ages, scaled by their average age in years. Two funds with the same investment style are expected to exhibit high commonality in holdings and returns. We control for this by using a dummy, *SameStyle*, which equals 1 if the paired two funds have the same investment objective, and 0 otherwise. Given that

managers with a higher educational level have a greater chance of becoming alumni, we control for average educational level of managers of paired funds. First, we score the educational levels. Specifically, it is scored 4 for doctoral degree, 3 for master's degree, 2 for bachelor's degree and 1 for other cases. We then define *Medu* as the average educational scores of managers of paired funds. We also control for year and quarter fixed effects. All continuous variables are winsorized at the 1st and 99th percentile levels.

2.7 Summary statistics

Table 1 reports the summary statistics of sample funds. In our sample, about 8% of the quarterly paired observations are of alumni managers. The largest alumni network in our sample is connected with Peking University, and it connects to 38 alumni managers. The average percentage of assets invested in the common holdings of any paired managers in the second and fourth calendar quarters (as measured by *Comhold_24q*) is 7.53%, and the maximum value is 27.82%. In the first and third quarter, when only top ten holdings are reported, on average, approximately 2.662% of the assets (as measured by *Comhold_13q*) is invested in the common holdings. We also find that, on average, there are 7.549 stocks commonly held by two managers in the second and fourth quarters vs 0.804 in the first and third quarters. For the entire sample, the mean (median) correlation of net daily returns is 0.778 (0.863), with a range of [0.043, 0.981]. The average correlation of one- and three-factor returns are 0.307 and 0.243, respectively.

It is noted that approximately 35.9% of the observations are based on the paired funds located in the same city, and approximately 3.7% of the observations are of paired funds from the same fund family. The average difference in size of the paired funds is approximately 28.7%, while the difference in fund age is approximately 20.3%.

3. Alumni networks and mutual fund portfolios

3.1 Univariate analysis

In this section, we compare common stock holdings, common holding changes and fund return correlations between various groups of managers. Table 2 shows that alumni

Variable	*N*	Mean	Median	Std. dev.	Min.	Max.
Alumni	106,184	0.079	0	0.27	0	1
Alumnisize	106,184	1.49	0	5.929	0	38
Comhold_24q (%)	51,228	7.53	5.92	7.374	0	27.82
Comholdchg_24q (%)	51,228	4.331	2.946	4.789	0	17.89
Comhold_13q (%)	54,956	2.662	0	4.046	0	27.82
Comnum_24q	51,228	7.549	6	7.565	0	30
Comnumchg_24q	51,228	6.82	5	7.414	0	28
Comnum_13q	54,956	0.804	0	1.133	0	10
Corr_ret	106,184	0.778	0.863	0.217	0.043	0.981
Corr_f1	106,184	0.307	0.352	0.326	−0.541	0.858
Corr_f3	106,184	0.243	0.247	0.261	−0.346	0.796
Samecity	106,184	0.359	0	0.48	0	1
Samefamily	106,184	0.037	0	0.189	0	1
Samestyle	106,184	0.245	0	0.43	0	1
Diffsize	106,184	0.287	0.306	0.151	0.006	0.495
Diffage	106,184	0.203	0.167	0.151	0	0.5
Medu	106,184	3.092	3	0.243	2	4

Note(s): The table reports the summary statistics of main variables used in empirical analyses. The sample covers 162 actively managed open-end equity funds in China during 2003–2014. All variables are defined as in Table A1

Table 1.
Descriptive statistics

Table 2.
Univariate analysis

	Alumni (1)	Non-alumni (2)	(1)–(2)	Same city (3)	Different city (4)	(3)–(4)	Same fund family (5)	Different family (6)	(5)–(6)
Comhold_24q	9.405	8.189	1.216*** (0.126)	9.373	7.670	1.703*** (0.070)	14.925	8.025	6.900*** (0.176)
Comholdchg_24q	8.555	4.561	3.994*** (0.116)	5.187	4.443	0.745*** (0.046)	5.271	4.664	0.607*** (0.079)
Comhold_13q	3.882	3.090	0.792*** (0.075)	3.792	2.794	0.998*** (0.042)	6.937	3.004	3.933*** (0.105)
Comnum_24q	9.510	8.230	1.280*** (0.131)	9.019	7.943	1.076*** (0.073)	13.985	8.111	5.874*** (0.183)
Comnumchg_24q	8.814	7.345	0.969*** (0.128)	7.956	7.118	0.838*** (0.072)	12.893	7.207	5.686*** (0.180)
Comnum_13q	1.159	0.936	0.223*** (0.021)	1.119	0.861	0.258*** (0.012)	1.956	0.914	1.042*** (0.029)
Corr_ret	0.800	0.775	0.025*** (0.003)	0.788	0.772	0.016*** (0.002)	0.799	0.777	0.022*** (0.004)
Corr_f1	0.330	0.305	0.025*** (0.004)	0.314	0.304	0.010*** (0.002)	0.374	0.305	0.067*** (0.005)
Corr_f3	0.276	0.253	0.023*** (0.003)	0.263	0.250	0.013*** (0.002)	0.343	0.255	0.092*** (0.005)

Note(s): The table compares the means of measures for commonalities in holdings, trades and return correlations between managers inside and outside networks based on alumni relationship, geography and professions. The sample covers 162 actively managed open-end equity funds in China during 2003–2014. All variables are defined as in Table A1. Standard errors are reported in parentheses. *** indicates statistical significance at the 1% level

managers have larger stakes invested in their common holdings. In the second and fourth quarters, their common holdings (*Comhold_24q*) account for 9.405% of their assets, while the common holdings of non-alumni managers account for only 8.189%. The difference is statistically significant at the 1% level. We observe similar patterns in the first and third quarters (*Comhold_13q*), 3.882% for alumni managers vs 3.090% for non-alumni managers. When we compare common holding changes for the second and fourth quarters (*Comholdchg_24q*) between alumni and non-alumni managers, we find that the change in common holdings for alumni managers accounts for 8.555% of their assets, and the value of this change is approximately 91% of the common holding value. For non-alumni managers, however, the change in their common holdings accounts for only 5.561% of their assets and approximately 56% of their common holding value. These differences indicate that an alumni manager is more likely to buy or sell a given stock when other connected managers are conducting the same trade [1]. Similarly, we observe that alumni managers exhibit more commonality in individual firms invested in, as indicated by *Comnum_24*, *Comnum_13q* and *Comnumchg_24q*. The differences in these three variables between alumni and non-alumni managers are statistically significant at the 1% level.

Since alumni managers exhibit higher commonality in holdings and trading, it is not a surprise that they experience higher correlations in fund performance measured by all three return measures. For instance, the correlation of three-factor returns is 0.276 for alumni managers, compared to 0.253 for non-alumni managers; the difference is 0.023 (t-value = 7.323). The patterns are the same for net returns and one-factor risk-adjusted returns.

When comparing between managers based on community network and fund family network, we find that, consistent with the findings of Hong *et al.* (2005), managers living in the same city or working in the same fund family exhibit higher correlations in returns and have more common stock holdings. The t-tests are all statistically significant at the 1% level.

3.2 Alumni networks and common holdings

We begin our main analysis by examining the effect of alumni networks on common stock holdings. Specifically, we estimate the following regression:

$$Comhold_{i,j,t} = \beta_0 + \beta_1 Alumni_{i,j,t} + \beta_2 Samecity_{i,j,t} + \beta_3 Samefamily_{i,j,t} + \beta_4 Samestyle_{i,j,t} + \beta_5 Diffsize_{i,j,t} + \beta_6 Diffage_{i,j,t} + YearDum + QuarterDum + \varepsilon_{i,j,t}, \quad (4)$$

where the dependent variable $Comhold_{i,j,t}$ refers to the measures of common holdings between two paired funds i and j at the end of quarter t. $Alumni_{i,j,t}$ is an indicator variable that equals one if at least one manager from fund i is an alumni of a manager from fund j during quarter t. In all our regression models, we cluster standard errors by fund-pair and include fixed effects for year and quarter. If alumni-based networks affect fund managers' portfolio choice, we expect β_1 to be positive.

Table 3 shows the results of the regression equation (4) to examine the effect of alumni networks on common holdings, controlling for the potential influence of the other two networks and the differences in fund characteristics. In the first regression specification, where the dependent variable is *Comhold_24q*, the percentage of the assets invested in the common holdings as of the end of June and December, the coefficient of *Alumni* is 1.035, with a 1% significance level. The regression with observations based on the top ten stocks disclosed in March and September produces consistent results (demonstrated in Column 2): the

	Comhold_24q (1)	*Comhold_13q* (2)	*Comnum_24q* (3)	*Comnum_13q* (4)
Alumni	1.035*** (0.168)	0.634*** (0.092)	1.018*** (0.190)	0.185*** (0.025)
Samecity	0.708*** (0.109)	0.430*** (0.053)	0.240* (0.125)	0.105*** (0.015)
Samefamily	4.941*** (0.481)	3.048*** (0.297)	4.293*** (0.499)	0.816*** (0.080)
Samestyle	0.053 (0.122)	0.078 (0.059)	−0.299** (0.141)	−0.000 (0.016)
Diffsize	−6.339*** (0.357)	−2.294*** (0.170)	−7.765*** (0.409)	−0.695*** (0.048)
Diffage	−2.514*** (0.294)	−0.980*** (0.165)	−3.378*** (0.329)	−0.300*** (0.046)
Medu	0.315* (0.163)	0.037 (0.084)	0.362** (0.174)	0.049** (0.024)
Constant	15.289*** (0.852)	5.092*** (0.510)	17.179*** (0.718)	1.563*** (0.151)
Year dummies	Yes	Yes	Yes	Yes
Quarter dummies	Yes	Yes	Yes	Yes
Adjusted R^2	0.358	0.219	0.310	0.224
No. of obs.	51,228	54,956	51,228	54,956

Note(s): This table reports the coefficient estimates and standard errors from the ordinary least squares (OLS) estimation of the following regression

$$Comhold_{i,j,t} = \beta_0 + \beta_1 Alumni_{i,j,t} + \beta_2 Samecity_{i,j,t} + \beta_3 Samefamily_{i,j,t} + \beta_4 Samestyle_{i,j,t} + \beta_5 Diffsize_{i,j,t} + \beta_6 Diffage_{i,j,t} + \beta_7 Medu_{i,j,t} + YearDum + QuarterDum + \varepsilon_{i,j,t}$$

where $Comhold_{i,j,t}$ refers to various measures of common holdings between two paired funds i and j at the end of quarter t. $Alumni_{i,j,t}$ is an indicator variable that equals one if at least one manager from fund i is an alumni of a manager from fund j during quarter t. Fixed effects for year and quarter are included. Standard errors are clustered by fund-pair. All variables are defined as in Table A1. The sample covers quarterly observations of 162 actively managed open-end equity funds in China during 2003–2014. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

Table 3. Alumni networks and mutual fund common holdings

coefficient of *Alumni* is 0.634, and is also at the 1% significance level. These outcomes indicate that, compared to non-alumni managers, alumni managers have a larger stake in common holdings. We also observe that the networks based on locality and institutional boundary have positive and significant effects on common stock holdings, which is consistent with the extant literature.

Columns 3 and 4 report the results wherein the measures for the number of individual stocks commonly held by the paired funds are used as the dependent variable in the regression. The estimated coefficients of *Alumni* are 1.018 and 0.185, respectively. These findings are consistent with those in Columns 1 and 2.

3.3 Alumni network and common trades

In this section, we examine if fund pairs of alumni managers are more likely to make similar trades than those of non-alumni managers. Based on the changes of portfolio holdings as of the end of June and December, we estimate the following regression:

$$Comholdchg_{i,j,t} = \alpha_0 + \alpha_1 Alumni_{i,j,t} + \alpha_2 Samecity_{i,j,t} + \alpha_3 Samefamily_{i,j,t} + \alpha_4 Samestyle_{i,j,t} + \alpha_5 Diffsize_{i,j,t} + \alpha_6 Diffage_{i,j,t} + Year\,Dum + Quarter\,Dum + \varepsilon_{i,j,t}, \quad (5)$$

where $Comholdchg_{i,j,t}$ refers to the change of common holdings between funds i and j during period t. Table 4 reports the regression results of equation (5). The results are consistent with those reported in Table 3: fund pairs of alumni managers have significantly more overlapping trades. To be more specific, the coefficient of *Alumni* is 0.306 in Column 1 and 0.473 in Column 2, both of which are statistically significant at the 1% levels. Based on these findings, we conclude that, compared to non-alumni managers, alumni managers are more likely to buy or sell the same stocks simultaneously.

	Comholdchg_24q (1)	*Comnumchg_24q* (2)
Alumni	0.306*** (0.099)	0.473*** (0.170)
Samecity	0.238*** (0.065)	0.135 (0.114)
Samefamily	3.120*** (0.306)	4.490*** (0.483)
Samestyle	−0.205*** (0.073)	−0.520*** (0.130)
Diffsize	−1.892*** (0.218)	−4.763*** (0.383)
Diffage	−7.582*** (0.171)	−12.524*** (0.300)
Medu	0.883*** (0.102)	1.356*** (0.167)
Constant	−0.436 (0.348)	−0.446 (0.564)
Year dummies	Yes	Yes
Quarter dummies	Yes	Yes
Adjusted R^2	0.258	0.278
No. of obs.	51,228	51,228

Note(s): The table reports the coefficient estimates and standard errors from the OLS estimation of the regression equation

$$Comholdchg_{i,j,t} = \alpha_0 + \alpha_1 Alumni_{i,j,t} + \alpha_2 Samecity_{i,j,t} + \alpha_3 Samefamily_{i,j,t} + \alpha_4 Samestyle_{i,j,t} + \alpha_5 Diffsize_{i,j,t} + \alpha_6 Diffage_{i,j,t} + \alpha_7 Medu_{i,j,t} + YearDum + QuarterDum + \varepsilon_{i,j,t}$$

where $Comholdchg_{i,j,t}$ refers to the change of common holdings between funds i and j during quarter t. Fixed effects for year and quarter are included. Standard errors are clustered by fund-pair. All variables are defined as in Table A1. The sample covers quarterly observations of 162 actively managed open-end equity funds in China during 2003–2014. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

Table 4.
Alumni networks and mutual fund common trades

3.4 Alumni networks and return correlations

In the next step, we run the following regression to test the effect of alumni networks on the correlation of fund returns:

$$Corr\_ret_{i,j,t} = \varphi_0 + \varphi_1 Alumni_{i,j,t} + \varphi_2 Samecity_{i,j,t} + \varphi_3 Samefamily_{i,j,t} + \varphi_4 Samestyle_{i,j,t} + \varphi_5 Diffsize_{i,j,t} + \varphi_6 Diffage_{i,j,t} + Year\,Dum + Quarter\,Dum + \varepsilon_{i,j,t}, \quad (6)$$

where $Corr_{i,j,t}$ is the correlation coefficient of the returns of the two paired funds i and j during quarter t; quarter and year dummies are also included. We report the regression results in Table 5. Regardless of the performance measure used, we observe that the estimated coefficients of *Alumni* in all three columns are positive and statistically significant at the 1% level. The statistics suggest that the correlation of two mutual funds' returns will increase by 1.8–2.2% if the managers of these two funds are alumni. The current finding suggests that there is information dissemination among alumni managers, so they adopt similar investment strategies, resulting in higher return correlations.

3.5 Moderating effect of the size of alumni networks

When fund managers have private information, with whom will they share the information? All alumni they know? We contend that private information is not likely to circulate in the entire alumni network; only intimate or closely connected managers are likely to share private information. Managers in small alumni networks are expected to interact with each other more often than managers in large alumni networks. Therefore, when there are more managers connected within an alumni network, the commonalities in their investments should decline. To test the moderating effect of the size of alumni networks, we estimate the following regression specification:

	Corr_ret (1)	*Corr_f*1 (2)	*Corr_f*3 (3)
Alumni	0.018*** (0.005)	0.022*** (0.008)	0.016*** (0.006)
Samecity	0.011*** (0.004)	0.000 (0.006)	0.002 (0.004)
Samefamily	0.007 (0.010)	0.058*** (0.018)	0.081*** (0.014)
Samestyle	0.005 (0.004)	0.009 (0.006)	0.003 (0.004)
Diffsize	−0.201*** (0.013)	−0.253*** (0.018)	−0.164*** (0.013)
Diffage	−0.033*** (0.010)	−0.029* (0.015)	−0.074*** (0.011)
Medu	0.008 (0.005)	−0.096*** (0.009)	−0.046*** (0.006)
Constant	0.847*** (0.016)	0.829*** (0.029)	0.493*** (0.024)
Year dummies	Yes	Yes	Yes
Quarter dummies	Yes	Yes	Yes
Adjusted R^2	0.081	0.057	0.143
No. of obs.	106,184	106,184	106,184

Note(s): The table reports the coefficient estimates and standard errors from the OLS estimation of the regression equation

$$Corr_{i,j,t} = \varphi_0 + \varphi_1 Alumni_{i,j,t} + \varphi_2 Samecity_{i,j,t} + \varphi_3 Samefamily_{i,j,t} + \varphi_4 Samestyle_{i,j,t} + \varphi_5 Diffsize_{i,j,t} + \varphi_6 Diffage_{i,j,t} + \varphi_7 Medu_{i,j,t} + YearDum + QuarterDum + \varepsilon_{i,j,t}$$

where $Corr_{i,j,t}$ is the correlation coefficient of the returns of the two paired funds i and j during quarter t; quarter and year dummies are also included. Standard errors are clustered by fund-pair. All variables are defined as in Table A1. The sample covers quarterly observations of 162 actively managed open-end equity funds in China during 2003–2014. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively

Table 5. Alumni networks and mutual fund return correlations

$$\begin{aligned} Comhold_{i,j,t}/Comholchg_{i,j,t}/Corr\_ret_{i,j,t} = {} & \lambda_0 + \lambda_1 Alumni_{i,j,t} + \lambda_2 Alumni_{i,j,t} \times Alumnisize_{i,j,t} \\ & + \lambda_3 Samecity_{i,j,t} + \lambda_4 Samefamily_{i,j,t} \\ & + \lambda_5 Samestyle_{i,j,t} + \lambda_6 Diffsize_{i,j,t} + \lambda_7 Diffage_{i,j,t} \\ & + Year\ Dum + Quarter\ Dum + \varepsilon_{i,j,t} \end{aligned} \tag{7}$$

where the dependent variable refers to the measures for common stock holdings (*Comhold_24q*, *comhold_13q*, *Comnum_24q*, *Comnum_13q*), changes in common stock holdings (*Comholdchg_24q* and *Comnumchg_24q*) and correlation coefficient of the returns (*Corr_ret*, *Corr_f1*, *Corr_f3*) of the two paired funds i and j; t refers to a quarter. We are interested in the coefficient of the interaction term *Alumni* × *Alumnisize* λ_2, which was expected to be negative.

The regression results are reported in Table 6. Columns 1 to 4 report the results of regressions, with common holdings as the dependent variable. As expected, the coefficients of *Alumni* × *Alumnisize* are consistently negative and statistically significant in Columns 1, 3, and 4. Columns 5 and 6 report the results with common holding changes as the dependent variable. They show that the coefficients of *Alumni* × *Alumnisize* are also negative and statistically significant. Columns 7, 8 and 9 yield similar results when return correlations are used as dependent variables. The negative moderating effects of the network scale on common holdings, common trades and the correlation between fund returns suggests that the dissemination of private information mostly occurs between intimate alumni managers within small alumni networks.

Table 6.
Regression of commonalities on network size

	Comhold_24q (1)	*Comhold_13q* (2)	*Comnum_24q* (3)	*Comnum_13q* (4)	*Comholdchg_24q* (5)	*Comnumchg_24q* (6)	*Corr_ret* (7)	*Corr_f1* (8)	*Corr_f3* (9)
Alumni	1.911*** (0.301)	0.777*** (0.203)	3.145*** (0.359)	0.278*** (0.058)	1.072*** (0.182)	2.520*** (0.327)	0.059*** (0.008)	0.041*** (0.014)	0.056*** (0.010)
Alumni × *Alumnisize*	−0.046*** (0.013)	−0.008 (0.009)	−0.112*** (0.014)	−0.005** (0.002)	−0.040*** (0.008)	−0.108*** (0.013)	−0.002*** (0.000)	−0.001 (0.001)	−0.002*** (0.000)
Samecity	0.716*** (0.109)	0.432*** (0.053)	0.259** (0.125)	0.105*** (0.015)	0.245*** (0.065)	0.153 (0.114)	0.011*** (0.004)	0.000 (0.006)	0.002 (0.004)
Samefamily	4.891*** (0.480)	3.038*** (0.297)	4.173*** (0.497)	0.810*** (0.080)	3.077*** (0.306)	4.375*** (0.481)	0.004 (0.010)	0.057*** (0.018)	0.078*** (0.014)
Samestyle	0.057 (0.122)	0.079 (0.059)	−0.290** (0.141)	0.000 (0.016)	−0.202*** (0.073)	−0.512*** (0.130)	0.005 (0.004)	0.009 (0.006)	0.003 (0.004)
Diffsize	−6.331*** (0.357)	−2.294*** (0.170)	−7.746*** (0.408)	−0.694*** (0.048)	−1.885*** (0.217)	−4.745*** (0.382)	−0.201*** (0.013)	−0.253*** (0.018)	−0.164*** (0.013)
Diffage	−2.548*** (0.293)	−0.986*** (0.165)	−3.460*** (0.328)	−0.304*** (0.046)	−7.612*** (0.170)	−12.604*** (0.300)	−0.035*** (0.010)	−0.030** (0.015)	−0.076*** (0.010)
Medu	0.278* (0.163)	0.030 (0.084)	0.271 (0.173)	0.044* (0.024)	0.850*** (0.102)	1.268*** (0.166)	0.006 (0.005)	−0.097*** (0.009)	−0.048*** (0.006)
Constant	15.379*** (0.852)	5.106*** (0.510)	17.396*** (0.715)	1.572*** (0.151)	−0.358 (0.348)	−0.237 (0.565)	0.851*** (0.016)	0.831*** (0.029)	0.497*** (0.024)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.358	0.219	0.312	0.224	0.258	0.280	0.082	0.057	0.143
No. of obs.	51,228	54,956	51,228	54,956	51,228	51,228	106,184	106,184	106,184

Note(s): The table reports the coefficient estimates and standard errors from the OLS estimation of the regression equation

$$Comhold_{i,j,t}/Comholchg_{i,j,t}/Corr_{i,j,t} = \lambda_0 + \lambda_1 Alumni_{i,j,t} + \lambda_2 Alumni_{i,j,t} \times Alumnisize_{i,j,t} + \lambda_3 Samecity_{i,j,t} + \lambda_4 Samefamily_{i,j,t} + \lambda_5 Samestyle_{i,j,t} + \lambda_6 Diffsize_{i,j,t} + \lambda_7 Diffage_{i,j,t} + \lambda_8 Medu_{i,j,t} + YearDum + QuarterDum + \varepsilon_{i,j,t}$$

where the dependent variable refers to the measures for common stock holdings (*Comhold_24q, comhold_13q*, *Comnum_24q, Comnum_13q*), changes in common stock holdings (*Comholdchg_24q* and *Comnumchg_24q*) and correlation coefficient of the returns (*Corr_ret, Corr_f1, Corr_f3*) of the two paired funds *i* and *j*; *t* refers to a quarter. *Alumnisize* is the size of alumni networks measured as the number of alumni managers who graduated from the same college/university. Fixed effects for year and quarter are included. Standard errors are clustered by fund-pair. All variables are defined as in Table A1. The sample covers quarterly observations of 162 actively managed open-end equity funds in China during 2003–2014. ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively

4. Performance effect of alumni network

In the preceding sections, we present solid evidence that interpersonal communications within alumni networks play an important role in mutual fund managers' investment decisions, shown by similarity in their portfolio holdings, trades and higher correlation in fund performance. In this section, we investigate whether the social interaction among alumni mangers indicates the transmission of value-related information. To examine whether the overlap in holdings of alumni managers reflects sharing of value-related information, we follow Pool *et al.* (2015) and investigate investment returns of their common holdings and common trades.

We first perform the holding-based portfolio tests. We sort all stocks in each fund's portfolio into two groups. If at least one alumni fund also holds the same stock in the previous quarter, we place the stock in the "alumni" portfolio; otherwise, we place the stock in the "non-alumni" portfolio. To compare the performance of alumni portfolios to that of non-alumni portfolios, we compute alumni and non-alumni portfolio quarterly returns for each fund based on holdings as of the prior quarter:

$$R^{A_{i,t}} = \sum_{k \in A_{i,t}} \left(\frac{w_{i,k,t}}{\sum_{k \in A_{i,t}} w_{i,k,t}} \right) \bullet ret_{k,t+1} \tag{8}$$

and

$$R^{NA_{i,t}} = \sum_{k \in NA_{i,t}} \left(\frac{w_{i,k,t}}{\sum_{k \in NA_{i,t}} w_{i,k,t}} \right) \bullet ret_{k,t+1}, \tag{9}$$

where $A_{i,t}$ is the set of stock of alumni portfolio for fund i, and $NA_{i,t}$ is the set of all other stocks in fund i's portfolio not held by any alumni fund in quarter t. Following Coval and Moskowitz (2001), we first average these quarterly alumni and non-alumni returns for each fund in each quarter. Next, we aggregate the alumni and non-alumni portfolio returns by calculating the weighted average returns with equations (8) and (9) across funds, weighting each fund's return by its size.

We assess the performance of the alumni and non-alumni portfolios with raw returns and benchmark-adjusted returns. The benchmark-adjusted returns are measured in three ways: (1) excess return, which is calculated as the difference between buy-and-hold stock return and value-weighted market return; (2) risk-adjusted returns based on the market model (F1_adjusted return); and (3) risk-adjusted returns based on the Fama–French three-factor model (F3_adjusted return).

Table 7 reports the average returns for the alumni (R^A) and non-alumni (R^{NA}) holdings portfolios and the difference between the averages. As shown in the table, the alumni portfolios outperform the non-alumni portfolios by an average ranging from 2.5 to 4.9% per quarter for the four different measures of return. These results indicate that alumni managers have an information advantage in common stock holdings.

Next, we examine whether the common trades among alumni managers are informative. At the beginning of each quarter, we construct four distinct portfolios based on two criteria. First, whether a fund bought or sold a stock during the previous quarter, and second, whether a trade (buy or sell) overlapped with any alumni managers. Bought stocks are placed in a "buy" portfolio, while stocks that were sold are aggregated into a "sell" portfolio. Next, two subgroups are created within the buy and sell portfolios: "alumni" and "non-alumni" trading portfolios. Then, for each fund and each quarter, we compute the equally weighted average returns of these portfolios. Last, we find the average returns of each sub-portfolio across sample funds, weighting each fund return with fund size in the previous quarter. Thus, we

	R^A (1)	R^{NA} (2)	R^A-R^{NA} (3)
Raw return	0.111*** (0.039)	0.062* (0.032)	0.049 (0.053)
Excess return	0.094*** (0.020)	0.046*** (0.011)	0.048** (0.022)
F1_adjusted return	0.028** (0.014)	0.000 (0.007)	0.028* (0.015)
F3_adjusted return	0.023** (0.010)	−0.003 (0.006)	0.025** (0.012)

Note(s): The table presents returns for "alumni (*A*)" and "non-alumni (*NA*)" portfolios of fund managers. The alumni portfolio of fund *i* consists of those stocks in the fund's portfolio that are also held by at least one other fund managed by a manager who is in the same alumni network with at least one of the managers of fund *i*. Non-alumni portfolio contains holdings that do not meet this criterion. We calculate the alumni and non-alumni returns in each quarter for each fund by averaging the quarterly performance measures as follows:

$$R^{A_{i,t}} = \sum_{k \in A_{i,t}} \left(\frac{w_{i,k,t}}{\sum_{k \in A_{i,t}} w_{i,k,t}} \right) \bullet ret_{k,t+1}$$

$$R^{NA_{i,t}} = \sum_{k \in NA_{i,t}} \left(\frac{w_{i,k,t}}{\sum_{k \in NA_{i,t}} w_{i,k,t}} \right) \bullet ret_{k,t+1}$$

We then average across funds in the quarter, using the total assets of each fund in the previous quarter as weights, to produce value-weighted average quarterly returns of the alumni and non-alumni portfolios. $A_{i,t}$ denotes the set of alumni stocks, $NA_{i,t}$ the set of non-alumni stock and $w_{i,k,t}$ the actual portfolio weight of fund *i* in stock *k* during quarter *t*. Columns 1 and 2 present the average raw and risk-adjusted quarterly returns for the alumni and non-alumni portfolios, respectively. Excess return is calculated as the difference between buy-and-hold stock return and value-weighted market return. F1_adjusted return and F3_adjusted return are risk-adjusted returns based on market model and Fama–French three-factor model, respectively. Column 3 presents the difference in returns between alumni and non-alumni portfolios. Standard errors are reported in parentheses. ***, ** and * indicate statistical significance for tests of difference in means at the 1, 5 and 10% levels, respectively

Table 7.
The performance effect of alumni networks: holdings

obtain quarterly returns of the alumni and non-alumni buy and sell portfolios for each quarter.

The results of the trade-based portfolio tests are presented in Table 8. As shown in Column 1, the alumni buy portfolio outperforms its benchmark portfolio by 2.5–12.1% per quarter for different benchmark models. On the sell side, column 2 shows that the alumni portfolio performs no different than its risk-adjusted benchmarks. Column 3 reports the long-short strategy of buying (and simultaneously selling) stocks that alumni managers buy (and sell) together. The strategy delivers significantly positive returns, ranging from 3.4 to 12.7% per quarter for the four return measures. Columns 4 to 6 present the results of buy and sell portfolios for non-alumni managers. Like the alumni portfolios, the returns of the non-alumni buy portfolio are consistently positive and statistically significant for different return measures and those of the non-alumni sell portfolio are not significant. The long–short strategy also yields significantly positive performance for excess return and the Fama–French three-factor benchmark return. Column 7 reports the difference-in-difference estimates. The results show that our estimates are consistently positive and statistically significant at the 1% level, ranging from 1.3 to 5.9% per quarter. This finding suggests that trading ideas that managers share via alumni interactions yield abnormal returns.

In summary, our findings reported in this section suggest that interpersonal communication among alumni managers signifies the transmission of valuable information.

5. Conclusion

The literature shows that information is spread around through various types of channels in social networks. We investigate a particular type of social network, that of a common educational experience: the alumni relationship. One convenient aspect of the alumni network

Table 8. The performance effect of alumni networks: trades

	Alumni portfolio			Non-alumni portfolio			
	Buys (1)	Sells (2)	Diff (3)	Buys (4)	Sells (5)	Diff (6)	Diff.-Diff (7)
Raw return	0.156** (0.063)	0.029 (0.044)	0.127* (0.073)	0.109* (0.053)	0.042 (0.043)	0.067 (0.068)	0.059*** (0.015)
Excess return	0.121*** (0.029)	−0.004 (0.011)	0.125*** (0.031)	0.075*** (0.018)	0.008 (0.008)	0.067*** (0.019)	0.058*** (0.015)
F1_adjusted return	0.041** (0.014)	−0.003 (0.009)	0.044** (0.017)	0.026* (0.014)	0.002 (0.010)	0.023 (0.017)	0.021*** (0.004)
F3_adjusted return	0.025*** (0.009)	−0.008 (0.006)	0.034*** (0.010)	0.014** (0.007)	−0.007 (0.005)	0.021** (0.009)	0.013*** (0.004)

Note(s): This table presents the performance of portfolios based on trades made by alumni and non-alumni mutual fund managers. For each fund and at the beginning of each quarter, we construct four distinct portfolios based on two criteria. First, whether a fund bought or sold a stock during the previous quarter, and second, whether a trade (buy or sell) overlapped with any alumni managers. Bought stocks are placed in a "buy" portfolio, while stocks that were sold are aggregated into a "sell" portfolio. Two subgroups are created within the buy and sell portfolios: "alumni" and "non-alumni" trades. We calculate the equally weighted average quarterly returns of these portfolios for each fund in each quarter. We then average the returns of each subportfolio across the funds in our sample, using the total asset under management of each fund in the previous quarter as weights, to produce average quarterly returns of the alumni and non-alumni buy and sell portfolios for each quarter. Excess return is calculated as the difference between buy-and-hold stock return and value-weighted market return. F1_adjusted return and F3_adjusted return are risk-adjusted returns based on market model and Fama–French three-factor model, respectively. Columns 1 and 2 report the average quarterly returns of alumni buy and sell portfolios, respectively. Columns 4 and 5 provide the corresponding results for non-alumni portfolios. Columns 3 and 6 report the difference of the returns of buy and sell portfolios for the alumni and non-alumni stocks, and Column 7 presents the difference-in-difference estimate. ***, ** and * indicate statistical significance for tests of difference in means at the 1, 5 and 10 levels, respectively

is that it has been formed *ex ante*; its formation is thus independent from the information to be transferred. We examine the information flow between alumni mutual fund managers and the effect of alumni networks on managers' portfolio composition, trading activities and investment returns.

Exploring a data set of 162 actively managed equity mutual funds in the Chinese financial market, we uncover a systematic pattern of commonality in both holdings and returns of alumni managers. Specifically, we find that fund managers connected through an education network place larger concentrated bets on common assets than non-connected managers, and, as a result, their performance shows a higher correlation than that of non-connected managers. We also find that the information shared among alumni managers is valuable, as suggested by the evidence that alumni managers' common holding returns are higher than those of non-alumni managers, and that an investment strategy that long (and short) stocks purchased (and sold) by alumni managers yields positive risk-adjusted returns. Our findings suggest that information dissemination among alumni managers could be one of the driving forces for mutual fund herding behavior.

Note

1. Because the reports as of the end of March and September disclose only top ten stocks held by mutual funds, we intend to focus on the sixth-month holding changes based on the portfolio composition as of the end of June and December.

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Appendix

Variables	Definition
Alumni	An indicator variable that equals 1 if any two managers from different funds went to the same college or university, and 0 otherwise
Alumnisize	The number of alumni managers who went to the same college/university
Comhold_24q	The common holdings of any two paired funds as a percentage of total assets as of the end of June and December
Comholdchg_24q	The common trades of any two paired funds as a percentage of total net assets as of the end of June and December
Comnum_24q	The number of individual stocks commonly held by any two paired funds as of the end of June and December
Comnumchg_24q	The number of stocks that commonly are traded by any two paired funds as of the end of June and December
Comhold_13q	The common holdings of any two paired funds as a percentage of total net asset as of the end of March and September
Comnum_13q	The number of stocks commonly held by any two paired funds as of the end of June and December
Corr_ret	The correlation coefficient of daily returns of any two paired funds over a calendar quarter
Corr_1f	The correlation coefficient of daily one-factor risk-adjusted returns of any two paired funds over a calendar quarter
Corr_3f	The correlation coefficient of daily three-factor risk-adjusted returns of any two paired funds over a calendar quarter
Samecity	An indicator variable that equals 1 if any two funds' headquarters are located in the same city, and 0 otherwise
Samefamily	An indicator variable that equals 1 if any two funds are from the same fund family, and 0 otherwise
Samestyle	An indicator variable that equals 1 if any two funds have the same investment objective, and 0 otherwise
Diffsize	$\frac{2\lvert TNAi - TNAj\rvert}{(TNAi+TNAj)}$, *TNA* is the total net assets, and *i* and *j* refer to any two funds
Diffage	$\frac{2\lvert AGEi - AGEj\rvert}{AGEi+AGEj}$, *AGE* is the fund age in year, and *i* and *j* refer to any two funds
Medu	The average educational scores of managers of paired funds. It is scored 4 for doctoral degree, 3 for master's degree, 2 for bachelor's degree and 1 for other cases

Table A1.
Variable definitions

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