

Analysis of the Effect of Size on Small-Cap Mutual Fund Performance

Criteria Used in Selecting Funds

Using the *Morningstar Principia* database,* we selected those mutual funds that met all of the following criteria:

- US Small Company Equity Mutual Funds
- Equity style = Small
- Investment objective = Small Company
- Net assets under management (beginning 1997) > \$800 million
- Fund inception \leq 01/93

*As of 12/31/97

Overview of Small-Cap Fund Performance vs Fund Size

Asset Size (\$millions)

Fund Name	Beginning Assets 1997	Percentile* Ranking 1997	Beginning Assets 1996	Percentile* Ranking 1996	Beginning Assets 1995	Percentile* Ranking 1995	Beginning Assets 1994	Percentile* Ranking 1994	Beginning Assets 1993	Percentile* Ranking 1993	Beginning Assets 1992	Percentile* Ranking 1992
Fidelity Low-Priced Stock	\$5,664	54	\$3,350	18	\$2,355	34	\$2,060	14	\$2,240	34	\$375	12
Kaufmann	\$5,342	55	\$3,160	38	\$1,591	50	\$965	11	\$313	42	\$140	58
AIM Aggressive Growth	\$2,724	55	\$2,304	60	\$715	37	\$274	4	\$38	6	\$16	14
Vanguard Explorer	\$2,264	83	\$1,648	78	\$1,122	60	\$848	34	\$620	51	\$430	54
Heartland Value	\$1,627	71	\$1,191	51	\$339	17	\$187	30	\$49	49	\$30	1
Amer. Cent-20thC Giftrust	\$874	91	\$603	90	\$274	47	\$164	7	\$97	8	\$64	24
T. R. Price Small-Cap Value	\$1,410	48	\$936	27	\$408	21	\$454	59	\$264	16	\$53	39
Lindner Growth Inv	\$1,495	98	\$1,408	51	\$1,503	70	\$1,469	49	\$1,074	35	\$836	76
DFA US 9-10 Small Company	\$1,187	73	\$946	68	\$663	11	\$643	21	\$672	31	\$730	25
Lazard Small Cap Insti.	\$982	46	\$647	27	\$430	57	\$351	28	\$168	2	\$3	19
Janus Venture	\$1,706	53	\$1,790	86	\$1,496	86	\$1,779	23	\$1,706	84	\$1,464	64
Oppenheimer Discovery A	\$1,111	65	\$840	58	\$606	51	\$622	92	\$427	45	\$167	31
Average	\$2,199	66	\$1,569	54	\$958	45	\$818	31	\$639	34	\$359	35

DataSource: RogersCasey Investworks & Morningstar Principia

*Percentile Ranking = total return ranking within the fund's respective *Morningstar Category*

Analysis of Effect of Size on Alpha

Comparison of each fund's average annual alpha* before assets exceeded \$800 million versus after assets exceeded \$800 million

Fund	Before \$800 Million	After \$800 Million
Fidelity Low-Priced Stock	10.16%	3.79%
Kaufmann	10.22%	2.48%
AIM Aggressive Growth	6.13%	-3.76%
Vanguard Explorer	-3.06%	-2.79%
Heartland Value	-0.05%	-2.25%
American Cent-20thC Giftrust	5.67%	-16.75%
T. Rowe Price Small-Cap Value	-1.94%	7.09%
Lindner Growth Inv	6.06%	-0.59%
Lazard Small Cap Institutional	0.48%	-10.43%
Janus Venture	11.75%	0.39%
Oppenheimer Discovery A	7.60%	-2.53%
Average	4.82%	-2.30%

Data Source: RogersCasey Investworks & Morningstar Principia

*Fund alphas reported by *RogersCasey Investworks* as of 12/31/97; DFA (US 9-10) not included.

Relative Performance Analysis

Comparison of each fund's average annual relative performance before assets totaled \$800 million versus after assets exceeded \$800 million

Fund Name	Before \$800 Million	After \$800 Million
Fidelity Low-Priced Stock	11.67%	30.80%
Kaufmann	26.67%	38.50%
AIM Aggressive Growth	45.73%	57.50%
Vanguard Explorer	43.79%	63.75%
Heartland Value	32.08%	61.00%
American Cent-20thC Giftrust	30.23%	91.00%
T. Rowe Price Small-Cap Value	37.57%	37.50%
Lindner Growth Inv	31.33%	63.17%
DFA US 9-10 Small Company	44.82%	70.50%
Lazard Small Cap Institutional	26.60%	46.00%
Janus Venture	34.25%	66.00%
Oppenheimer Discovery A	39.44%	65.00%
Average	33.68%	57.56%

Percentile* Drop	23.88%
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DataSource: RogersCasey Investworks & Morningstar Principia

*Percentiles reflect relative performance with all other funds in the same *Morningstar Category*

Loss of Return - Potential Sources

- Deconcentration of Portfolios
 - Increased number of holdings
 - Poorer quality ideas included in the portfolio
- Style Drift
 - Investing in larger companies
 - Violating investment process and standards
- Increased Trading Costs
 - Larger positions increase transaction costs and limit flexibility in the marketplace

Number of Holdings vs Relative Performance

Fund Name	Total Year-End Holdings 1997	Percentile* Ranking 1997	Total Year-End Holdings 1992	Percentile* Ranking 1992
Fidelity Low-Priced Stock	906	54	468	12
Kaufmann	463	55	116	58
AIM Aggressive Growth	360	55	73	14
Vanguard Explorer	301	83	166	54
Heartland Value	270	71	58	1
American Cent-20thC Giftrust	77	91	50	24
T. Rowe Price Small-Cap Val	180	48	92	39
Lindner Growth Inv	194	98	113	76
Lazard Small Cap Instl	93	46	NA	19
Janus Venture	155	53	127	64
Oppenheimer Discovery A	162	65	151	31
Average w/out DFA	287	65	141	36

DFA US 9-10 Small Company	2647	73	2076	25
Average w/DFA	484	66	317	35

DataSource: RogersCasey Investworks, Morningstar Principia & Fortune Magazine

*Percentiles reflect relative performance with all other funds in the same *Morningstar Category*

Analysis of the Most Recent Reported Top Ten Holdings for the Largest Small-Cap Mutual Funds

Top 10 Holdings	< \$1.2 Billion Market Cap	> \$1.2 Billion Market Cap
Fidelity Low-Priced Stock	2	8
Kaufmann	4	6
AIM Aggressive Growth	4	6
Vanguard Explorer	6	4
Heartland Value	7	3
American Cent-20thC Giftrust	4	6
T. Rowe Price Small-Cap Value	5	5
Lindner Growth Inv	6	4
Lazard Small Cap Inst.	2	8
Janus Venture	1	9
Oppenheimer Discovery A	4	6
Average	4	6

DataSource: Bloomberg

*Data as of 3/12/98

Trading Costs Analysis

- Trading costs are a logarithmic function of the size of a portfolio's position vs the daily trading volume of the stock.
- Numeric Investors, LP analyzed 25,000 of their trades and developed formulas that estimate the one-way trading costs of buying or selling stocks.
- The key variable in each of their formulas is the size of a manager's portfolio as a percentage of that stock's average daily trading volume.
- They have four formulas, each designed to measure the trading costs of a different style of investing.

Numeric Investors, LP Formulas For Trading Costs

Value Hedge: Large, value

$$\text{Trading Cost} = 39\text{bp} + 0.022 \cdot \log(\text{days volume} + 1)$$

Core Aggressive: Blend, large, mid-cap

$$\text{Trading Cost} = 51\text{bp} + 0.018 \cdot \log(\text{days volume} + 1)$$

Original Hedge: Blend large, mid-cap and small stocks

$$\text{Trading Cost} = 50\text{bp} + 0.038 \cdot \log(\text{days volume} + 1)$$

Small Growth: Momentum, small and mid-cap growth

$$\text{Trading Cost} = 75\text{bp} + 0.052 \cdot \log(\text{days volume} + 1)$$

- For purposes of our analysis of liquidity in the small-cap market, we used the “Original Hedge” and “Small Growth” Formulas

Trading Costs Analysis

- We ranked the stocks of the Russell 2000 Index by average daily trading volume (calculated over a 20 day period: 02/06/98 - 03/05/98).
- We composed three model portfolios made up of different sections of the Russell 2000 Index based upon the liquidity of the stocks.
- Portfolio Structure #1 -- concentrated and liquid
- Portfolio Structure #2 -- deconcentrated and liquid
- Portfolio Structure #3 -- concentrated and illiquid

Trading Costs Analysis

- Each portfolio structure was used to create \$500 million and \$1.5 billion model portfolios for a total of six portfolios.
- We then calculated the estimated trading costs of each of the six portfolios under two different investment strategies -- Numeric's Original Hedge and Numeric's Small Growth.
- We also assumed a 60% annual rate of turnover of each portfolio -- the same average turnover level experienced by the 12 funds analyzed in this study.

Model Portfolios and Trading Costs

	Estimated Trading Cost \$500 Million Portfolio	Estimated Trading Cost \$1.5 Billion Portfolio	Incremental Total Trading Cost from Larger Asset Size
Portfolio Structure #1 -- 50 Most Liquid Stocks In the Russell 2000			
Small Growth Methodology	5.512%	7.796%	2.740%
Original Hedge Methodology	3.980%	5.649%	2.002%
Portfolio Structure #2 -- 300 Most Liquid Stocks In the Russell 2000			
Small Growth Methodology	3.795%	5.834%	2.447%
Original Hedge Methodology	2.725%	4.215%	1.788%
Portfolio Structure #3 -- Diversified Portfolio (50 Holdings) Among All Stocks In the Russell 2000			
Small Growth Methodology	10.877%	13.339%	2.938%
Original Hedge Methodology	7.901%	9.700%	2.159%

Effect of Expense Ratios on Long-Term Relative Investment Performance

5 Year Average				
Expense Ratio Range	(X < .85)	(0.85 <= X < 1.0)	(1 <= X <1.3)	(X >= 1.3)
Average Percentile Ranking*	48	50	50	47
Average Expense Ratio	0.56	0.92	1.14	1.71
10 Year Average				
Expense Ratio Range	(X < .85)	(0.85 <= X < 1.0)	(1 <= X <1.3)	(X >= 1.3)
Average Percentile Ranking*	46	46	50	45
Average Expense Ratio	0.57	0.92	1.13	1.77

Universe of Funds Considered

Morningstar Investment Objective = Small Company Morningstar Equity Style

Box = Small

Time Period: 1988 - 1997

Note: Numbers do not average to 50% because of rounding and because of the Morningstar Principia Style versus Category differential

Source: Morningstar Principia

*Percentile Ranking = total return ranking within the fund's respective *Morningstar Category*