

Hedge Funds and the Technology Bubble

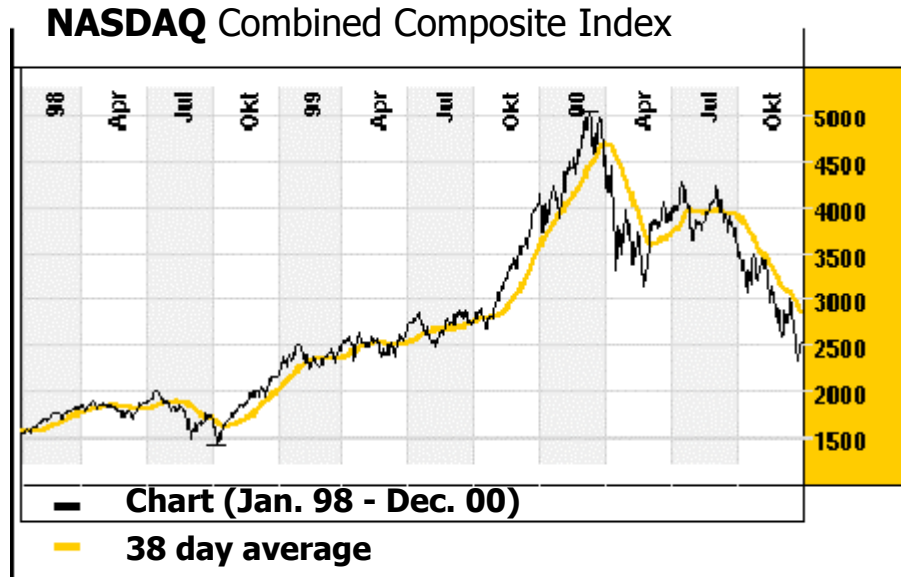
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The Technology Bubble



- Ofek-Richardson (2001WP): Valuation of Internet stocks implied
 - **Average** expected earnings growth of about 3,000% in ten years, assuming that they **already** achieved 'old economy' profit margins
 - **Zero** percent cost of capital for ten years
- A price bubble? We assume so and try to understand it.

Bubbles and Rational Speculative Activity

- **Efficient markets view**

"If there are many sophisticated traders in the market, they may cause these "bubbles" to burst before they really get under way"

(Fama 1965)

- **Limits to "arbitrage"?**

"Had I followed my own advice, I would have lost my shirt ... everybody knew that it could not go on like this. The start and end of a bubble just cannot be explained rationally."

(Milton Friedman, 2001)

"So, you think that investors are irrational—but then you expect them to become rational just when you have gone short?"

(A hedge fund manager's wife, 1999)

- **How did sophisticated investors react to the bubble?**

Why Did Rational Speculation Fail to Prevent the Bubble ?

(1) Unawareness of the bubble?

- **Implication:** Rational speculators would perform as badly as other investors when prices collapse

(2) Limits to arbitrage?

- Reluctance to trade against mispricing
 - Fundamental risk (Wurgler-Zhurvaskaya 2002)
 - Noise trader risk and myopia (DSSW 1990a; Dow-Gorton 1994)
 - Liquidation risk (Shleifer-Vishny 1997)
 - Synchronization risk (Abreu-Brunnermeier 2002; 2003)
 - Short-sales constraints (Ofek-Richardson 2003; Cochrane 2002)
- **Implication:** Rational speculators may be reluctant to go short in overpriced Tech stocks

Why Did Rational Speculation Fail to Prevent the Bubble ?

(3) Predictable investor sentiment

- Incentives for rational arbitrageurs to ride a bubble
 - Predictable bubble growth (Abreu-Brunnermeier 2003)
 - Anticipation of positive-feedback trader demand (DSSW 1990b)

- **Implication:** Rational speculators may want to hold Tech stocks and try to go short before prices collapse

Hedge Funds

- We look at positions held by hedge funds
- Why hedge funds?
 - Hedge funds are able to go short
 - Managers have high-powered incentives
 - Lock-in periods
- Hedge Funds come close to the ideal of 'rational speculators'

Outline & Preview

1. Related Empirical Literature
2. Data and Methodology
3. Empirical Results
 - On balance, hedge funds had significant long exposure to technology stocks – they were riding the bubble
 - Hedge Funds skillfully anticipated the downturn on a stock-by-stock level
4. Conclusions

Related Empirical Literature

- Technology Bubble
 - Ofek-Richardson (2003), Lamont-Thaler (2003), Cochrane (2002)
- Limits to Arbitrage
 - Pontiff (1996), Mitchell-Pulvino-Stafford (2002), Baker-Savasoglu (2002), Wurgler-Zhuravskaya (2002)
- Hedge Funds
 - Skills and risks: Fung-Hsieh (1997), Ackermann et al. (1999), Agarwal-Naik (2000)
 - Role in financial crises: Brown-Goetzmann-Park (2000), Fung-Hsieh (2000)

Data

- Hedge fund stock holdings 1998 - 2000
 - Quarterly 13F SEC filings from the CDA/Spectrum Database
 - Filing of 13F is mandatory for all institutional investors
 - With holdings in U.S. stocks of more than \$100 million
 - Domestic and foreign
 - Holdings reported at the *manager* level, not at the *fund* level
 - Example 1: Holdings aggregated for Soros Fund Management, without a break-up for the Quantum Fund and other Soros-funds
 - Example 2: Holdings for Montgomery Asset Management dominated by its large mutual funds/investment advisory activities. Discarded.
 - No short positions

Data

- Identification of hedge fund managers
 - Hedge Fund Research Inc. (HFR) *Money Manager Directory 1997*
 - Barron's Feb. 1996
 - List of large hedge fund managers in Cottier (1997)
- Pre-sample period sources to avoid survivor bias

Data

- Sample size
 - Initial list of 71 managers with CDA/Spectrum data
 - 18 managers are discarded because a large mutual fund/investment advisory business dominates their reported stock holdings
 - If registered as investment adviser with the SEC
 - and registration documents (Form ADV) indicate large non-hedge business
 - Final sample: 53 managers
 - Includes Soros, Tiger, Tudor, D.E. Shaw, and other well-known managers

Data

- Hedge Fund Performance Data 1998 - 2000
 - Returns on HFR hedge fund style indexes
 - Returns on individual hedge funds managed by the five managers with the largest stock holdings in our sample
 - Soros, Tiger, Husic, Omega, Zweig-DiMenna
- Stock Returns and Accounting Data
 - CRSP/COMPUSTAT Merged Database

Table I
Summary Statistics

Year	Qtr.	Number of Mgrs.	<u>Stock Holdings per Mgr.</u>			<u>No. of Stocks per Mgr.</u>			<u>Portfolio Turnover</u>			Aggregate Stock Hldgs. (\$ mill)
			Mean (\$ mill)	Median (\$ mill)	s.i.q.r. (\$ mill)	Mean	Median	s.i.q.r.	Mean (ann.)	Median (ann.)	s.i.q.r. (ann.)	
1998	1	35	1280	295	755	150	56	77				44,794
	2	42	1053	231	445	113	50	49	1.02	0.94	0.34	44,234
	3	42	728	145	364	71	44	30	0.83	0.57	0.40	30,594
	4	41	925	178	417	66	39	36	1.16	1.05	0.58	37,912
1999	1	39	1070	216	538	74	47	39	0.98	0.84	0.55	41,742
	2	42	995	211	382	75	48	38	1.12	1.12	0.50	41,807
	3	43	927	244	426	69	37	42	1.28	1.32	0.46	39,879
	4	44	1136	270	615	83	46	41	1.02	0.95	0.51	49,981
2000	1	43	1138	316	792	85	39	49	1.33	1.12	0.71	48,933
	2	44	772	246	383	67	37	41	1.19	0.99	0.75	33,988
	3	45	861	269	413	80	37	34	1.21	1.22	0.63	38,747
	4	48	812	190	427	100	45	37	1.06	0.77	0.70	38,989

Definition of the 'Bubble' Segment

- We look at NASDAQ stocks with high lagged Price/Sales (P/S) ratios
 - Advantage over Price/Book, Price/Earnings:

P/B and P/E can be negative for both distressed 'Old Economy' and high-flying 'New Economy' stocks.

Sales are always positive – even for internet stocks!
- Focus on NASDAQ stocks above the 80th P/S percentile
- Largely identical with "technology segment":
Contains virtually all dot-coms, Cisco, Sun, EMC etc.

Total return index

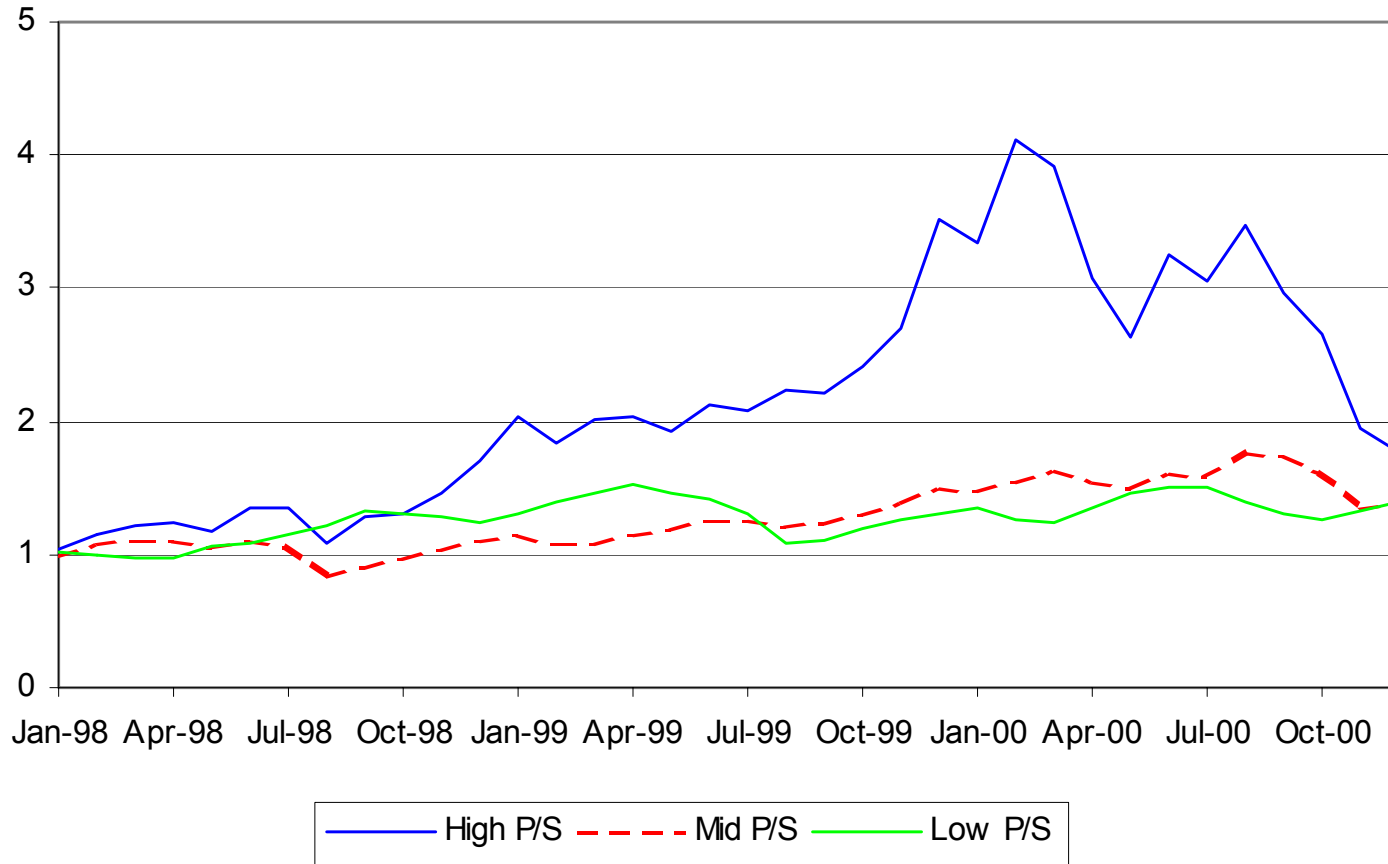


Figure 1: Returns for NASDAQ price/sales quintile portfolios 1998-2000.

Outline

1. Related Empirical Literature
2. Data and Methodology
3. Empirical Results

- **Did hedge funds ride the bubble?**
 - **Stock holdings**
 - **Factor exposure**
 - **Positions of individual managers**

- Did they successfully time their exposure to technology stocks?
 - Performance of individual stock holdings

4. Conclusions

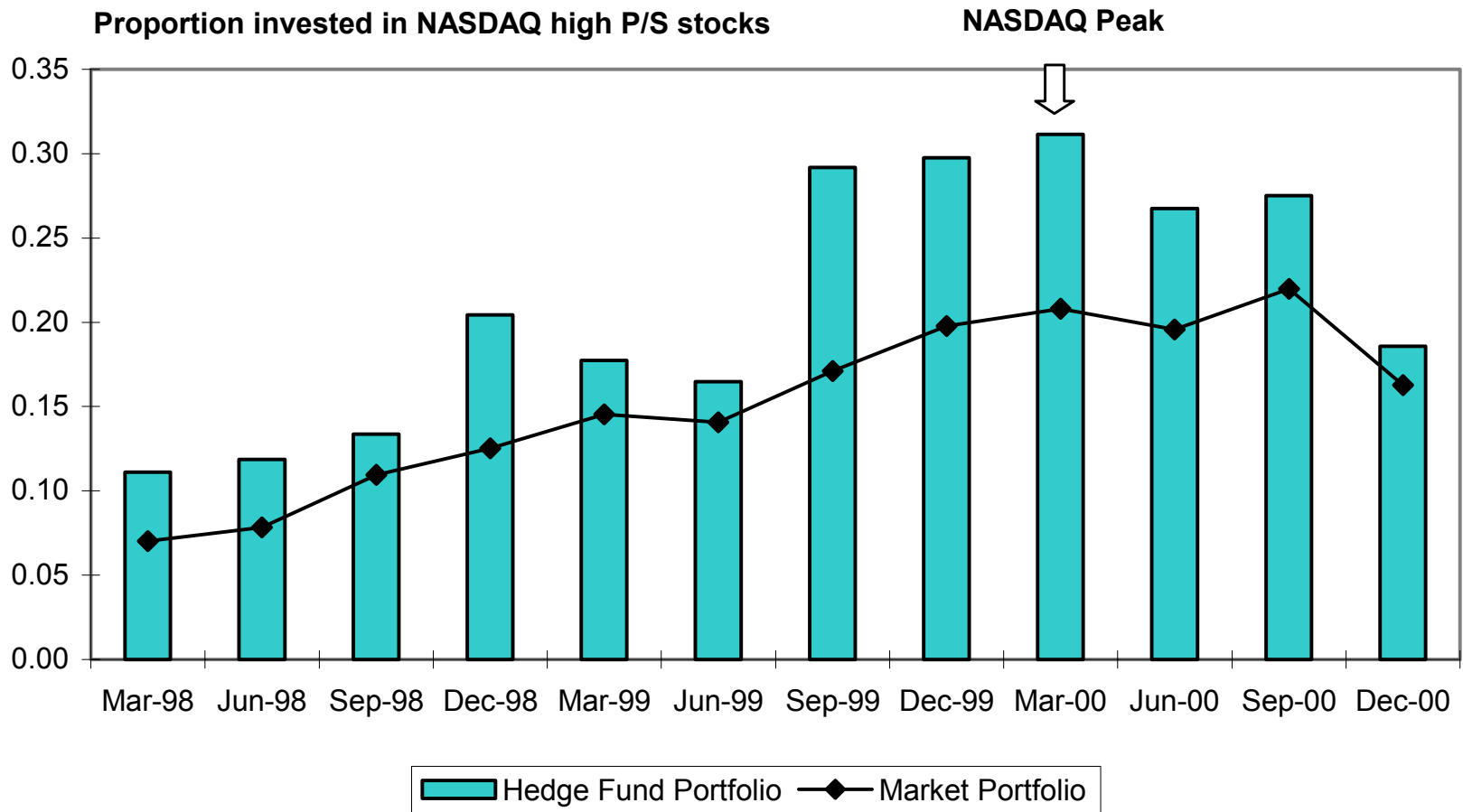


Figure 2: Weight of NASDAQ technology stocks (high P/S) in aggregate hedge fund portfolio versus weight in market portfolio

Assessing Short Positions: Factor Model

- Simple model of hedge fund returns: linear combination of asset class returns
 - R_{Mt} : Market Return
 - $R_{Tt} - R_{Mt}$: Return on a hypothetical “technology hedge fund”
Long tech stocks, short the market
 - e_t : idiosyncratic return

$$R_t = bR_{Mt} + g(R_{Tt} - R_{Mt}) + e_t$$

- Estimation of b and g by OLS

$$R_t = \alpha + \beta R_{Mt} + \gamma(R_{Tt} - R_{Mt}) + \varepsilon_t$$

Assessing Short Positions: Backing out Portfolio Weights

(a) In Figure 2 before:

$$w_0 = \frac{\text{long Tech holdings}}{\text{long stock holdings}}$$

(b) Taking account of short positions

$$w_2 = \frac{\text{net Tech holdings}}{\text{net stock holdings}} = \frac{\beta m_T + \gamma(1 - m_T)}{|\beta|}$$

($m_T = 0.15$, average weight of tech stocks in the market portfolio, Fig. 2)

More comparable to Fig. 2 (set $\beta = 1$):

$$w_1 = \frac{\text{net tech holdings}}{\text{long stock holdings}} = m_T + \gamma(1 - m_T)$$

Assessing Short Positions: Hedge Fund Returns

- Monthly returns (net-of-fees) on hedge fund indexes
 - Returns on funds of five largest largest managers in our holdings sample (equal-weighted index)
 - HFR hedge fund performance indexes for style groups

Table II
Exposure of Hedge Funds to the Technology Segment: Two-Factor Return Regressions

Index	Factor Loadings		adj. R ²	Implied weight of Tech stocks	
	β (Market)	γ (TECH)		w1 (rel. to agg. long)	w2 (rel. to agg. net)
Panel A: Equal-weighted index of largest funds in our sample (1998-2000)					
Large	0.42 (3.51)	0.17 (2.51)	0.56	0.29 [0.06]	0.49 []
Panel B: HFR hedge fund style indexes (1998-2000)					
Equity-Hedge	0.45 (6.36)	0.15 (3.92)	0.80	0.28 [0.03]	0.44 []
Equity Non-Hedge	0.74 (9.07)	0.16 (3.57)	0.86	0.29 [0.04]	0.34 []
Equity Market-Neutral	0.07 (1.54)	0.01 (0.53)	0.10	0.16 [0.02]	0.32 []
Market Timing	0.25 (3.45)	0.07 (1.67)	0.48	0.21 [0.03]	0.38 []
Short-Selling Specialists	-1.00 (-5.93)	-0.43 (-4.57)	0.80	*	-0.52 []
Macro	0.13 (1.84)	0.09 (2.13)	0.34	0.23 [0.03]	0.70 []
Sector Technology	0.71 (5.29)	0.57 (7.62)	0.86	0.64 [0.06]	0.84 []

Assessing Short Positions

Some example calculations

Time-Variation in Factor Exposure

Time-varying coefficients model

$$R_t = \bar{\alpha} + \xi_{1t} + (\bar{\beta} + \xi_{2t})R_{Mt} + (\bar{\gamma} + \xi_{3t})(R_{Tt} - R_{Mt}) + \varepsilon_t$$

State vector dynamics:

$$\begin{pmatrix} \xi_{1t+1} \\ \xi_{2t+1} \\ \xi_{3t+1} \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & \phi & 0 \\ 0 & 0 & \phi \end{pmatrix} \begin{pmatrix} \xi_{1t} \\ \xi_{2t} \\ \xi_{3t} \end{pmatrix} + \begin{pmatrix} \eta_{1t+1} \\ \eta_{2t+1} \\ \eta_{3t+1} \end{pmatrix}$$

Estimation:

1. Kalman filtering, maximum-likelihood: $\hat{\xi}_{t|t-1}$
2. Smoothing: $\hat{\xi}_{t|T}$

Time-Variation in Factor Exposure

Simplified set of test assets:

- **13F:** Returns on aggregate hedge fund long positions from 13 filings
- **Large:** Index of large manager funds, as before.
- **HFR:** Equal-weighted index of all HFR style indexes, except short sellers
- **HFR Short:** HFR short sellers

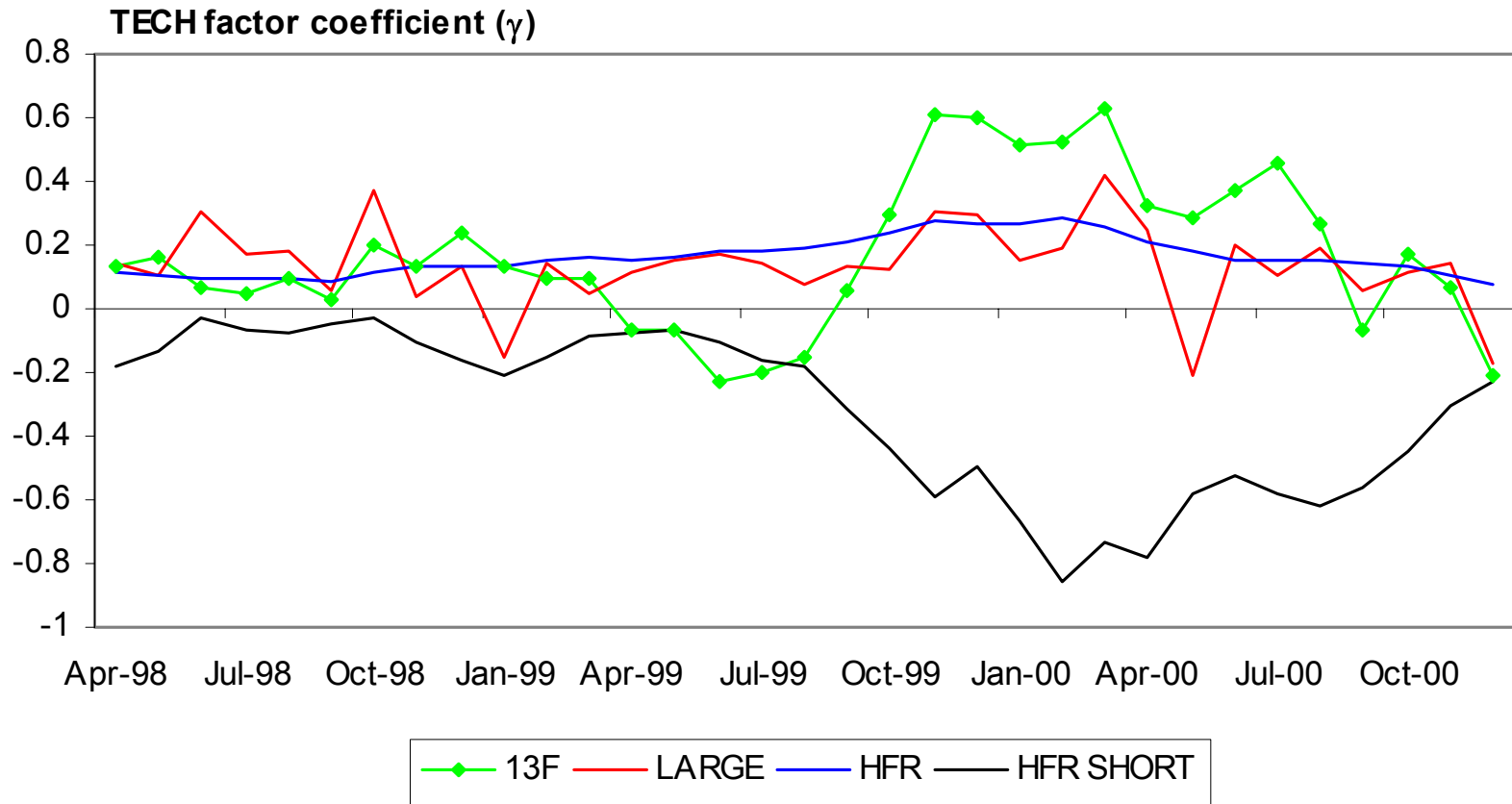


Figure 3. Exposure of hedge funds to the technology segment: Smoothed Kalman Filter estimates

Stock Holdings of Individual Hedge Funds

- How did individual hedge fund managers trade?
 - Five managers with largest stock holdings

- Are differences in positions associated with differences in flows?
 - Back-out flows from data on returns and assets under management
 - Problem: Incomplete data on assets under management
 - Two important examples: Quantum Fund (Soros) and Jaguar Fund (Tiger)

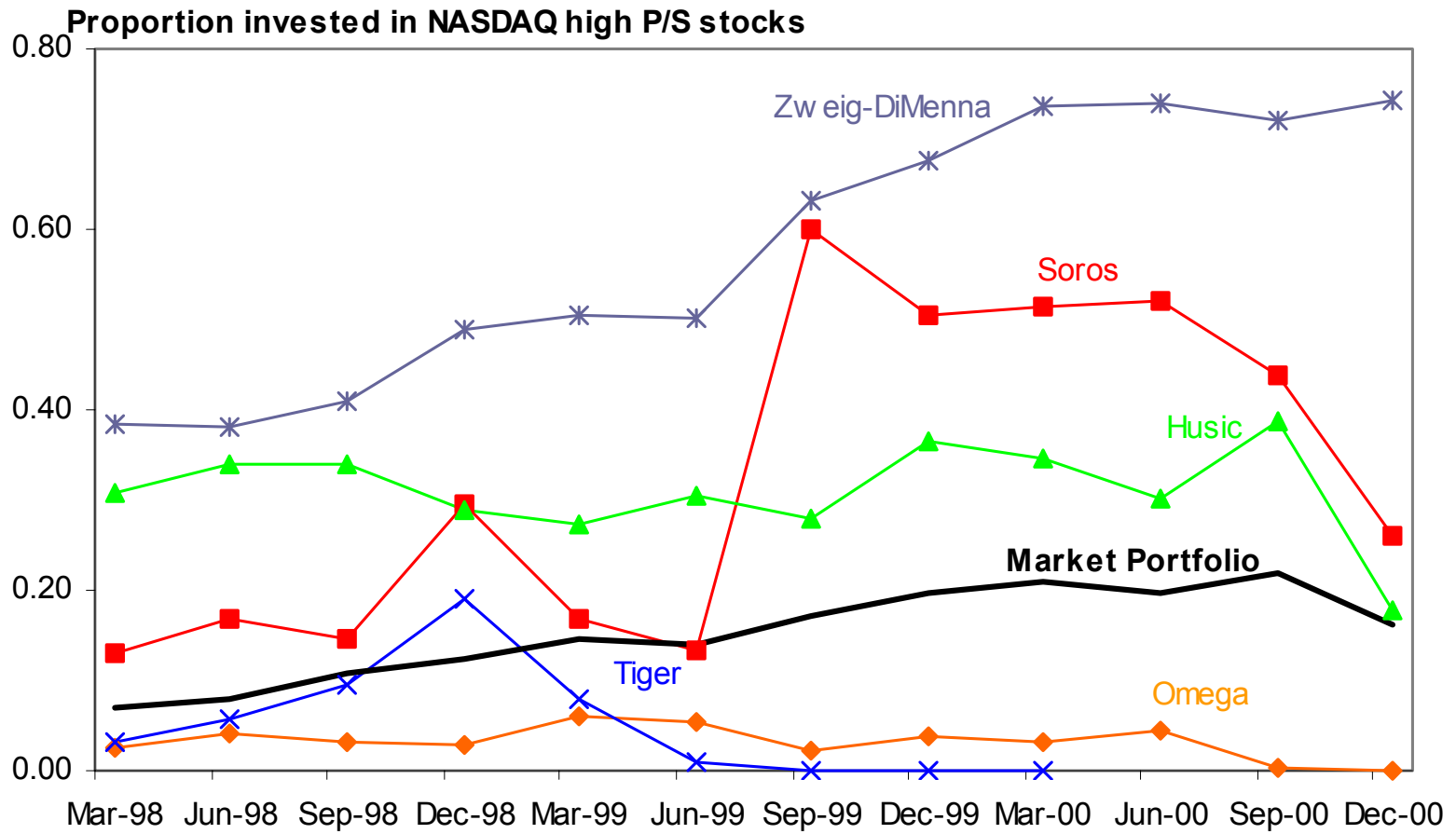


Fig. 4a: Weight of technology stocks in hedge fund portfolios versus weight in market portfolio

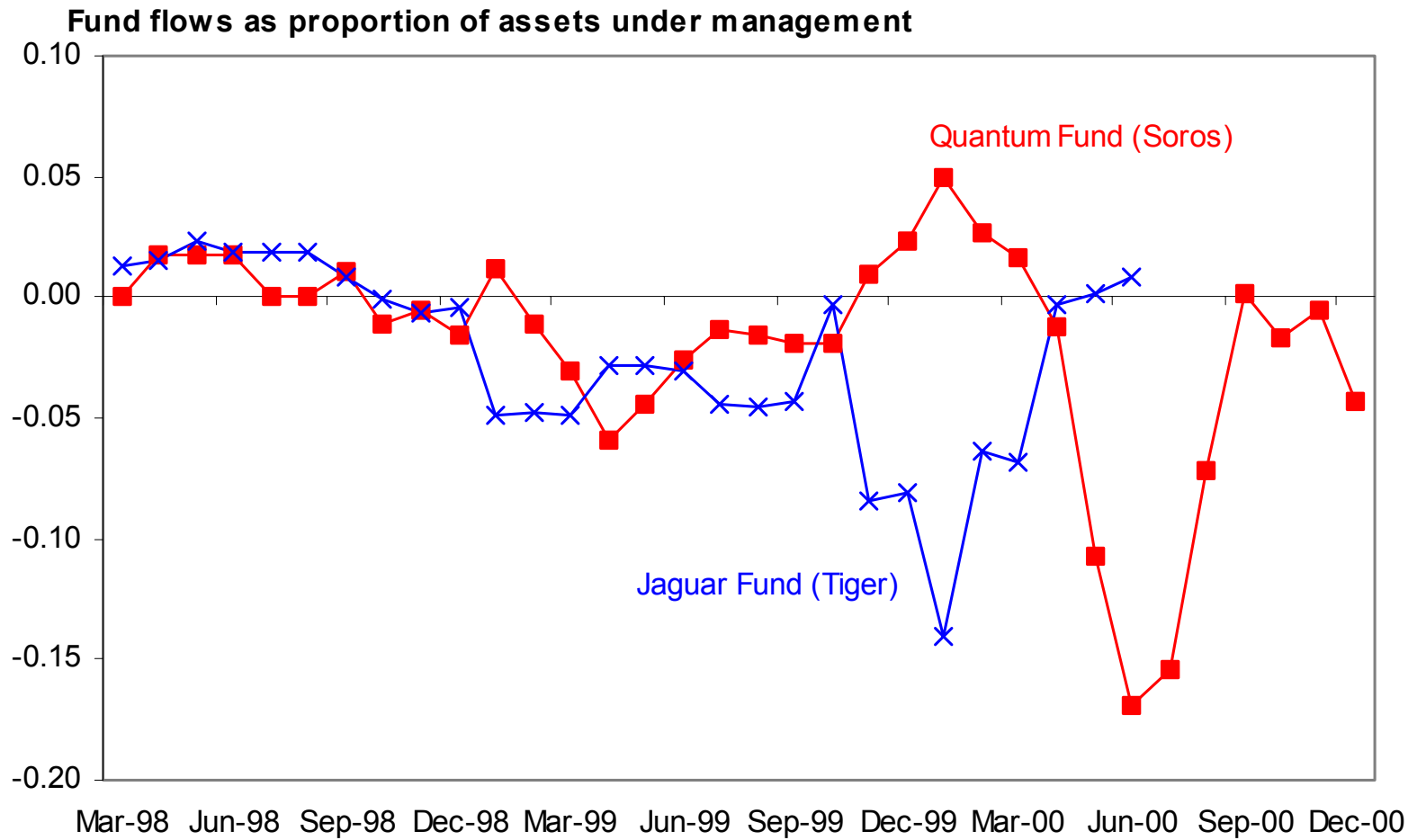


Fig. 4b: Funds flows, three-month moving average

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Did Timing the Bubble Pay Off?

Two possible explanations for hedge funds' ride of the bubble:

- Unawareness of the bubble?

- Deliberate market timing?
 - Rational response to predictable sentiment
 - Opportunities to reap gains at the expense of unsophisticated investors

- In the latter case, hedge funds should have outperformed in the bubble segment

Price Peaks

Table III
Distribution of Price Peaks of NASDAQ Technology (High P/S) stocks

Year	Quarter	Number of Peaks
1999	1	58
	2	86
	3	38
	4	207
2000	1	285
	2	98
	3	198
	4	49

- Not all stocks crashed at the same time
- Did Hedge Funds anticipate price peaks?

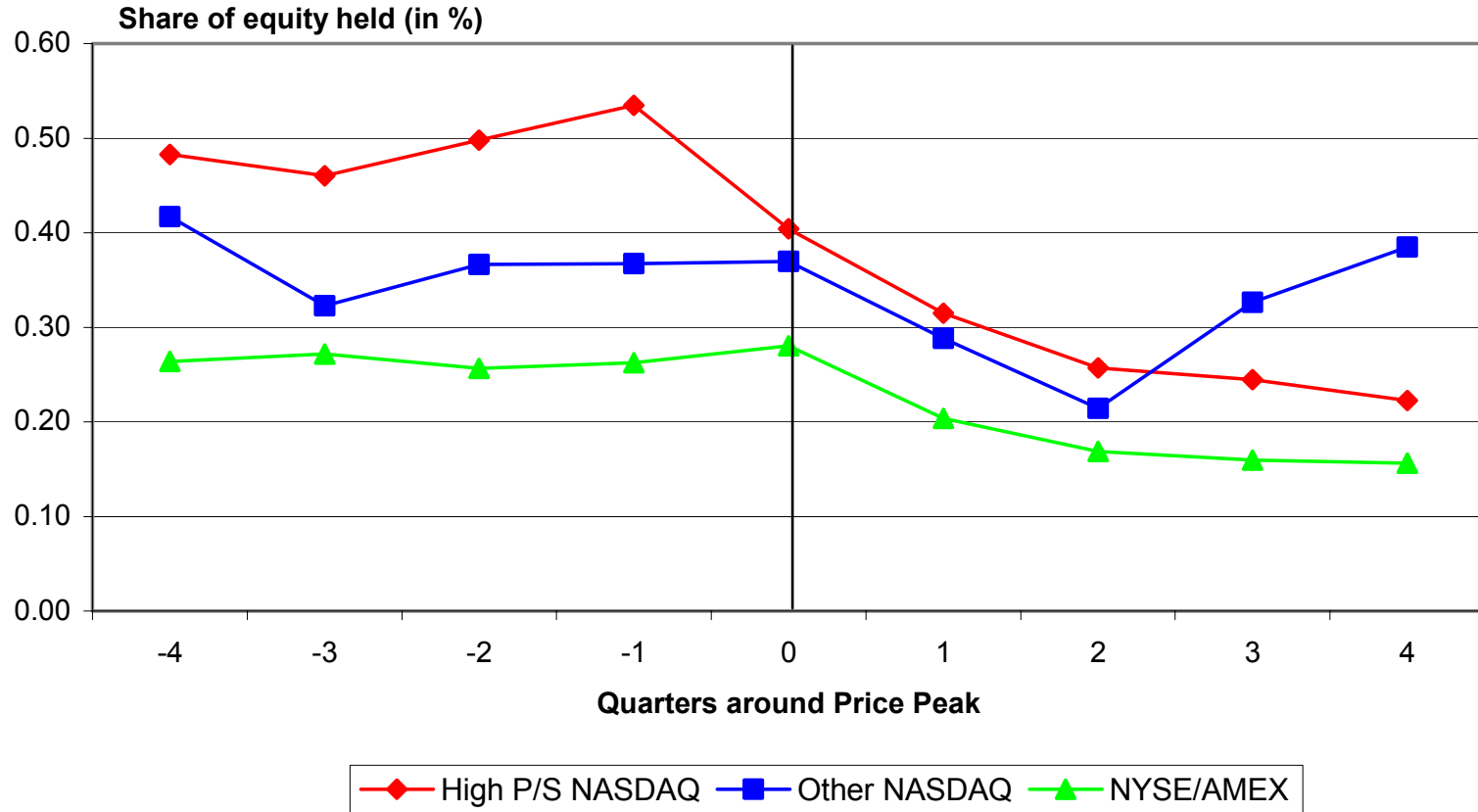


Figure 5. Average share of outstanding equity held by hedge funds around price peaks of individual stocks

Performance Evaluation

Methodology: Daniel-Grinblatt-Titman-Wermers (1997); Chen-Jegadeesh-Wermers (2000)

- For each P/S quintile segment we form “copycat” portfolios
 - They mimic the holdings of hedge funds
 - Quarterly rebalancing
- Characteristics-matched benchmark
 - Individual stocks matched to 125 benchmark portfolios (5x5x5) based on size, P/S, past six-months returns, and exchange
 - Gross of fees and transaction costs

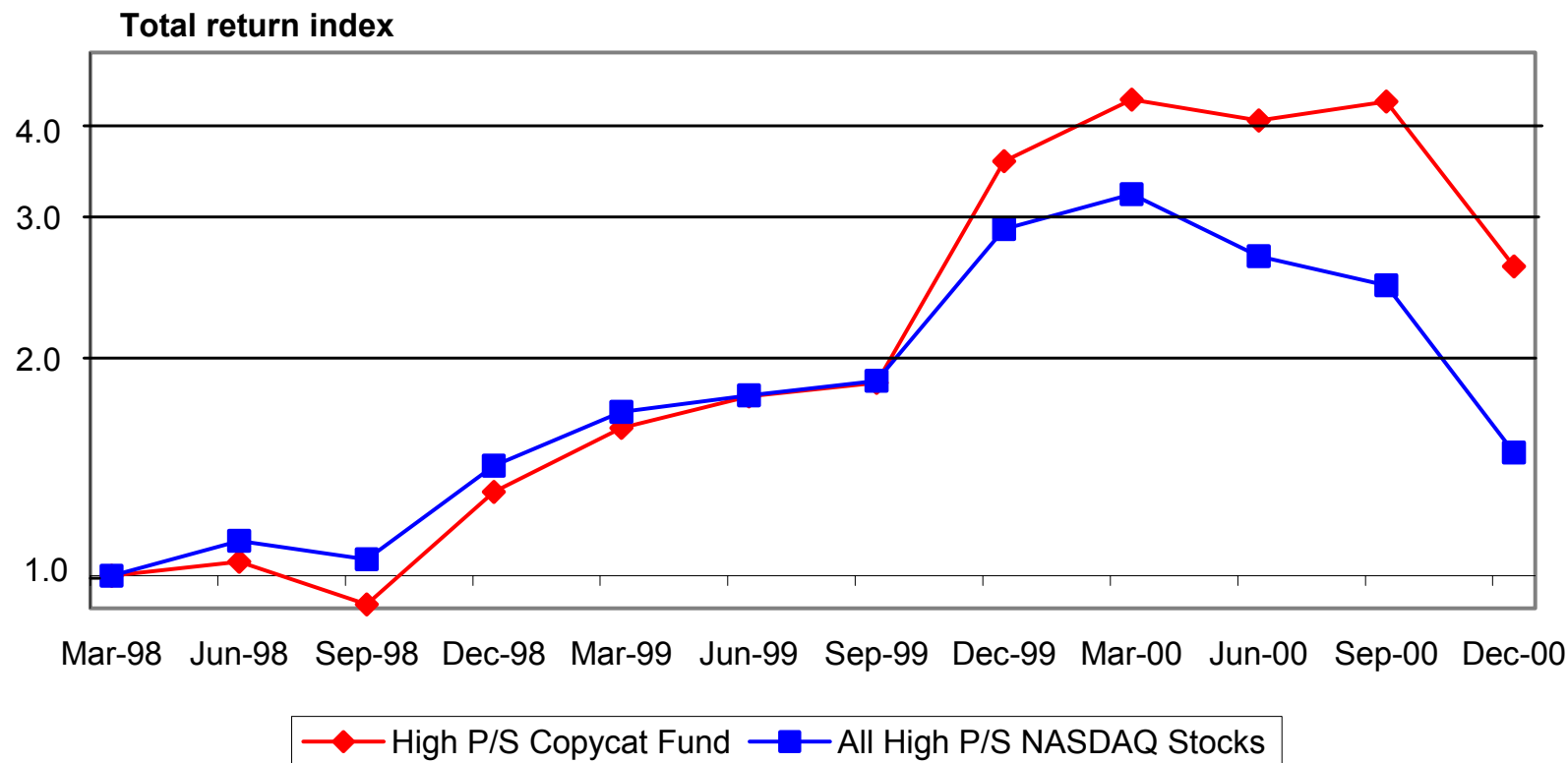


Figure 6: Performance of a copycat fund that replicates hedge fund holdings in the NASDAQ high P/S segment

Table IV
Characteristics-Adjusted Performance of Hedge Fund Portfolio

Market Segment	Quarters after 13F	Number of Stocks		Value in \$bn.		Quarterly Abnormal Returns Copycat Portfolio	
		Total	Copycat	Total	Copycat	Mean	<i>t</i> -statistic
		High P/S NASDAQ stocks (Technology Segment)	+1	720	320	2071	8.0
	+2					2.71	(2.02)
	+3					0.39	(0.22)
	+4					1.01	(0.77)
Other NASDAQ stocks	+1	3163	472	1236	4.1	0.55	(0.58)
	+2					0.36	(0.30)
	+3					-1.64	(-1.12)
	+4					-0.89	(-0.55)
NYSE/AMEX stocks	+1	2118	885	9891	25.0	0.24	(0.31)
	+2					0.25	(0.31)
	+3					0.32	(0.30)
	+4					-0.48	(-0.45)

Conclusions

- Hedge Funds were riding the bubble
- Short-sales constraints and “arbitrage” risks are not sufficient to explain this behavior

- Timing bets of hedge funds were well placed. Outperformance.
- Suggests predictable investor sentiment. Riding the bubble for a while may have been a rational strategy

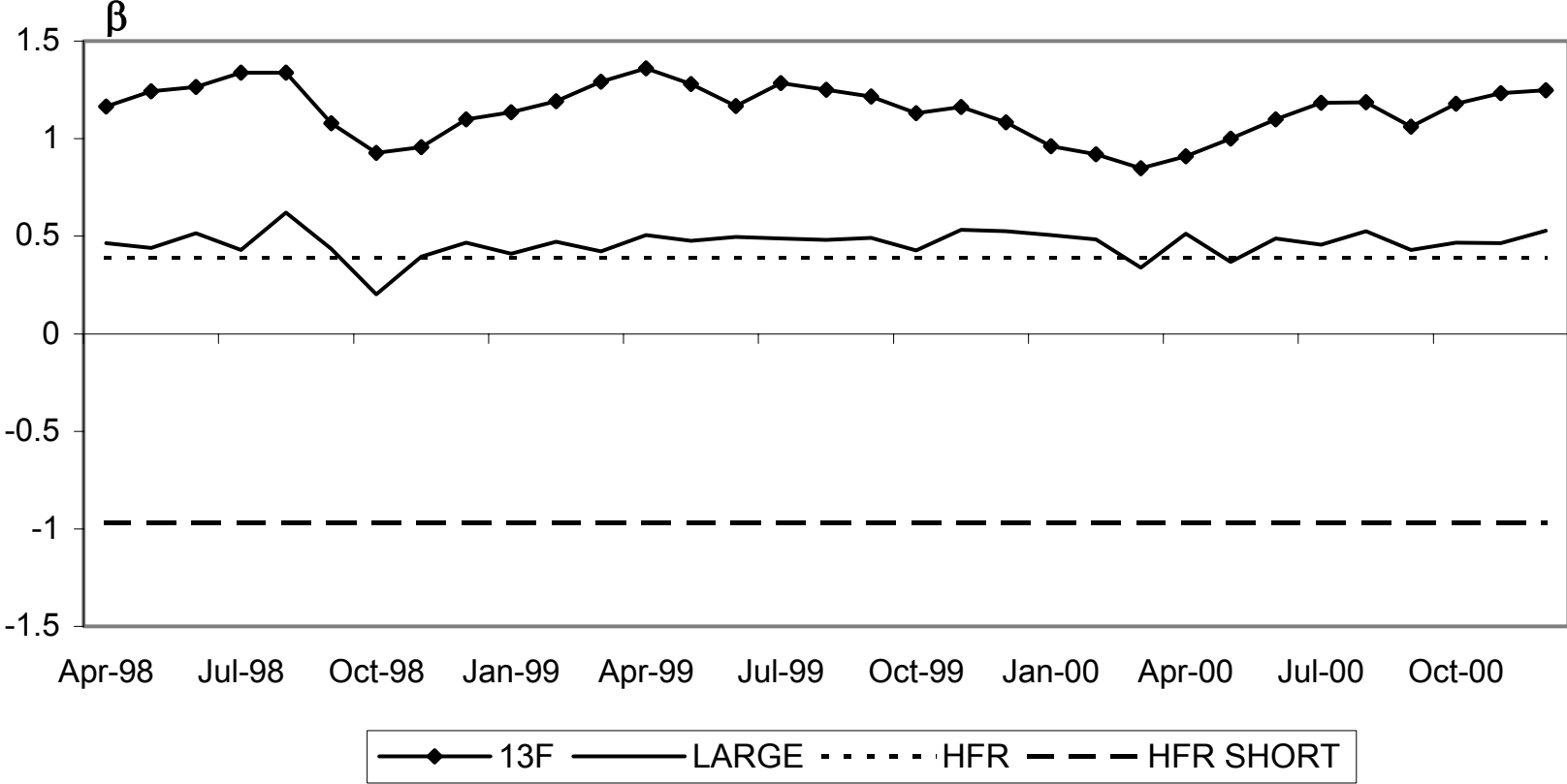
⇒ **Supports ‘bubble-timing’ models**

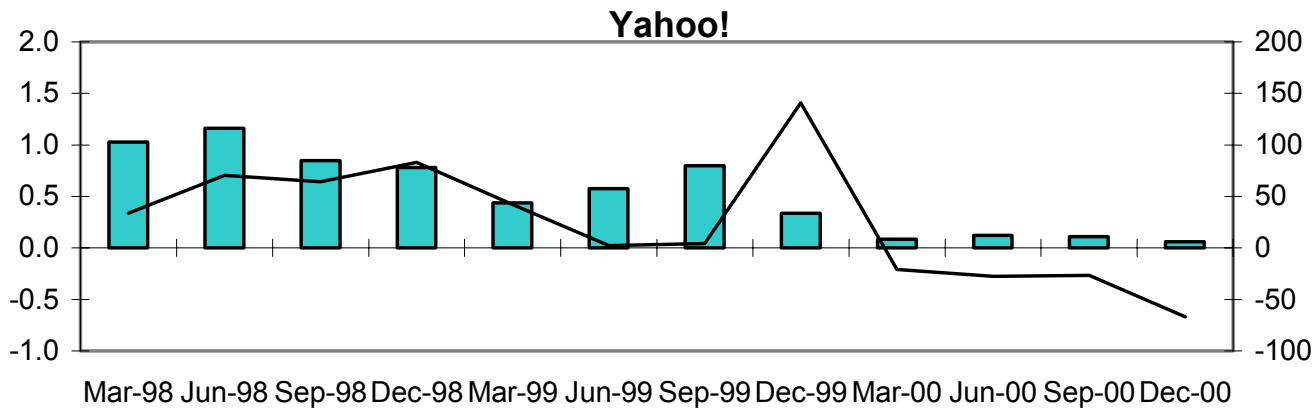
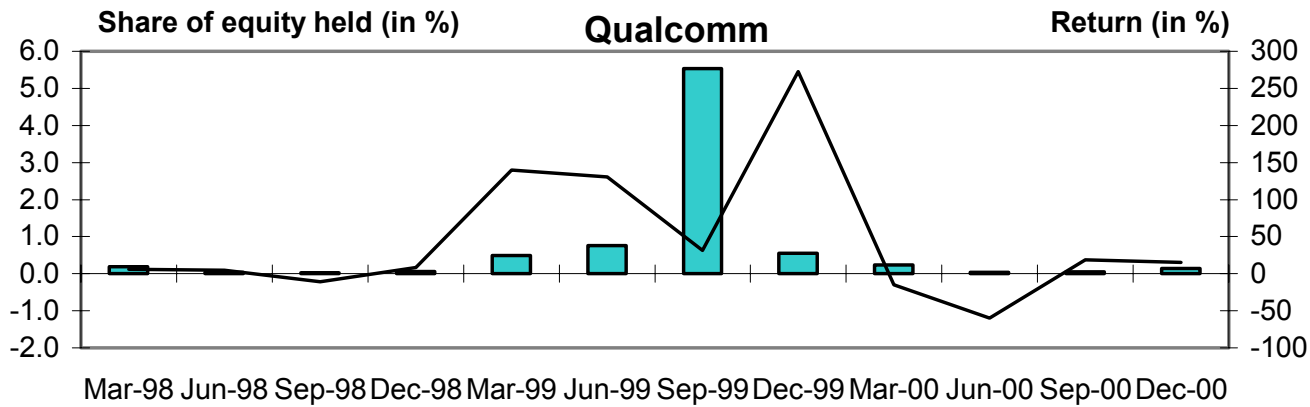
⇒ **Presence of sophisticated investors need not help to contain bubbles in the short-run**

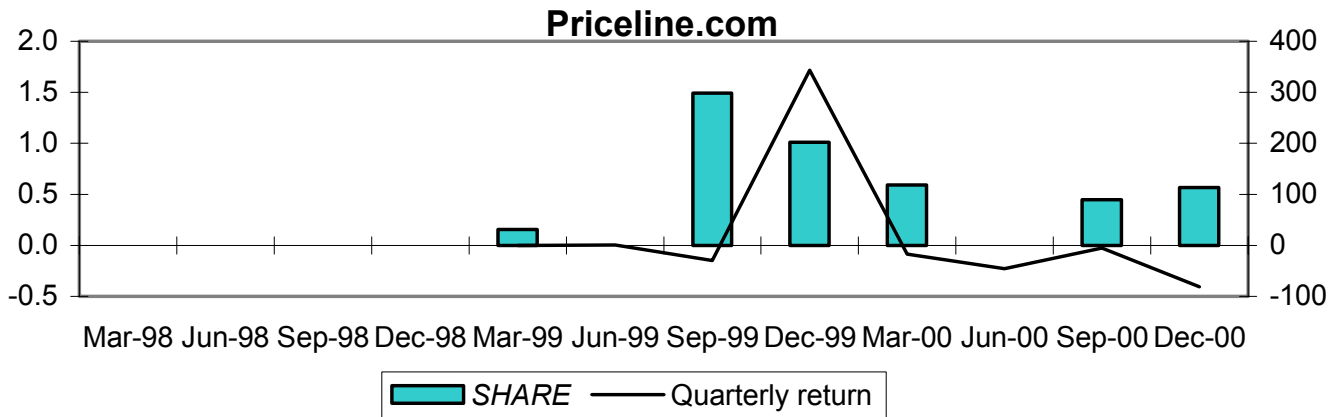
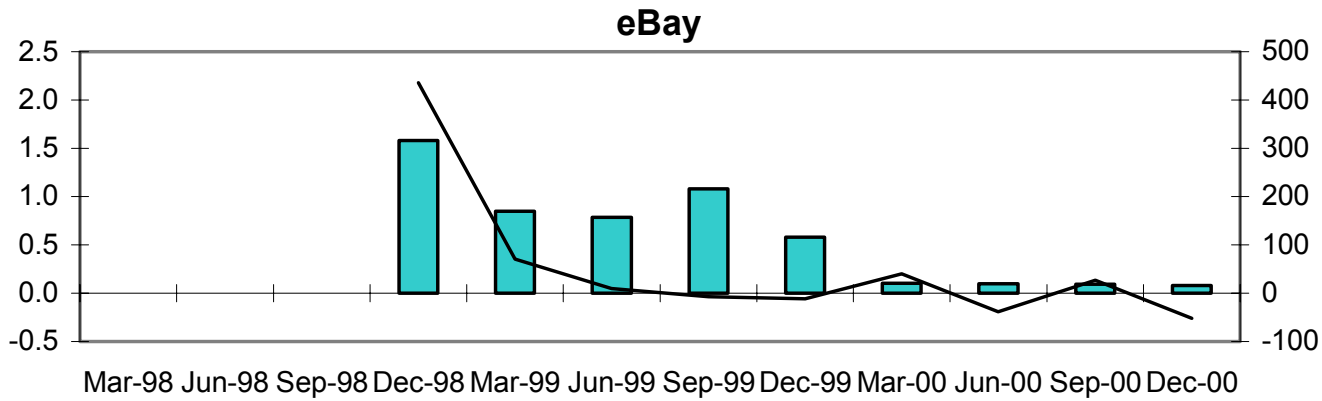
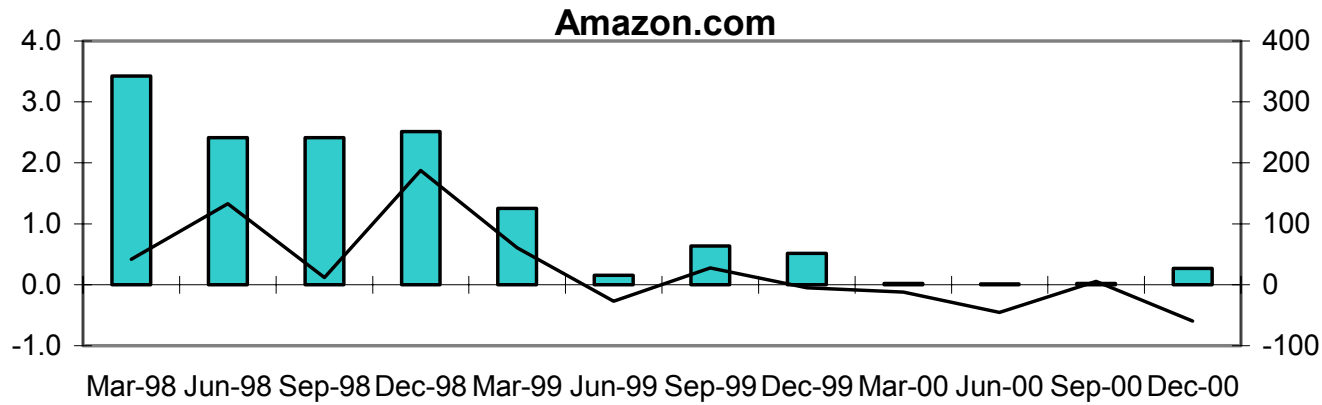
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Time-Variation in Factor Exposure

Figure 3b: Market exposure



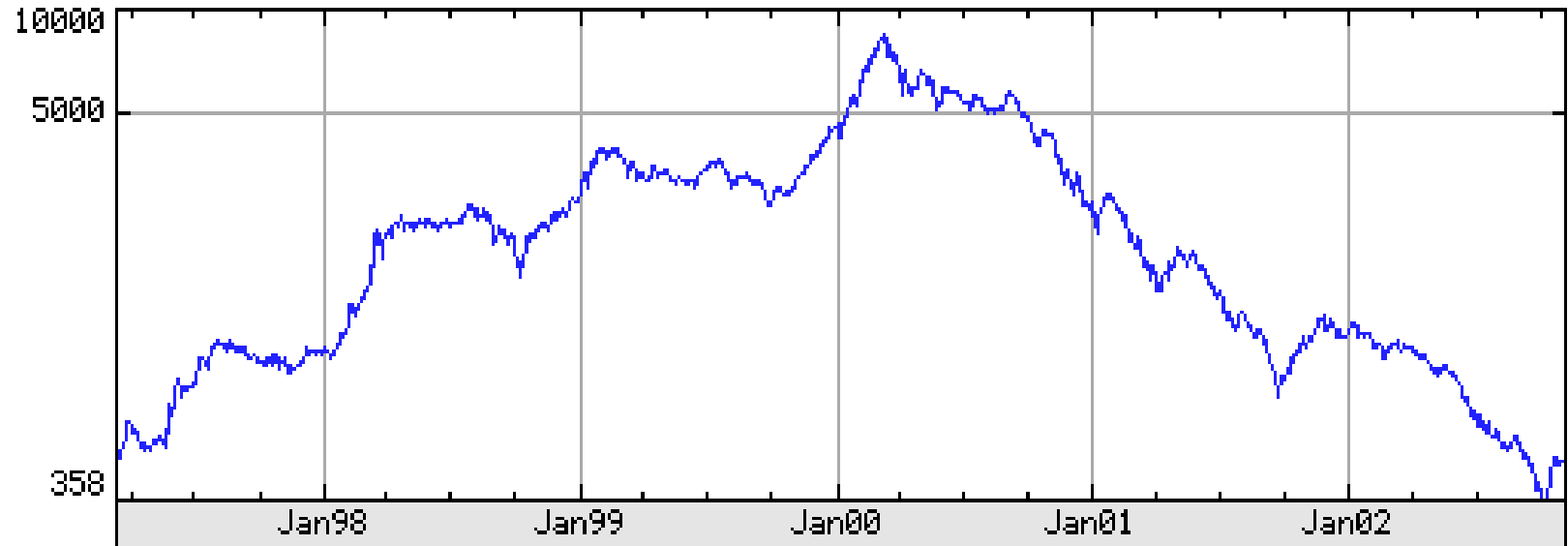




The 'Technology Bubble'

Germany: NEMAX AllShare (Neuer Markt)

NEMAX ALL SHR PF
as of 1-Nov-2002



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- **Down about 95% since its peak.**

