University of Zurich
Institute for Empirical Research in Economics

FINRISK
National Centre of Competence in Research
Financial Valuation and Risk Management

Behavioral Finance and Asset Management

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Asset Management

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Contents

Contents

Traditional Finance and Asset Management

- The Rational Investor
- Random Walk
- Econometric Evidence

The Rational Investor

- Has no emotions
- Always look ahead
- Has perfect foresight
- Reacts correctly to news

→ Anticipation Principle:

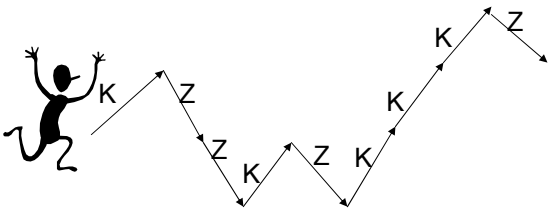
"**Every trend is already anticipated in current prices.**

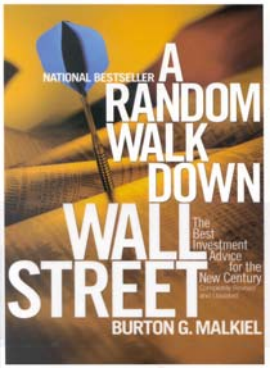
Prices fluctuate according to news. News are unpredictable.

Prices are unpredictable."

Random Walk

Asset Prices fluctuate like repeatedly tossing a fair coin.



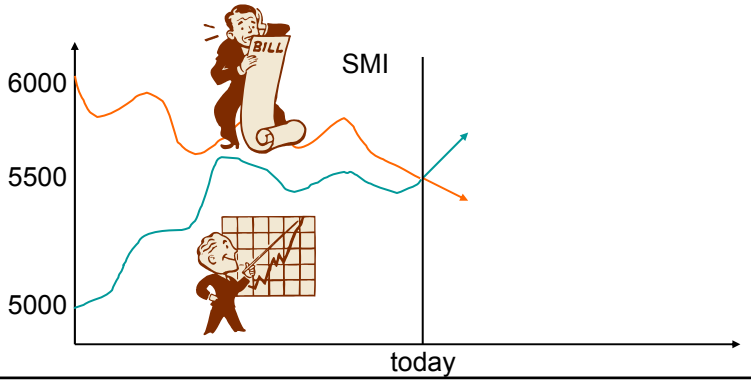


The best asset management is a passive buy&hold strategy.

Do Prices really have no memory?

Is the trajectory along which we reached a certain price really **irrelevant**?

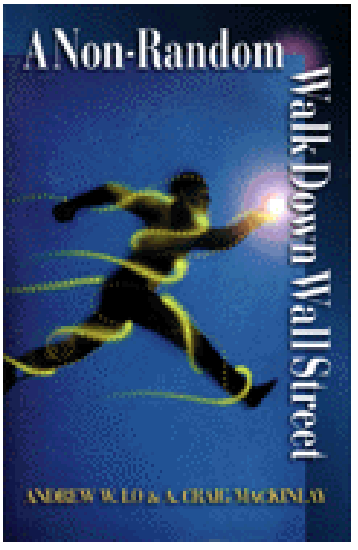
Do **emotions** matter for asset prices?



Econometric Evidence

Lo & MacKinley (1999):

- Momentum & Reversal
- Over- & Underreaction



Contents

Behavioral Finance and Asset Management

- The Behavioral Investor and Predictability
- Econometric Methods

The Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel 2002

"for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty"

Daniel Kahneman

1/2 of the prize

"for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms"

Vernon L. Smith

1/2 of the prize

The Four Steps to Success

- Psychological Phenomena
- Laboratory Experiments
- Empirical Evidence
- Trading Strategy

Examples

1. Mental Accounting, Loss Aversion and Equity Premium
2. Representativeness Bias, Gambler`s Fallacy and Momentum&Reversal
3. Anchoring, Underreaction and Post-Earnings Announcement Drift
4. Favorite-Long-Shot Bias and Skew trading

Example 1: Mental Accounting and Loss Aversion

First choose between:

(A) A sure gain of CHF 2400 or

(B) a 25% chance of a CHF 10.000 gain and a 75% chance of winning nothing at all.

Then choose between:

(C) a sure loss of CHF 7500 or

(D) a 75% chance of a CHF 10.000 loss and a 25% chance of losing nothing at all.

Your payoff is the combination of the two lotteries you have chosen!

What is your decision?

Mental Accounting and Loss Aversion

Typical Choice:

(A) Because the extra CHF 100 is not worth to take the risk of not getting anything.

(D) Because it avoids the sure loss and gives the chance of not loosing anything.

Mental Accounting and Loss Aversion

Typical Choice:

(A) Because the extra CHF 100 is not worth to take the risk of not getting anything.

(D) Because it avoids the sure loss and gives the chance of not loosing anything.

Combined Payoff:

(A) and (D) (75%; -7600, 25%; 2400)

(B) and (C) (75%; -7500, 25%; 2500) .

Hence the combination (A) and (D) leaves CHF 100 on the table!

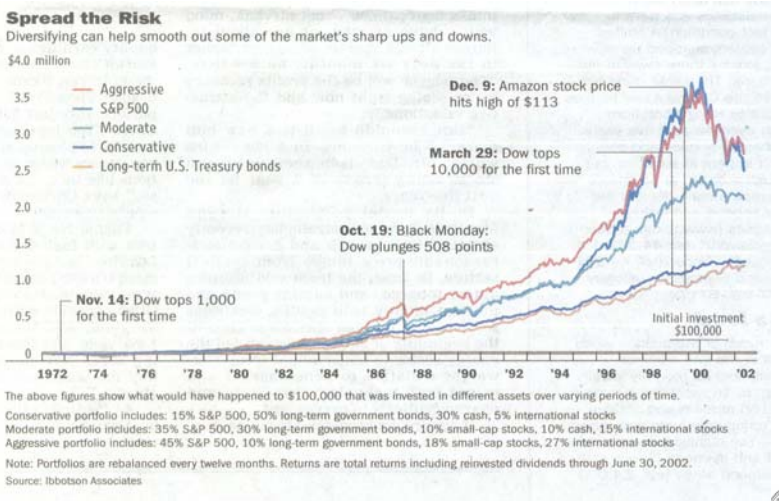
Mental Accounting, Loss Aversion and Stocks

A Loss of 10.000 needs to be compensated by a gain of at least 22.500:

"Compare two investors, Nick who calculates the gains and losses in his portfolio every day, and Dick who only looks at his portfolio once per decade. Since, on a daily basis, stocks go down in value almost as often as they go up, Nick's loss aversion will make stocks appear very unattractive to him. In contrast, loss aversion will not have much effect on Dick's perception of stocks since at ten year horizons stocks offer only a small risk of losing money."

Benartzi and Thaler (1995) "Myopic Loss Aversion", Journal of Political Economy.

Equity Premium Puzzle



Example 2:

- Representativeness Bias
- Gambler`s Fallacy
- Momentum and Reversal

Representativeness Bias (1)

Test

A fund manager is known to beat the market in 2 of 3 years.

Which of the following protocols is most likely?

a) BLBBB *b) LBLBBB* *c) LBBBBB*

Representativeness Bias (2)

Typical answer: *b)* *LBLBBB*

Explanation: Frequencies in are most representative for 2/3.

Representativeness Bias (3)

Typical answer: *b)* *LBLBBB*

Correct answer: *a)* *BLBBB*

Explanation: Frequencies in are most representative for 2/3.

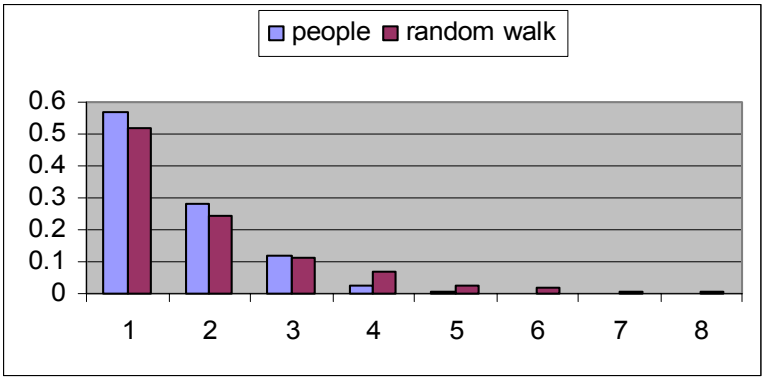
But b) is the protocol a) and the condition that L comes before.

Gambler`s Fallacy (Runs of a RW)

Suppose you throw a fair coin 100 times

- How often does ist change sides immediately?
- How often does ist change sides after a run of order 2?
- How often does ist change sides after a run of order 3?
- How often does ist change sides after a run of order 4?
- How often does ist change sides after a run of order 5?
- How often does ist change sides after a run of order 6?

Frequency of Runs of the Coin Tossing Experiment



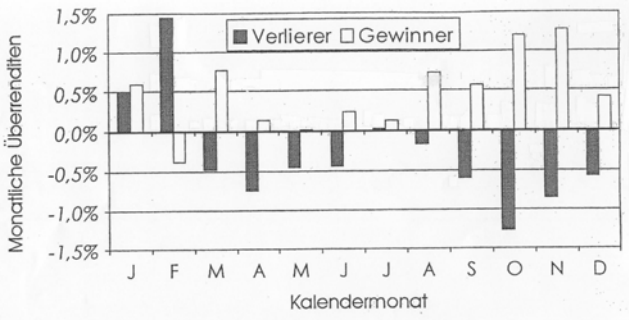
People underestimate the frequency of long runs of a random walk

Short-Run Momentum: The Trend is Your Friend

Formation Period: 3-12 Months

Holding Period: 3-12 Months

Strategy: Buy Winner, (Short)-Sell Losers



Basierend auf einer Momentumstrategie für den deutschen Aktienmarkt im Zeitraum 1973 bis 1997. Vgl. August, Schlereck und Weber (1999).

Long-Run Reversal (1): Value Investment Pays

Autoren	Untersuchte Länder	Zeitraum	Ergebnis
Lakonishok, Shleifer und Vishny (1994)	USA	4/1963 bis 4/1990	Renditedifferenz zwischen Value- und Growth-Aktien von 3,9 % p.a.
Fama und French (1992)	USA	6/1963 bis 12/1990	Renditedifferenz zwischen Value- und Growth-Aktien von 8,16 % p.a.
Chan, Hamao und Lakonishok (1991)	Japan	1/1971 bis 12/1988	Renditedifferenz zwischen Value-und Growth-Aktien von 4,92 % p.a.
Brouwer, van der Put und Veld (1996)	Deutschland, Frankreich, Niederlande, Großbritannien	6/1982 bis 6/1993	Renditedifferenz zwischen Value- und Growth-Aktien von 5 % p.a.
Wallmeier (2000)	Deutschland	1967 bis 1994	Renditedifferenz zwischen Value- und Growth-Aktien von 7,24 % p.a.

Tabelle 1: Identifikation von Value-Aktien anhand des Kurs-Gewinn-Verhältnisses

Long-Run Reversal (2): Value Investment Pays

Autoren	Untersuchte Länder	Zeitraum	Ergebnis
Lakonishok, Shleifer und Vishny (1994)	USA	4/1963 bis 4/1990	Renditedifferenz zwischen Value- und Growth-Aktien von 9,9 % p.a.
Hawawini und Keim (1995)	USA	4/1962 bis 12/1989	Renditedifferenz zwischen Value- und Growth-Aktien von 10,68 % p.a.
Chan, Hamao und Lakonishok (1991)	Japan	1/1971 bis 12/1988	Renditedifferenz zwischen Value- und Growth-Aktien von 9,48 % p.a.
Brouwer, van der Put und Veld (1996)	Deutschland, Frankreich, Niederlande, Großbritannien	6/1982 bis 6/1993	Renditedifferenz zwischen Value- und Growth-Aktien von 20,8 % p.a.
Wallmeier (2000)	Deutschland	1967 bis 1994	Renditedifferenz zwischen Value- und Growth-Aktien von 7,22 %
Keppler (1991b)	Weltweit	1/1979 bis 12/1989	Das Value-Portfolio schlägt den Index um 3,65 % p.a. und das Growth-Portfolio um 14,8 % p.a.

Tabelle 2: Identifikation von Value-Aktien anhand des Kurs-Cashflow-Verhältnisses

LSV-US Equity: Combining Momentum&Reversal

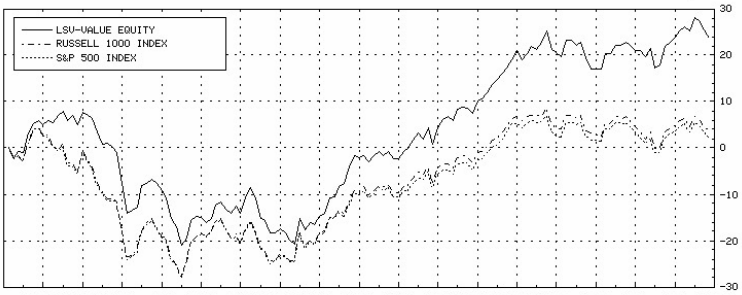
<HELP> for explanation. N184 Equity COMP
Hit 1<GO> for Options. Hit <Page> for table.

COMPARATIVE RETURNS Page 1/11

Range 2/ 1/02 - 10/22/04 Period W Weekly 142 Wk. Period

	Securities	Crncy	Prc Appr	Total Ret	Difference	Annual Eq
1	LSVEX US Equity	USD	19.59 %	23.73 %	19.94 %	8.13 %
2	RIY Index	USD	-.99 %	3.79 %		1.38 %
3	SPX Index	USD	-2.36 %	2.31 %	-1.48 %	.84 %

(* = No dividends or coupons)



Example 3:

- Anchoring
- Underreaction
- Post-Earnings Announcement Drift

Anchoring

- Experiment
  - 100 urns with 1000 balls each
  - 45 of those have 700 black and 300 red balls
  - 55 of those have 300 black and 700 red balls

  - ***Question 1: Probability that a randomly selected urn has more black balls?***

Anchoring

- Then 12 balls are drawn (with returning) from the randomly selected urn
- Result of this drawing: 8 black and 4 red

- ***Question 2: Probability that the randomly selected urn has more black balls?***

Anchoring

- Then 12 balls are drawn (with returning) from the randomly selected urn
- Result of this drawing: 8 black and 4 red

- ***Question 2: Probability that the randomly selected urn has more black balls?***

- Typical Answers: 45% and 67%

  Underreaction to new information!

- Correct answer: 96.04%

Bayes‘ Formula

- We look for:

$$p(s/*)=\frac{p(s)\ p(*/s)}{p(s)p(*/s)+p(r)p(*/r)}$$

where $p(s)=45\%$ $p(r)=55\%$

Binomial distribution

$$p(*/s)=\binom{12}{8}(0.7)^8\ (0.3)^4$$

$$p(s/*)=\frac{1}{1+\dfrac{p(r)p(*/r)}{p(s)p(*/s)}}$$

$$p(r)p(*/r)=\frac{55}{45}\ \frac{\binom{12}{8}(0.3)^8(0.7)^4}{\binom{12}{8}(0.7)^8(0.3)^4}\ =\ \frac{11}{9}\left(\frac{0.3}{0.7}\right)^4=0.027$$

$$\approx\ \frac{1}{1.027}\ \approx\ 96.04\%$$

Unterreaktion auf Earnings Surprises

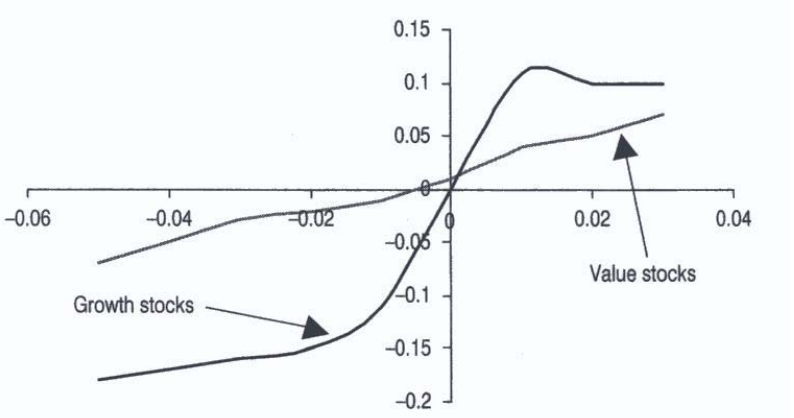


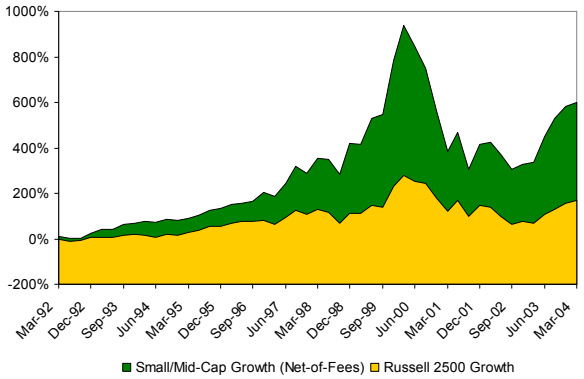
Figure 3.6 Earnings response functions

Source: Skinner and Sloan (1999).

Exploiting Unterreaction

Fuller and Thaler Asset Management (FTAM)

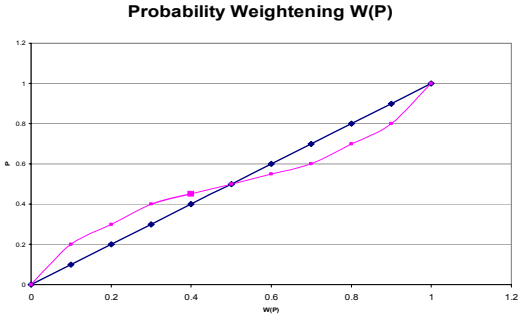
Buy stocks of companies with SUE because there will be the "post earnings announcement drift".



Example 4:

- Probability Weighting
- Favorite-Long-Shot Bias
- Skew trading

Probability Weighting



Possible but unlikely events get too much decision weight.

The Favorite Longshot-Bias (1)

Question:

Would you rather bet on a 2 to 5 shot and receive 40% profit if you win or on a 20 to 1 shot where you receive 2000% profit if you win?

Answer:

The public prefers the latter but the expected returns are much higher for the favorites.

The Favorite Longshort-Bias (2)

Question:

Would you rather bet on a 2 to 5 shot and receive 40% profit if you win or on a 20 to 1 shot where you receive 2000% profit if you win?

Answer:

The public prefers the latter but the expected returns are much higher for the favorites.

Expected Returns:

Favorite: $\frac{5}{7} \cdot 1.4 = 1$

Long-Shot: $\frac{1}{21} \cdot 20 = \frac{20}{21} < 1$

Favorite Long-Short Bias on Options

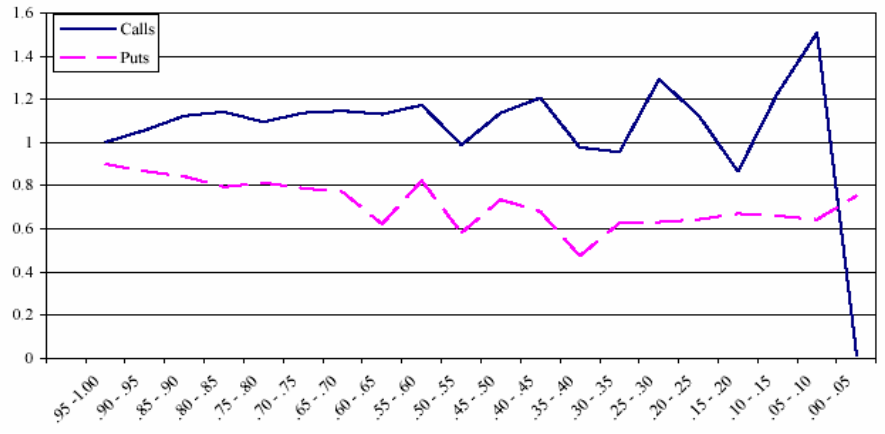
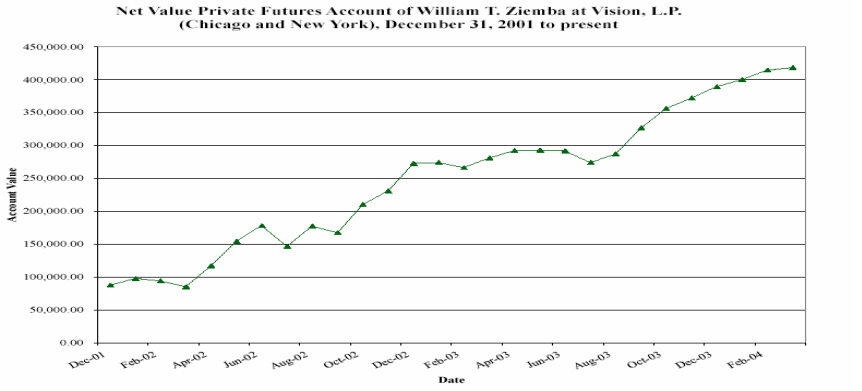


Figure 3.2: Expected return per $1 bet versus odds levels: 3-month calls and puts on S&P500 Futures, March 1985 to September 2002, Source: Hodges, Tompkins and Ziemba, 2002

Expected Return from Skew Trading

Sell overpriced puts hedge them with short futures and use the proceeds of the put sale to buy calls.



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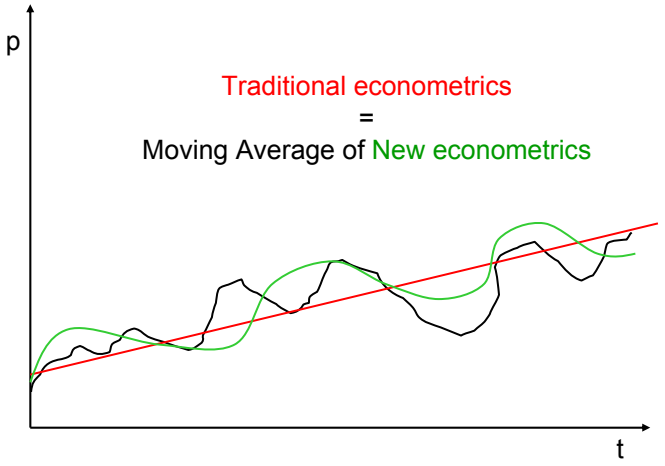
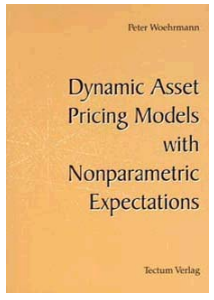
  - The Rational Investor and Random Walk
  - Econometric Evidence
- Behavioral Finance and Asset Management
  - The Behavioral Investor and Predictability
  - New Econometric Methods
- Conclusion

New Econometric Methods (1)

The most important key to success





New Econometric Methods (2)

hedge.funds WORLD
Africa 2002

TECHNOLOGICAL DEVELOPMENTS

16:45 **In-house solutions for quantitative hedge fund tools**

- Behavioural finance and prices
- Statistical models for m
- Evaluating third party to
- State of the art third party tools
- Reviewing in house developments
- Case studies: Recipes for developing in-house solutions

Peter Woehrmann
Partner
Quantrade AG

Panel session:
Why transparency and risk management for hedg products?
- The type of risk in fund of funds and structured pr
- An integrated view on the investment and risk ma process

8 – 10 October 2002, Sandton Convention Centre, Johannesburg, South Africa

hedge.funds WORLD
Germany 2003

11:45 **Managing risk and monitoring performance in the new generation of German hedge fund products**
- Essential information within the due diligence process
- Essential information and risk/return expectations
- Risk control through diversification

- Transparency and active risk management: daily analysis and control
- Risk analysis: outsourcing or internal development?

Panellists:
Dr Lars Jaeger
Partner, Quantitative Analysis and Risk Management
Partners Group

Peter Grünblatt
Head of Alternative Investments
Bank Leu

Manfred Kastner
Managing Director
Absolute Plus.com

Dr Peter Wohrmann
Partner
Quantrade AG

New Econometric Methods (3)

Measuring predictive ability avoiding data mining issues

Lemma. *Expectation of volume V of maximal sphere B_i around data point $\mathbf{x}_i$ and local densities $p(x_i)$ are related inversely by*

$$\mathsf{E}(V_i) \approx \frac{1}{(n-1)p(x_i)}.$$

Proof. Let us therefore denote by B_a the d-dimensional sphere with radius a

Using notation as introduced above the probability for the volume V_m of the maximal sphere around the origin to be larger than a given V_a can be computed as

$$\begin{aligned} \mathsf{P}(V_m > V_a) &= \mathsf{P}(\mathbf{x}_i \notin \mathsf{B}_a, \forall i) \\ &= (1 - \mathsf{P}(\mathbf{x}_i \in \mathsf{B}_a))^n \\ &= \left(1 - \int_0^{V_a} p_{\mathsf{B}|}(\tilde{V})d\tilde{V}\right)^n \\ &\approx e^{-n\int_0^{V_a} p_{\mathsf{B}|}(\tilde{V})d\tilde{V}}. \end{aligned}$$

We get a density function for the volumina from the differential quotient

$$\begin{aligned} p_{\mathsf{B}|}(V_a) &= \lim_{\epsilon\to 0}\frac{\mathsf{P}(V > V_a) - \mathsf{P}(V > V_{a+\epsilon})}{\epsilon} \\ &\approx -\frac{d}{dV}(e^{-n\int_0^V p_{\mathsf{B}|}(\tilde{V})d\tilde{V}}) \\ &= n\frac{d}{dV}\int_0^V p_{\mathsf{B}|}(\tilde{V})d\tilde{V}e^{-n\int_0^V p_{\mathsf{B}|}(\tilde{V})d\tilde{V}}. \end{aligned}$$

Expectation of the volume is computed as

$$\mathsf{E}(V) \approx \int_0^\infty \tilde{V}n\frac{d}{dV}\int_0^V p_{\mathsf{B}|}(\tilde{V})d\tilde{V}e^{-n\int_0^V p_{\mathsf{B}|}(\tilde{V})d\tilde{V}}d\tilde{V} = \frac{1}{np(0)},$$

because at zero the local densities $p(0)$ and $p_{\mathsf{B}|}(0)$ are equal. To estimate the local density $p(\mathbf{x}_i)$ for an arbitrary point $\mathbf{x}_i$ we substitute $p_{\mathbf{x}_i-\kappa\beta}(0)$ for

Theorem 3. *The mutual information $\mathcal{I} : \mathbf{R}\times\mathbf{R} \to \mathbf{R}$ of two random variables $X \in \mathbf{R}$ and $Y \in \mathbf{R}$,*

$$\mathcal{I}(X,Y) = -\int_{\mathbf{R}\times\mathbf{R}} p_{XY}(x,y)\ln\frac{p_{XY}(x,y)}{p_X(x)p_Y(y)}dxdy,$$

is estimated, based on realizations $\mathbf{x}_i, y_i, \quad i = 1, 2, \ldots, n$, by

$$\hat{\mathcal{I}}_{MSI}(X,Y) = n^{-1}\sum_{i=1}^{n}\ln\frac{V_{x_i}V_{y_i}}{V_{x_i y_i}} - \ln n - c_1$$

with bias $\mathsf{E}[\mathcal{I}(X) - \hat{\mathcal{I}}_{MSI}(X)] = 0$ and variance (if X and Y are independent) $\mathsf{E}[\mathcal{I}(X) - \mathsf{E}[\hat{\mathcal{I}}_{MSI}(X)]]^2 = n^{-1}(c_2 - c_1^2)^2$, where $c_1 = \int_0^\infty \ln\xi e^{-\xi}d\xi \approx -.57721$ and $c_2 = \int_0^\infty (\ln\xi)^2 e^{-\xi}d\xi \approx 1.97811$. Employing the law of large numbers we obtain the following test statistic for independence of X and Y,

$$\hat{\mathcal{I}}_{MSI}(X,Y) = .5\sqrt{n}(c_2 - c_1^2)^{-1}\hat{\mathcal{I}}_{MSI}(X,Y) \xrightarrow{d} N(0,1),$$

Table 1: *Empirical distribution of $\hat{\mathcal{I}}_{MSI}$ versus $N(0,1)$.*

θ	$\mathrm{Prob}(\mathcal{I} > \theta)$	$\mathrm{Prob}(X^{normal} > \theta)$
2.576	.012	.01
1.960	.053	.05
1.645	.131	.10

New Econometric Methods (4)

Variables: Holding period return R_{t+1} Information period returns $R(t) = R_t, R_{t-1}, \ldots$

Regimes: $\Omega(t)$ Momentum and reversal parameters $\theta(\cdot)$

Statistical model: $R_{t+1}^{expected} = \Psi(R(t); \theta(\Omega(t)))$ reading in the linear case:

$\Omega(\cdot) = \theta_0 + \theta_1 R_t + \theta_2 R_{t-1} + \ldots$ where $\theta_i > 0 \quad (< 0)$ indicates momentum (reversal) with respect to information period i. Parameters θ are estimated based on rigorous statistical tests instead of data mining.

Investment procedure: On each time step, let the statistical model decide based on recent historical data, whether, there is significant momentum or reversal in an asset. Then, carry out the respective trade signal.

New Econometric Methods (5): Case Study

Task

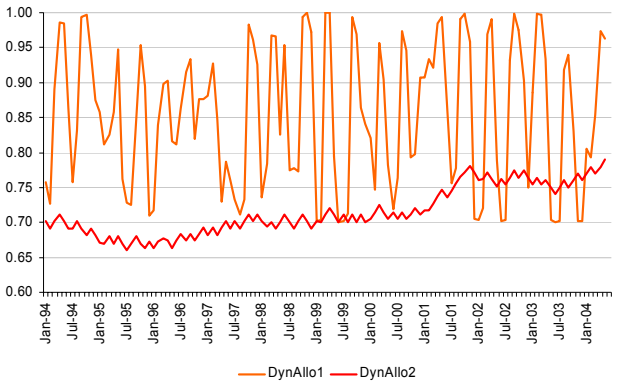
Improving the asset allocation performance of a pension fund by exploiting predictability of the relative performance of bonds and stocks

→ ***Switching model between bonds and stocks***

Assets

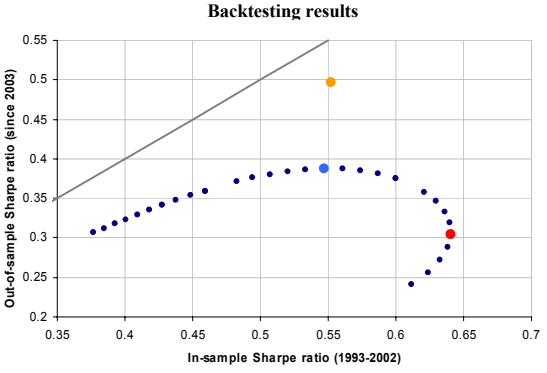
1) Bonds (Govies and corporate),
2) Real estate (Switzerland),
3) Stocks (Switzerland, EUroland, US, and Japan)

New Econometric Methods (6): Case Study



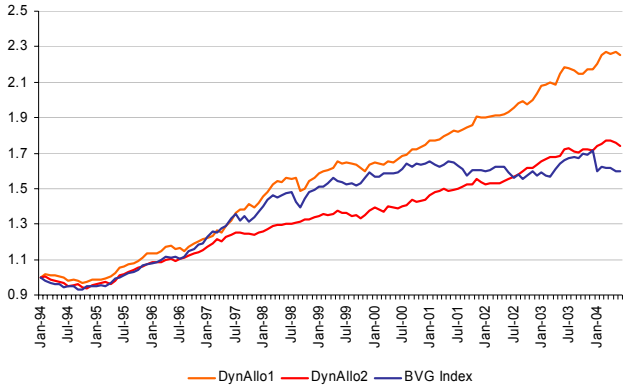
Weight of Interest rate related assets of two switching strategies

New Econometric Methods (7): Case Study



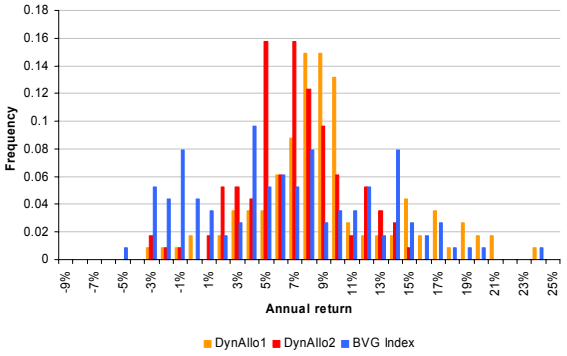
Dark blue: Feasible portfolio allocations, ligh blue: optimal mean-variance portfolio without prediction, red: portfolio chosen by recent methodology, orange: portfolio chosen by dynamic model with monthly prediction.

New Econometric Methods (8): Case Study



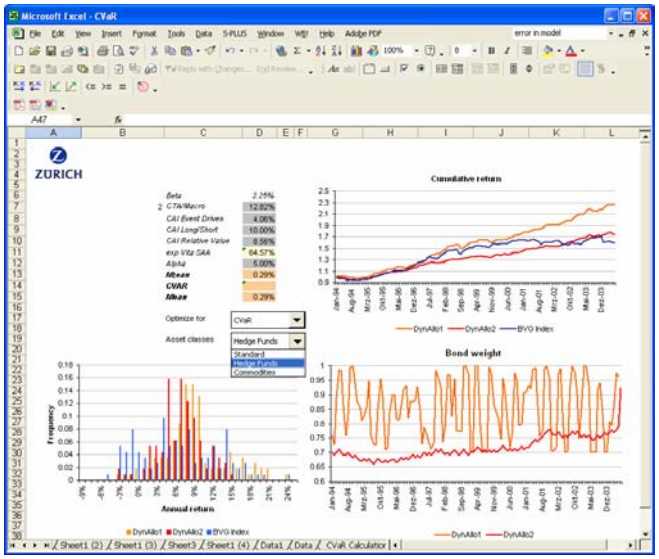
Cumulative returns

New Econometric Methods (9): Case Study



Relative frequencies of annual returns

New Econometric Methods (10): Case Study



Conclusion

- Traditional Finance suggests a passive asset management
- Behavioral Finance points at robust anomalies
- New Econometric Methods help to exploit predictability in Active asset management

www.behavioralfinance.ch