



The Rational Part of Momentum

James H. Scott

Jorge A. Murillo

General Motors Asset Management

Heilbrunn Center for Graham and Dodd Investing,

Columbia Business School



Major Point

- Stock Returns
 - Track current changes in fundamental value
 - Predict changes in fundamental value up to a year in advance

- That's why there's a Momentum Effect



Outline

- The Null Hypothesis
- A Rational Argument for Momentum
- Our Measure of Fundamental Value and its Relation to Stock Returns
- Time Paths of Fundamental Value and Momentum
- Concluding remarks



The Null Hypothesis: Market Efficiency

- E.g., Fama, JF, 1970; JF, 1991.
“At any time prices fully reflect all available information.”

- Implications:
 - Prices should track economic fundamentals
 - Returns in different periods should be uncorrelated
 - There should be no Momentum Effect



The Alternative: A Rational Model with Momentum

- Two types of investors
 - The first investigates companies, gains valuable insights, and trades accordingly
 - The second only trades on widely available information

- Momentum occurs because the trades of the first group move prices (in the right direction) before the information is widely available



Noisy Rational Expectations

- “On the Impossibility of Informationally Efficient Markets”
Grossman and Stiglitz, AER, 1980
 - Information is costly
 - Period 1: Some investors collect information and trade on it
 - Period 2: The information is revealed and uninformed investors trade
 - The uninformed understand that Period 1 prices partially reflect the expectations of informed investors, but randomness and risk aversion limits their trades
 - As a result, Period 1 returns convey information about
 - The information released in Period 2
 - Period 2 returns

- “Efficient Capital Markets: II,” Fama, JF, 1991
 - “Since there are surely positive information and trading costs, the extreme version of the market efficiency hypothesis is surely false”



Empirical Strategy

- Rank six month US stock returns (1985-2006)
 - CRSP and IBES data
 - An average of 1,977 firms per month
- Group the ranked returns into deciles
- Observe how the deciles behave in
 - 2 six month periods before the ranking period
 - 3 six month periods thereafter
- Roll the process forward a month and repeat



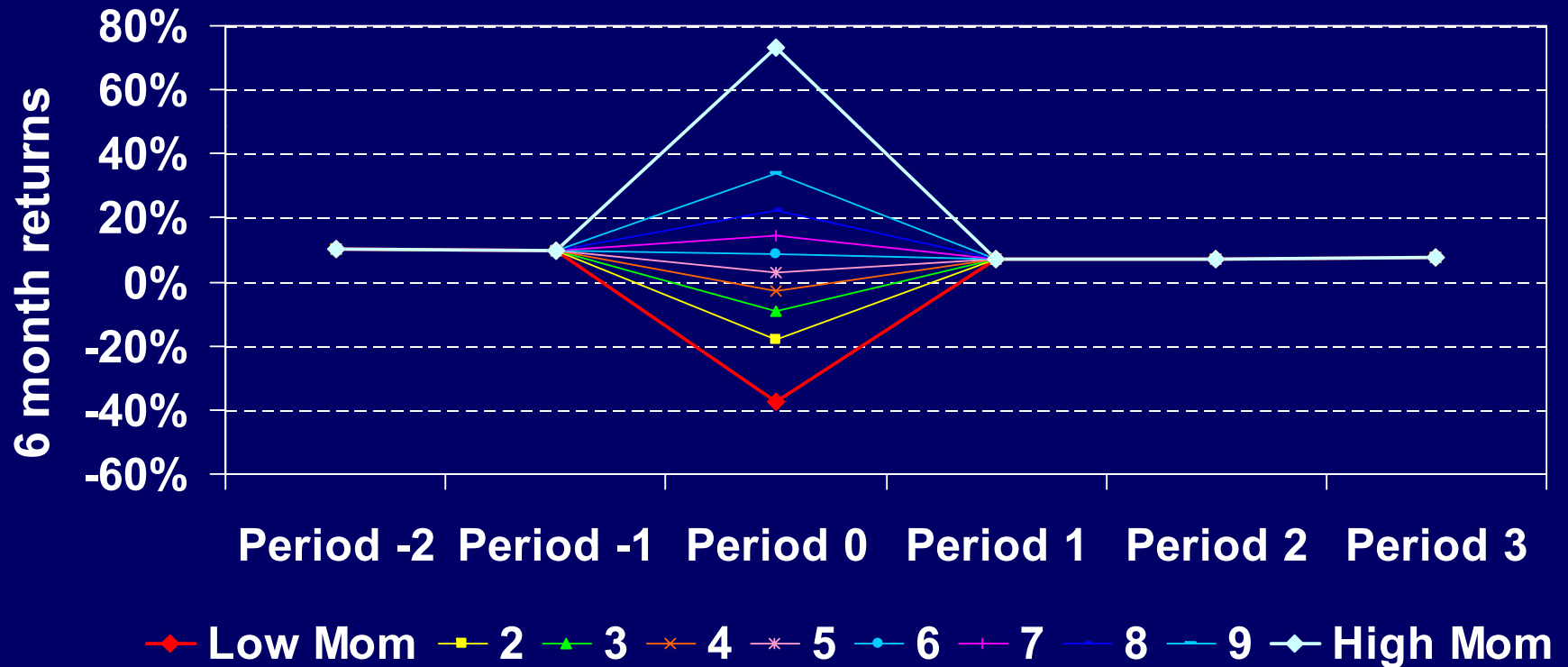
Market Efficiency Predicts

- In the ranking period (Period 0)
 - Returns differ because prices reflect changing stock fundamentals

- In the periods before and after the ranking period (Periods -2, -1, 1, 2, 3)
 - Within each non-ranking period, each decile is a random group of stocks
 - Decile returns should be equal



Hypothetical Momentum Deciles if the Market were Efficient





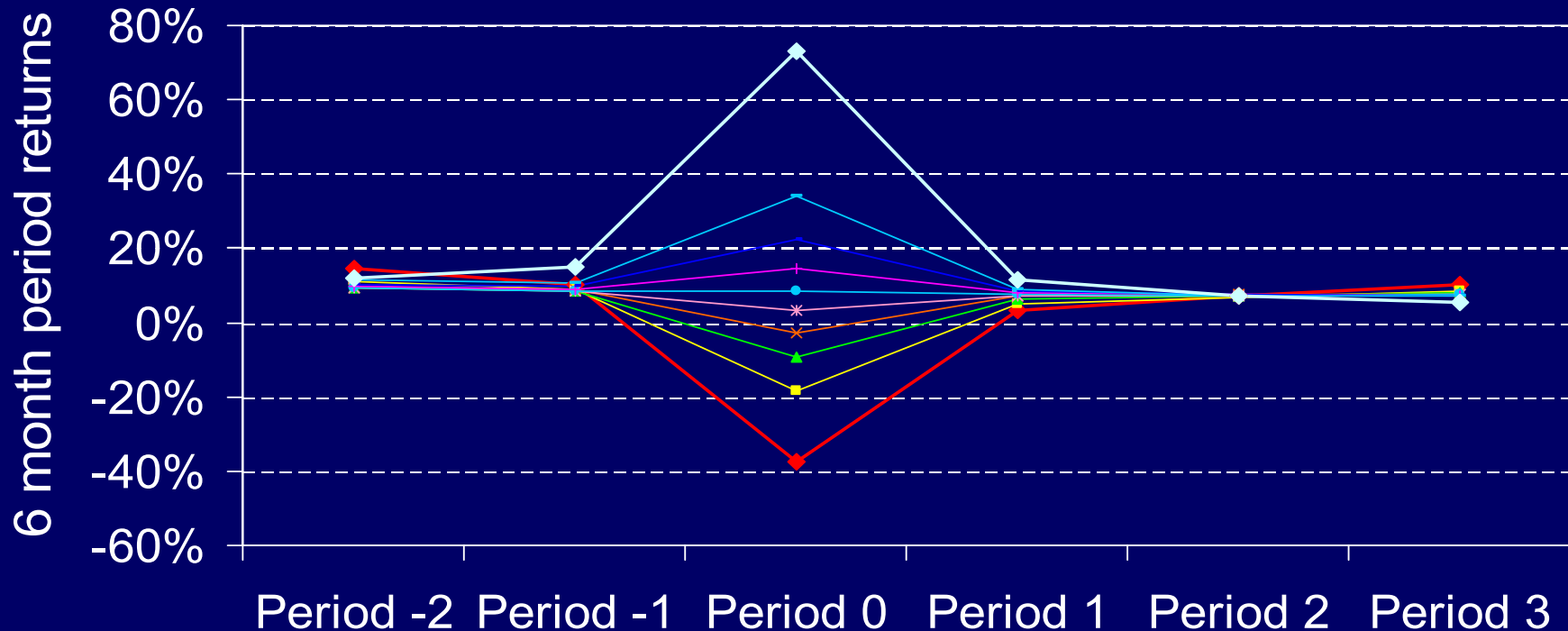
Noisy Rational Expectations Predicts

Returns Should Reflect:

- Current fundamentals (as in market efficiency) and
- The expectations of informed investors about future changes in company fundamentals



Momentum Deciles (1985 – 2006)



	Period -2	Period -1	Period 0	Period 1	Period 2	Period 3
Low Mom	15%	10%	-37%	3%	7%	10%
High Mom	12%	15%	73%	11%	7%	6%
High – Low	-3%	5%**	110%**	8%**	0%	-5%**





Momentum Regressions with Individual Stocks

- Average of monthly cross-sectional regression coefficients
- Current 6 month return as a function of lagged returns
- $R_{i,t} = \alpha + \beta_1 * R_{i,t-1} + \beta_2 * R_{i,t-2} + \beta_3 * R_{i,t-3} + \varepsilon_{i,t}$

Months	α	β_1	β_2	β_3	R ²	Avg # Obs
251	.065**	.069**			.014	1956
245	.070**		.005		.011	1764
239	.074**			-.037**	.009	1615
245	.064**	.062**	.004		.023	1763
239	.074**		.006	-.036**	.019	1605

* Significant at 95% ** Significant at 99%





A Simple Measure of Fundamental Value

- Many models of capital market equilibrium imply that rational investors use present value formulas
- Many professional investors use present value formulas in their investment processes
- If the market is rational, then changes in present value of future cash flows should mirror returns



Dividend Discount Model

$$V_i = \sum_{t=1}^{\infty} \frac{D_{it}}{(1+r)^t}$$

$$V_i = \frac{\lambda E_{i1}}{1+r} + \frac{\lambda E_{i2}}{(1+r)^2} + \sum_{t=3}^{\infty} \frac{\lambda_{it} E_{it}}{(1+r)^t}$$

$$V_i = (1+\gamma) \left[\frac{\lambda E_{i1}}{1+r} + \frac{\lambda E_{i2}}{(1+r)^2} \right]$$



Estimating the Change in Fundamental Value R_v

- Cross-sectionally, we assume the change in a firm's fundamental value is proportional to R_v , where

$$R_{vt} = V_{it} / V_{it-1} - 1$$

- Fundamental Value $V_{it} = \lambda[E_{it+1}/(1+r) + E_{it+2}/(1+r)^2]$

- $E_{it+1} = w \cdot \text{FY1} + (1 - w) \cdot \text{FY2}$
- $E_{it+2} = w \cdot \text{FY2} + (1-w) \cdot \text{FY2} \cdot (1 + \text{LTG}),$

where $w =$ number of months left in the fiscal year divided by 12, and r is a risk-adjusted discount rate



Does R_v Predict Future Return?

$$R_{i,t} = .072 + .214R_{v,t-1}$$

(4.8) (2.52)

$$R^2 = .005$$

$n = 1956$

$$R_{i,t} = .065 + .067R_{i,t-1}$$

(4.4) (5.19)

$$R^2 = .014$$

$n = 1956$

$$R_{i,t} = .065 + .005R_{v,t-1} + .066R_{i,t-1}$$

(4.45) (0.97) (5.12)

$$R^2 = .017$$

$n = 1956$



Do Returns Track Concurrent R_v ?

$$R_{i,t} = .064 + .214R_{v,t} \quad R^2 = .107$$

(4.4) (16.9) $n = 1956$

$$R_{i,t} = .061 + .214R_{v,t} + .017R_{i,t-1} \quad R^2 = .117$$

(4.4) (16.9) (1.4) $n = 1956$

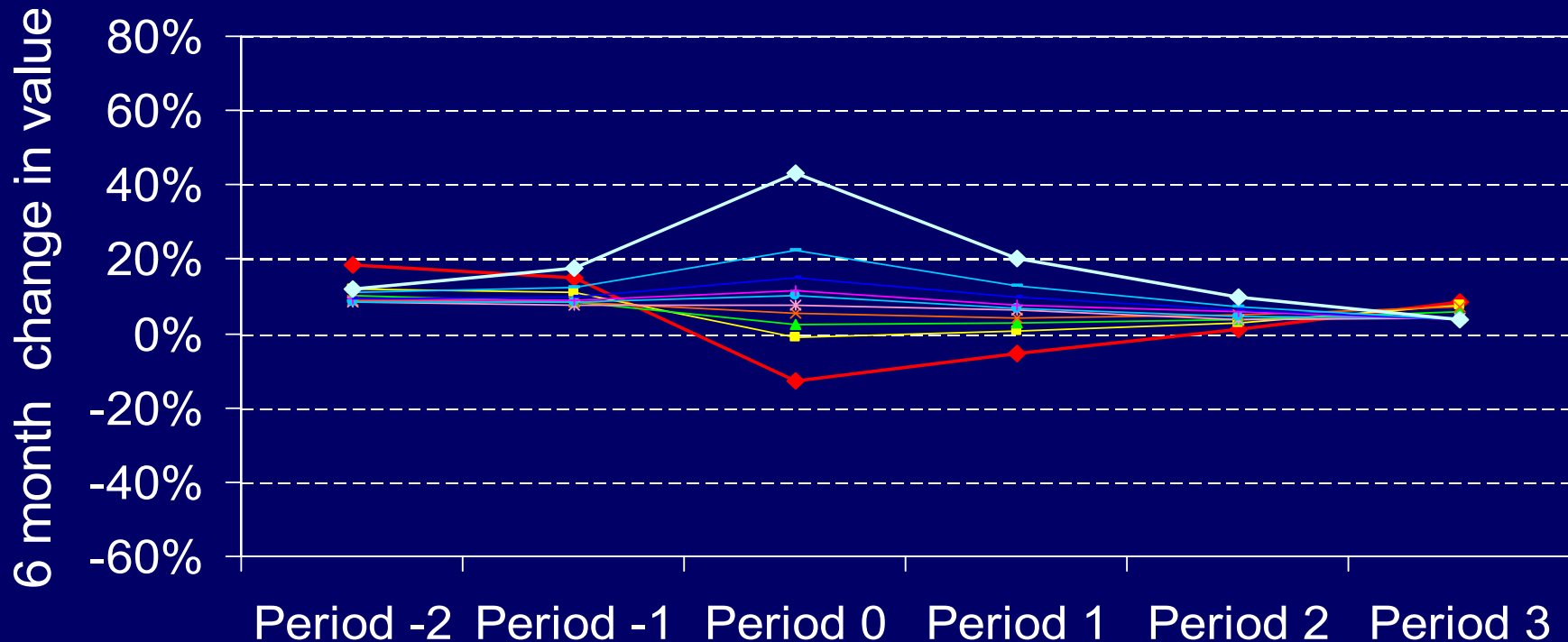
$$R_{i,t} = .014 + .203R_{v,t} + .704R_{ind,t} \quad R^2 = .173$$

(1.86) (16.9) (37.5) $n = 1956$





Fundamental Value Change For Momentum Deciles (1985 – 2006)



	Period -2	Period -1	Period 0	Period 1	Period 2	Period 3
Low Mom	19%	15%	-13%	-5%	1%	8%
High Mom	12%	18%	43%	20%	10%	4%
High - Low	-7%**	3%	56%**	25%**	9%**	-4%**



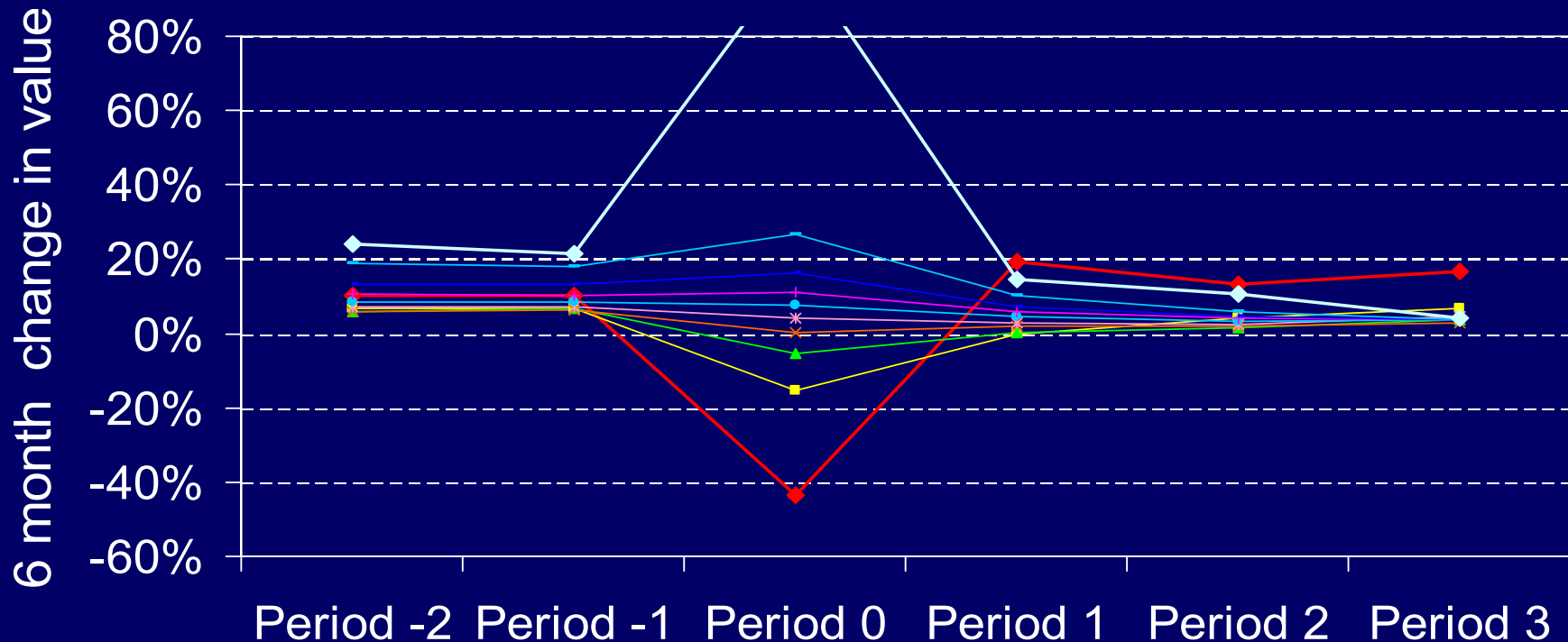


Reducing Error in R_v

- R_v measures earnings over the next two years
- Some fundamental information may be longer term
- “True R_v ” = R_v + error
- Sorting on return, as we just did, is likely to maximize the effect of the error term
- Sorting on R_v is likely to minimize it



Change in Value (R_v) Deciles

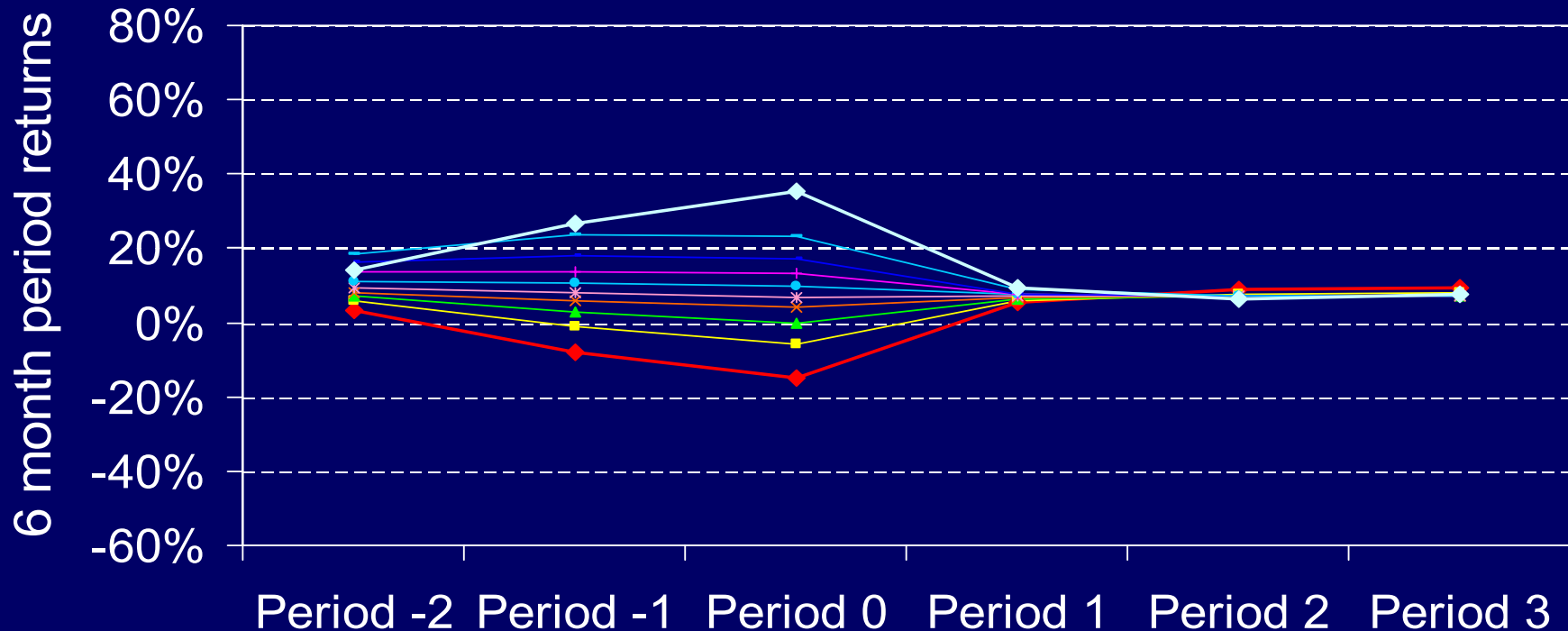


	Period -2	Period -1	Period 0	Period 1	Period 2	Period 3
Low $R_{v,t-6}$	10%	10%	-44%	19%	13%	17%
High $R_{v,t-6}$	24%	21%	102%	15%	11%	4%
High - Low	14%**	11%**	146%**	-4%	-3%	-13%**





Returns for Value Deciles



Low $R_{v,t-6}$	3%	-8%	-15%	5%	9%	9%
High $R_{v,t-6}$	14%	27%	35	9%	6%	7%
High – Low	11%**	35%**	50%**	4%**	-3%**	-2%**



Do Prices Predict Fundamentals? A Different Approach

- Conjecture: current prices partially reflect future changes in the market's estimate of fundamental value

- $P_t = \lambda_t V_t^{\beta_0} (1+R_{v,t+1})^{\beta_1} (1+R_{v,t+2})^{\beta_2}$

- Taking logarithms and first differences yields a regression equation

- $R_t = \alpha + \beta_0 R_{v,t} + \beta_1 (R_{v,t+1} - R_{v,t}) + \beta_2 (R_{v,t+2} - R_{v,t+1}) + u_t$



Current Prices Seem to Reflect Future Fundamental Values

$$R_{i,t} = \alpha + \beta_0 * R_{v,t} + \beta_1 * (R_{v,t+1} - R_{v,t}) + \beta_2 * (R_{v,t+2} - R_{v,t+1}) + \beta_3 * (R_{v,t+3} - R_{v,t+2}) + u_t$$

Months	α	β_0	β_1	β_2	β_3	R^2	Avg # of Obs
250	0.07	0.34	0.14	0.04		0.12	1900
t stat	4.9	18.9	13.5	6.3			
244	0.07	0.35	0.13	0.01	-0.02	0.13	1720
t stat	5.1	16.9	9.8	1.1	-2.5		



Subsequent Change in Value (R_v) When momentum works and fails...

	Low R_{t+n}	2	3	4	5	6	7	8	9	High R_{t+n}
One Month (n=1)										
Low Mom R_{t-6}	-5.6%	-3.0%	-1.0%	-1.2%	-2.0%	0.2%	0.0%	-0.1%	1.5%	4.3%
High Mom R_{t-6}	5.3%	4.5%	4.3%	4.5%	4.5%	4.9%	5.6%	5.5%	7.1%	10.7%
Three Months (n=3)										
Low Mom R_{t-6}	-18.1%	-9.1%	-7.6%	-6.7%	-2.5%	0.3%	1.1%	3.4%	7.4%	13.7%
High Mom R_{t-6}	5.3%	10.1%	11.3%	10.7%	14.4%	12.9%	13.0%	16.3%	18.6%	27.9%
Six Months (n=6)										
Low Mom R_{t-6}	-29.8%	-16.5%	-14.7%	-6.6%	1.5%	0.6%	0.4%	3.2%	11.8%	33.2%
High Mom R_{t-6}	1.9%	14.8%	15.8%	18.6%	24.9%	24.0%	24.1%	28.0%	36.2%	50.7%



Summary

- Using a measure of change in fundamental value based on analyst estimates, we found
 - Stock returns are correlated with concurrent fundamental return (consistent with Market Efficiency)
 - Stock returns predict changes in fundamental value up to a year in advance (inconsistent with Market Efficiency)

- These findings support a rational explanation of the Momentum Effect that is consistent with either:
 - A Noisy Rational Expectations Equilibrium, or
 - A properly specified heterogeneous expectations equilibrium