

# Research Affiliates Fundamental Index®

## Where Does Finance Theory Lead Us Astray?

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Research Affiliates, LLC

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# Are We Blinded by Theory?

**Theory does a *Marvelous* Job explaining how the world ought to work**

**Theories are sometimes *provable*, based on certain assumptions**

- These assumptions are rarely precisely true
- Most *originators* of important theories readily acknowledge that they will not mirror reality with precision

# Are We Blinded by Theory?

**Theory does a *Marvelous* Job explaining how the world ought to work**

**Theories are sometimes *provable*, based on certain assumptions**

**Gaps between theory and reality are *normal***

- They can help us to improve the theory
  - Consider CAPM -> APT -> Fama/French evolution
- These gaps can be important sources of profit

# Are We Blinded by Theory?

**Theory does a *Marvelous* Job explaining how the world ought to work**

**Theories are sometimes *provable*, based on certain assumptions**

**Gaps between theory and reality are *normal***

**Still, some observers cling to theory as *fact***

- Assume a theory is correct description of reality
- Assume that, therefore, the assumptions are correct
- Assume that empirical evidence to contrary is wrong
- *This is exactly backwards!*

# The Clairvoyance Paradox

## Suppose we have something better than strong-form EMH

- Perfect foresight; assets priced at “ex post realized value,” which Bill Sharpe refers to as “Clairvoyant value” (CV).  $MV = CV$
- MVW index is perfectly mean variance efficient. But there’s no risk.

## Suppose our crystal ball gets just *\*a little\** cloudy.

- MV no longer matches CV.
- MVW index fund overweights every single stock that's trading above CV and underweights every single stock that's trading below CV.
- Every stock above CV is priced to give lower IRR than it should; every stock below CV has higher IRR than it should.
- MVW index suffers a return drag relative to CV-weighted index.

## In the real world, our crystal ball is *\*a lot\** cloudy.

- So, the MVW indexes suffer a material return drag.

# The Clairvoyance Paradox

## Suppose we have something better than strong-form EMH

- Perfect foresight;  $MV = CV$ ; index is perfectly mean variance efficient.

## Suppose our crystal ball gets just \*a little\* cloudy.

- MVW overweights every stock trading above CV, underweights every stock below CV. No exceptions.
- Can't know CV, so can't say which stocks are over or under weight.

## Suppose we structure an index which is valuation-indifferent

- If valuation-indifferent weight “errors” (differences from CV weight) are uncorrelated with ex-post pricing error ( $CV - MVW$ ), the errors cancel.
- Return drag disappears.
- But, this is inconsistent with EMH.

# Illustrative Example

**Capitalization = Clairvoyant Value +/- Large Error Term**

**Suppose we have two stocks worth \$100 CV, priced at \$50 and \$150.  
Cap-weighting invests 75% in overvalued stock.**

- Top-cap stock(s) likely to have positive error!

**Suppose over ten years, today's errors are corrected ... and are replaced with a new 50% error (i.e., errors are steady-state).**

- Estimated cap-weighting return is zero; equal-weighting return is 33%.
- Cap-weighting gives up 2.8% per annum versus CVW portfolio.

# The Clairvoyance Paradox

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- MVW index suffers a return drag.

## Suppose we structure an index which is valuation-indifferent

- Return drag disappears.

## Equal weighting does this.

- Is superior historical performance of equal weighting from rebalancing,
- from small-cap bias, value bias, rebalancing ... **or**
- because it is valuation-indifferent and eliminates structural return drag of cap-weighting?

# Does Empirical Evidence Support the EMH?

How often did the top 10 stocks in the S&P 500 outperform the average stock (S&P 500 EW) in the years that followed?				
	1 year	3 years	5 years	10 years
1926-2006	44%	40%	37%	31%
1964-2006	38%	35%	30%	27%
By how much did the top 10 stocks underperform the average?				
	1 year	3 years	5 years	10 years
1926-2006	-2.9%	-11.0%	-17.7%	-29.4%
1964-2006	-3.6%	-15.9%	-24.9%	-37.0%

# The Clairvoyance Paradox

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## Suppose we structure an index which is valuation-indifferent

- Return drag disappears. Equal weighting does this.

## Can we quantify the return drag?

- Measure the average half-life of pricing error,
- the average log-magnitude of pricing error,
- and average weighting error of our weighting scheme,
- we can measure the return drag.
- Using reasonable assumptions, the drag is 2-4%.

# The Clairvoyance Paradox

## Suppose we have something better than strong-form EMH

- Perfect foresight;  $MV = CV$ ; index is perfectly mean variance efficient.

## Suppose our crystal ball gets just \*a little\* cloudy.

- MVW index suffers a return drag.

## Suppose we structure an index which is valuation-indifferent

- Return drag disappears. Equal Weighting does this.

**Can we quantify the return drag? Yes. It's 2-4%.**

## How do we reconcile:

- the fact that cap-weighted market portfolio, if it's all-inclusive, is the only *market-clearing* portfolio, with
- the fact that the cap-weighted market portfolio has a structural return drag that can be eliminated with simple expedients like equal weighting?

# The Clairvoyance Paradox

## Suppose we have something better than strong-form EMH

- Perfect foresight;  $MV = CV$ ; index is perfectly mean variance efficient.

## Suppose our crystal ball gets just \*a little\* cloudy.

- MVW index suffers a return drag.

## Suppose we structure an index which is valuation-indifferent

- Return drag disappears. Equal Weighting does this.

## Can we quantify the return drag? Yes. It's 2-4%.

## How do we reconcile ostensibly efficient market-clearing cap-weighted portfolio with a return drag that's easy to eliminate?

- Cap-weighted US equity index is *not* the market. True market portfolio must include all assets, domestic or foreign, in positive net supply. Stocks, bond, real estate, all alternative assets – perhaps even human capital.



# What is “Clairvoyant Value” and What Can It Teach Us?

# The Many Meanings of “Growth” and “Value”

## To the Financial Analyst

- Value is whatever an asset is worth
- Growth is growth in sales, profits, dividends or other metrics of company size, either past or expected

## To the Finance Professor or “Quant”

- Value refers to companies trading below market valuation multiples
- Growth is companies above market valuation multiples

## To the Portfolio Manager or Consultant

- Value investing reflects a preference for low multiples
- Growth investors prefer high growth expectations
- Valuation multiples tacitly reflect growth expectations

**Same terms used for multiple meanings!**

# Many Ways to Measure Company Size ...

## Going *W-a-y* Back: the Original Top 10 in S&P 500

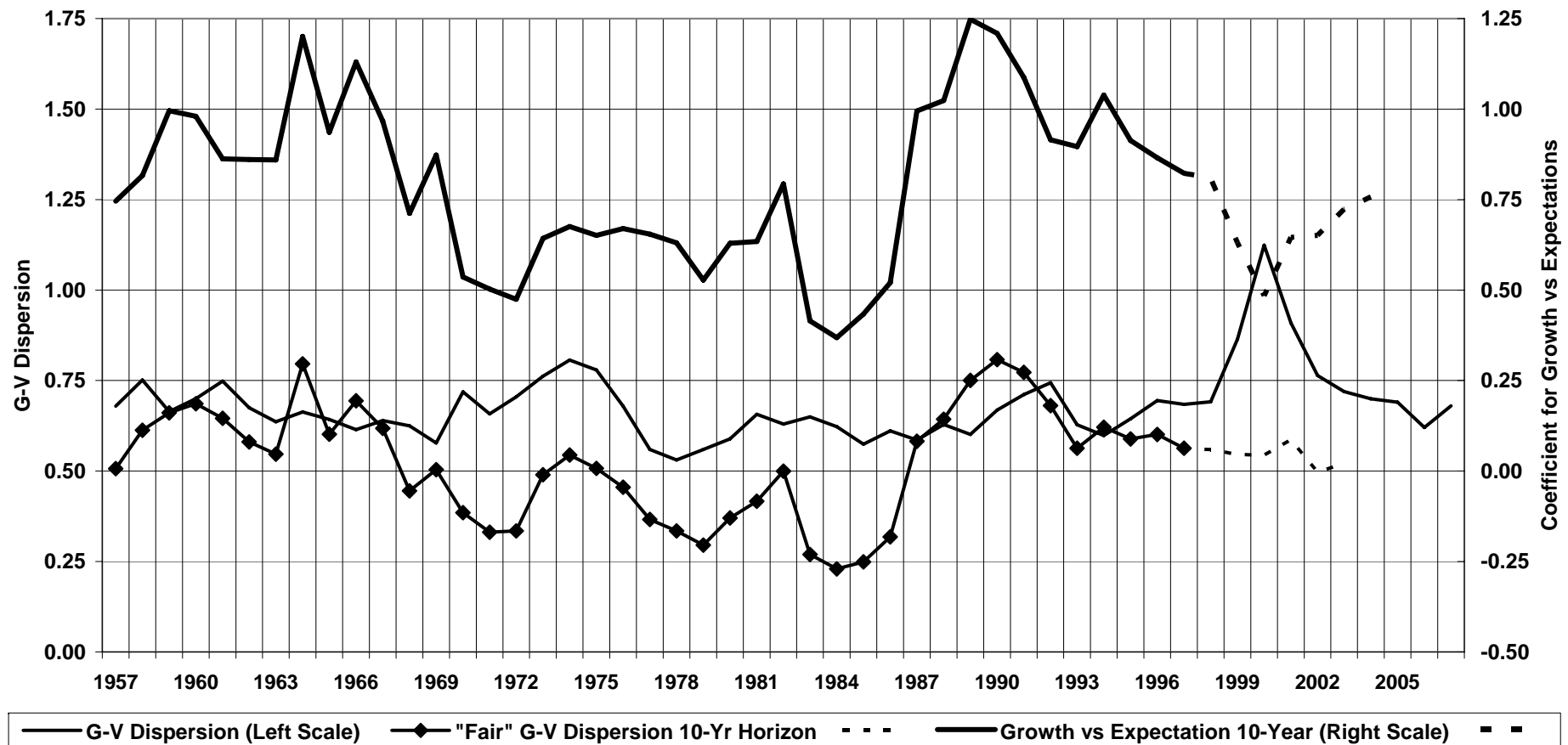
<b>Panel A. Company Size</b>	<b>Various Measures of Company Size</b>					
<b>Name</b>	<b>Market Cap (\$mil)</b>	<b>Total Assets (\$mil)</b>	<b>Sales (\$mil)</b>	<b>Cash Flow (\$Mil)</b>	<b>Dividends Paid (\$Mil)</b>	<b>Book Value (\$Mil)</b>
<b>GENERAL MOTORS CORP</b>	<b>\$12,206</b>	<b>\$6,569</b>	<b>\$10,796</b>	<b>\$1,985</b>	<b>\$553</b>	<b>\$4,235</b>
<b>STANDARD OIL CO N J</b>	<b>\$11,534</b>	<b>\$7,871</b>	<b>\$7,127</b>	<b>\$1,582</b>	<b>\$412</b>	<b>\$5,143</b>
<b>AMERICAN TELEPHONE &amp; TELEG C</b>	<b>\$10,778</b>	<b>\$16,207</b>	<b>\$5,825</b>	<b>\$2,039</b>	<b>\$517</b>	<b>\$9,554</b>
<b>DU PONT E I DE NEMOURS &amp; CO</b>	<b>\$8,769</b>	<b>\$2,591</b>	<b>\$1,917</b>	<b>\$616</b>	<b>\$296</b>	<b>\$1,885</b>
<b>GENERAL ELECTRIC CO</b>	<b>\$5,225</b>	<b>\$2,221</b>	<b>\$4,090</b>	<b>\$522</b>	<b>\$172</b>	<b>\$1,143</b>
<b>UNITED STATES STEEL CORP</b>	<b>\$3,947</b>	<b>\$4,109</b>	<b>\$4,199</b>	<b>\$948</b>	<b>\$145</b>	<b>\$2,454</b>
<b>GULF OIL CORP</b>	<b>\$3,657</b>	<b>\$2,865</b>	<b>\$2,340</b>	<b>\$601</b>	<b>\$69</b>	<b>\$1,901</b>
<b>UNION CARBIDE &amp; CARBON CORP</b>	<b>\$3,483</b>	<b>\$1,460</b>	<b>\$1,325</b>	<b>\$396</b>	<b>\$94</b>	<b>\$812</b>
<b>TEXAS CO</b>	<b>\$3,285</b>	<b>\$2,574</b>	<b>\$2,046</b>	<b>\$497</b>	<b>\$129</b>	<b>\$1,836</b>
<b>STANDARD OIL CO CALIFORNIA</b>	<b>\$3,114</b>	<b>\$2,041</b>	<b>\$1,453</b>	<b>\$415</b>	<b>\$104</b>	<b>\$1,711</b>
<b>AVERAGE, TOP TEN</b>	<b>\$6,600</b>	<b>\$4,851</b>	<b>\$4,112</b>	<b>\$960</b>	<b>\$249</b>	<b>\$3,067</b>
<b>AVERAGE, CAP/METRIC RATIO</b>		<b>1.36</b>	<b>1.61</b>	<b>6.87</b>	<b>26.49</b>	<b>2.15</b>

# What if our Crystal Ball Allowed Perfect Foresight? The “Clairvoyant Value” of the “Ancient” Top Ten

Panel B. Clairvoyant Values		Clairvoyant Value, based on Various Time Spans and Methods				
Name	Market Cap (\$mil)	S&P Rtn, 10- Year	S&P Rtn, 20- Year	S&P Rtn, thru 2007	CAPM Rtn, thru 2007	FF3 Rtn, thru 2007
GENERAL MOTORS CORP	\$12,206	\$12,947	\$14,219	\$9,276	\$9,439	\$6,209
STANDARD OIL CO N J	\$11,534	\$8,479	\$9,270	\$11,545	\$18,156	\$12,010
AMERICAN TELEPHONE & TELEG C	\$10,778	\$13,507	\$15,381	\$9,388	\$11,769	\$11,502
DU PONT E I DE NEMOURS & CO	\$8,769	\$6,479	\$6,305	\$4,308	\$4,422	\$3,377
GENERAL ELECTRIC CO	\$5,225	\$4,396	\$4,124	\$5,138	\$4,312	\$7,202
UNITED STATES STEEL CORP	\$3,947	\$1,784	\$1,559	\$1,391	\$1,454	\$950
GULF OIL CORP	\$3,657	\$3,321	\$3,438	\$2,793	\$3,074	\$2,165
UNION CARBIDE & CARBON CORP	\$3,483	\$1,919	\$1,870	\$1,724	\$1,746	\$1,162
TEXAS CO	\$3,285	\$4,925	\$4,856	\$3,343	\$4,251	\$2,706
STANDARD OIL CO CALIFORNIA	\$3,114	\$2,827	\$3,066	\$3,008	\$3,713	\$2,573
<i>AVERAGE, TOP TEN</i>	<i>\$6,600</i>	<i>\$6,058</i>	<i>\$6,409</i>	<i>\$5,191</i>	<i>\$6,234</i>	<i>\$4,986</i>
<i>AVERAGE, CAP/CLAIRVOYANT VALUE</i>		<i>1.09</i>	<i>1.03</i>	<i>1.27</i>	<i>1.06</i>	<i>1.32</i>

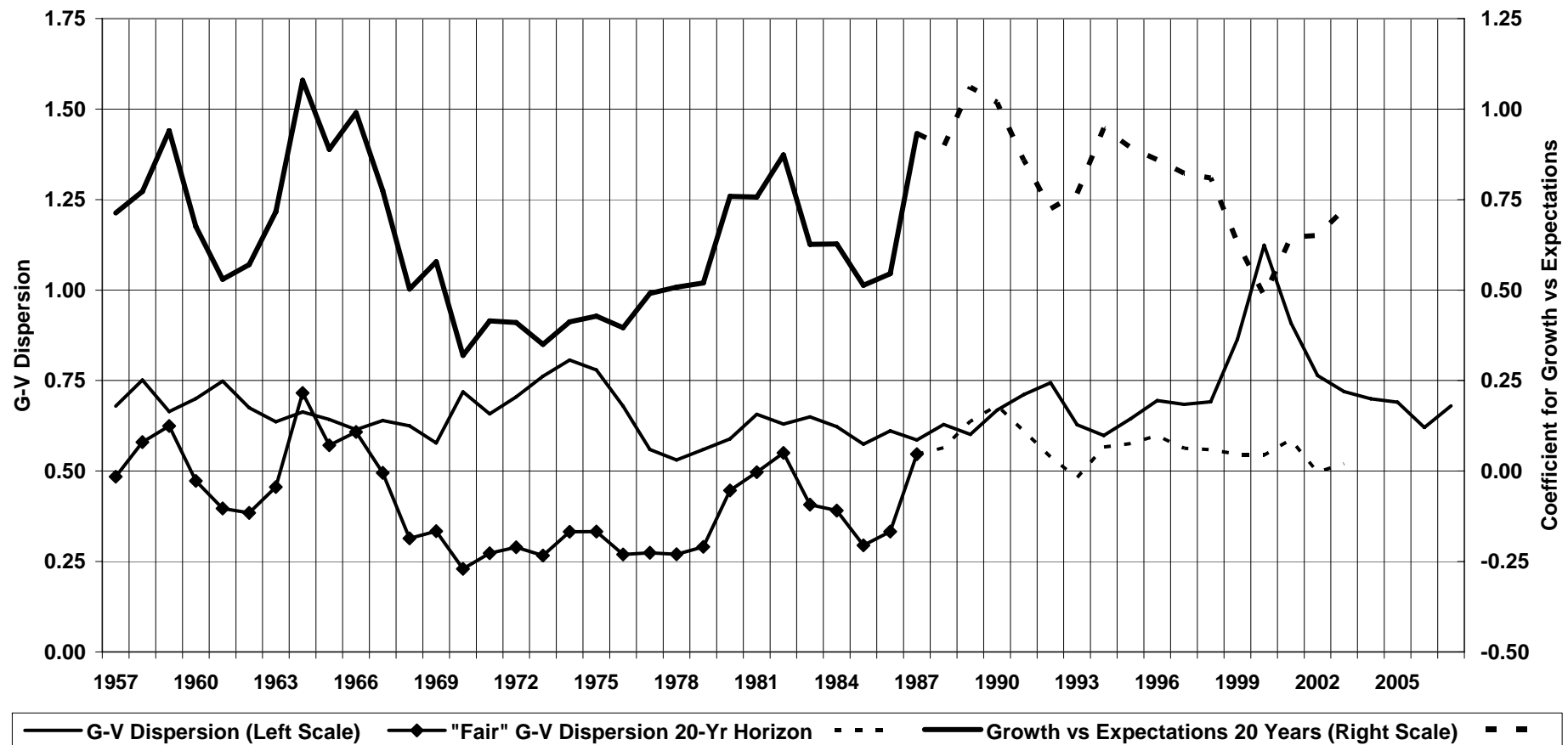
# What Does History Say About the Market's Clairvoyance? Overpaying for 10-Year Prospects

Panel C. Clairvoyance for 10 Years, S&P Discount Rate



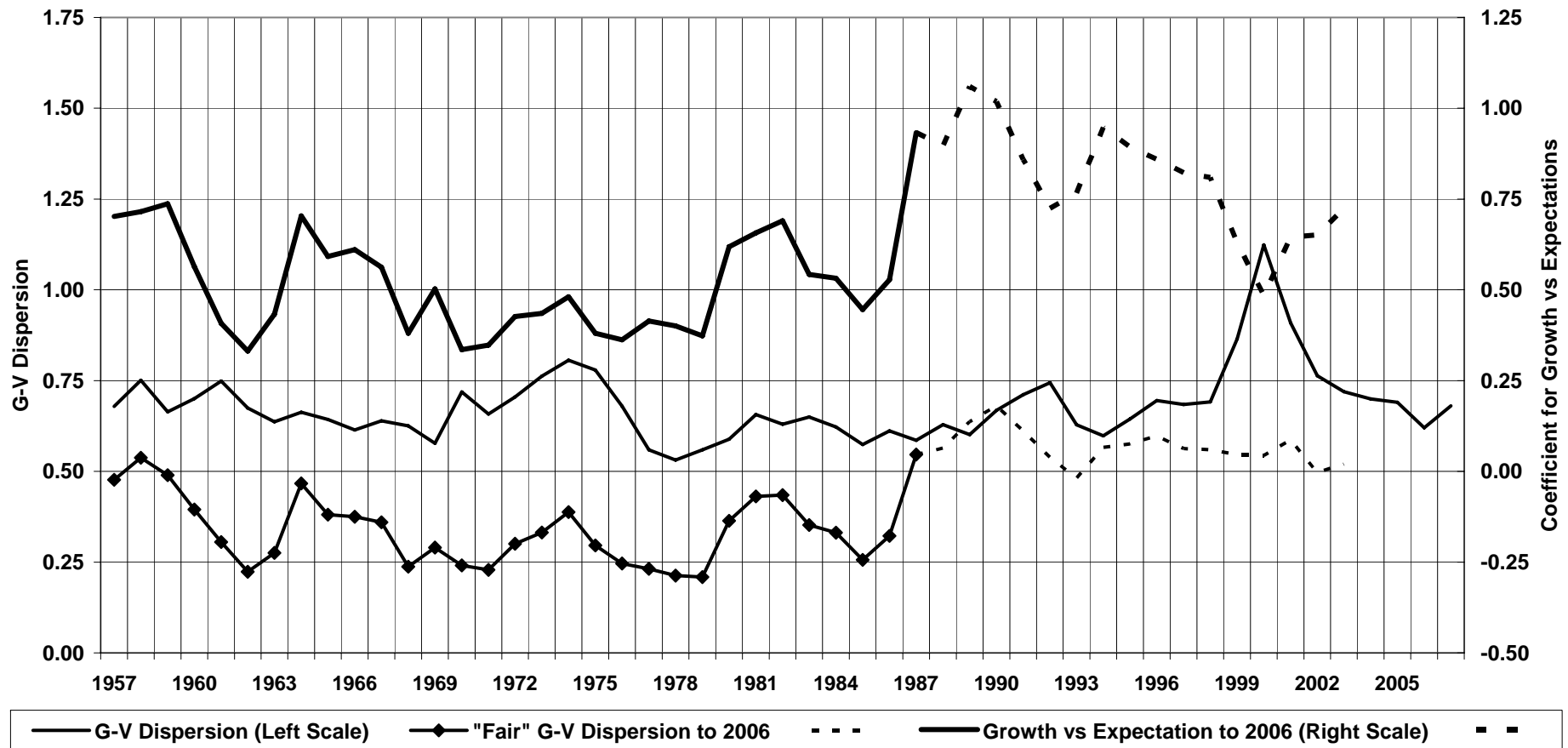
# What Does History Say About the Market's Clairvoyance? Overpaying for 20-Year Prospects

Panel B. Clairvoyance for 20 Years, S&P Discount Rate

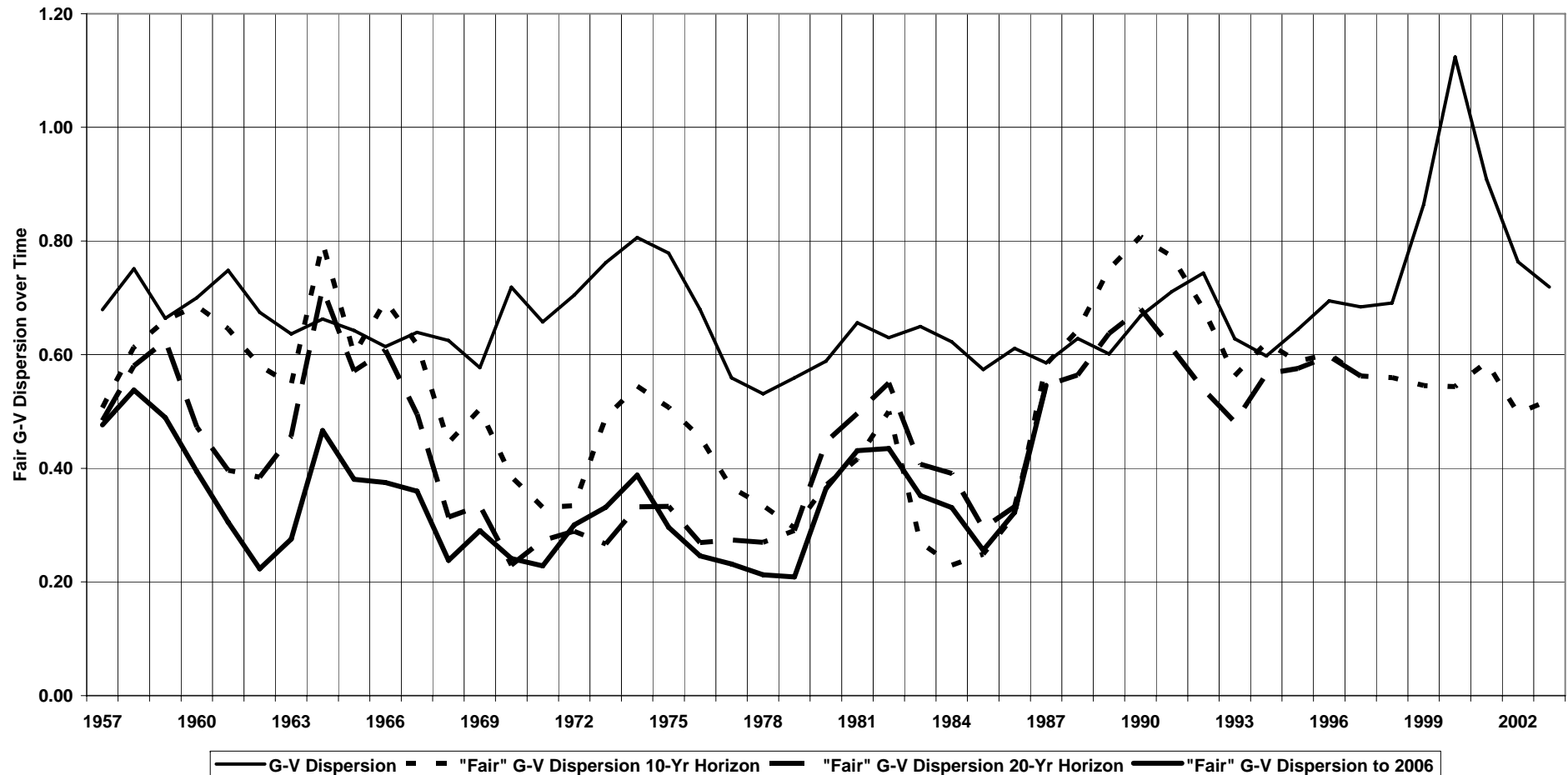


# What Does History Say About the Market's Clairvoyance? Overpaying for Prospects to 2007

Panel A. Clairvoyance through 2006, S&P Discount Rate



# What Does History Say About the Market's Clairvoyance? Market Pays Double for Growth!!





**RAFI®**  
**Efficient Indexing  
for an Inefficient Market**

# The RAFI Approach

## Create an index that reflects a company's economic footprint using fundamental measures of size

- Sales
- Cash flow
- Gross dividends paid
- Book value

## The result, for any of these:

- Breaks the link between pricing errors and portfolio weights
- Pricing errors are uncorrelated (and cancel)
  - For example, both overvalued and undervalued stocks will be overweighted and underweighted, but the errors largely offset each other
- Retains many benefits of an equivalent cap-weighted index
  - Diversification, indeed, more than cap-weighted in bubbles
  - Liquidity, transparency, and broad economic representation

# Five Large Companies Based on Fundamentals (January 31, 2008)

	5-Year Average Sales			5-Year Average Cash Flow		
	\$ Billion	Weight	Rank	\$ Billion	Weight	Rank
Exxon Mobil Corp.	\$264	3.0%	2	\$46	3.0%	1
General Electric Co.	\$141	1.6%	6	\$29	1.9%	3
Citigroup Inc.	\$111	1.3%	8	\$37	2.5%	2
Bank of America Corp.	\$72	0.8%	16	\$27	1.8%	4
Wal-Mart Stores Inc.	\$286	3.2%	1	\$20	1.3%	8
Top 1,000 Total	\$8,826			\$1,510		

	5-Year Average Dividend			Book Value		
	\$ Billion	Weight	Rank	\$ Billion	Weight	Rank
Exxon Mobil Corp.	\$7	3.3%	4	\$114	2.0%	5
General Electric Co.	\$9	4.2%	2	\$112	2.0%	6
Citigroup Inc.	\$7	3.5%	3	\$119	2.1%	2
Bank of America Corp.	\$6	3.0%	5	\$132	2.3%	1
Wal-Mart Stores Inc.	\$2	1.0%	19	\$62	1.1%	14
Top 1,000 Total	\$210			\$5,652		

Source: Research Affiliates, based on data from Bloomberg.

# RAFI Outperforms with Lower Volatility

1962-2007	Ending Value of \$1	Annual Return	Volatility	Sharpe Ratio	Tracking Error
S&P 500	\$90	10.3%	14.6%	0.37	1.7%
Cap 1000	\$88	10.2%	14.8%	0.36	--
Book	\$176	11.9%	14.6%	0.47	3.5%
Cash Flow	\$214	12.4%	14.6%	0.50	3.8%
Sales	\$248	12.7%	15.4%	0.50	4.8%
Gross Dividend	\$174	11.9%	13.3%	0.50	5.1%
<b>RAFI Composite</b>	<b>\$207</b>	<b>12.3%</b>	<b>14.4%</b>	<b>0.50</b>	<b>4.0%</b>

The Cap 1000 is an annually rebalanced portfolio of the top 1,000 U.S. stocks by capitalization dating back to 1962. Results are based on RA research. Hypothetical or simulated performance results have certain inherent limitations. Unlike actual performance records, simulated results do not represent actual trading.

Source: Research Affiliates, based on data from Bloomberg.

# Benefits of a Composite Approach

## **Any single-metric index works, but has a structural bias:**

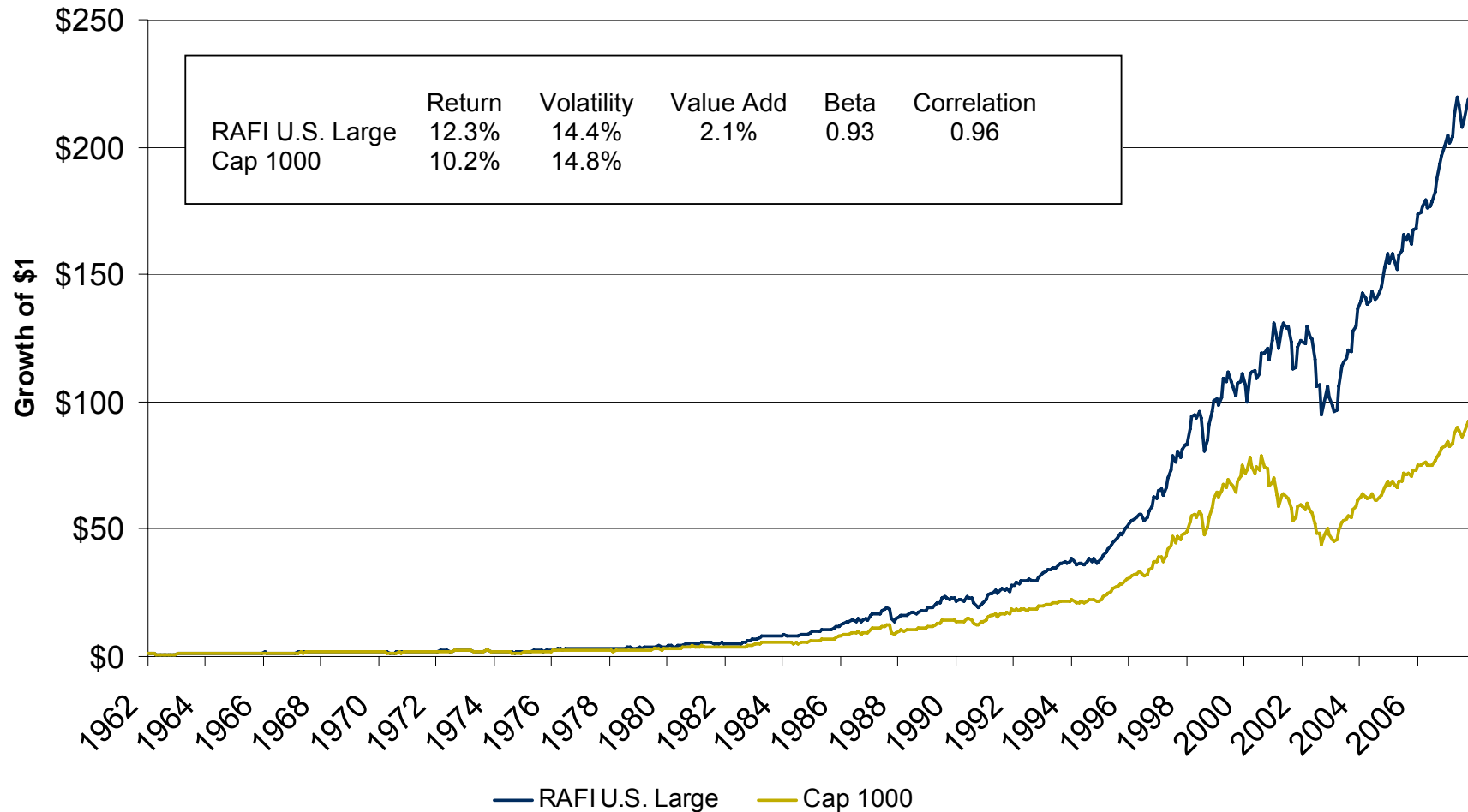
- Sales—overexposed to large companies with thin margins
- Cash flow—overexposed to cyclical stocks at cyclical peaks
- Dividends—overexposed to mature, high-yield companies and exclusion of growth companies
- Book value—overexposed to companies with aggressive accounting

## **Composite approach improves methodology**

- Diversifies exposure to data source, sectors, and other risks
- Improves robustness of methodology
- Improves stability of factors
- Superior risk–return performance\*

\*Research Affiliates historical data based on universe of U.S. equities 1962-2007.

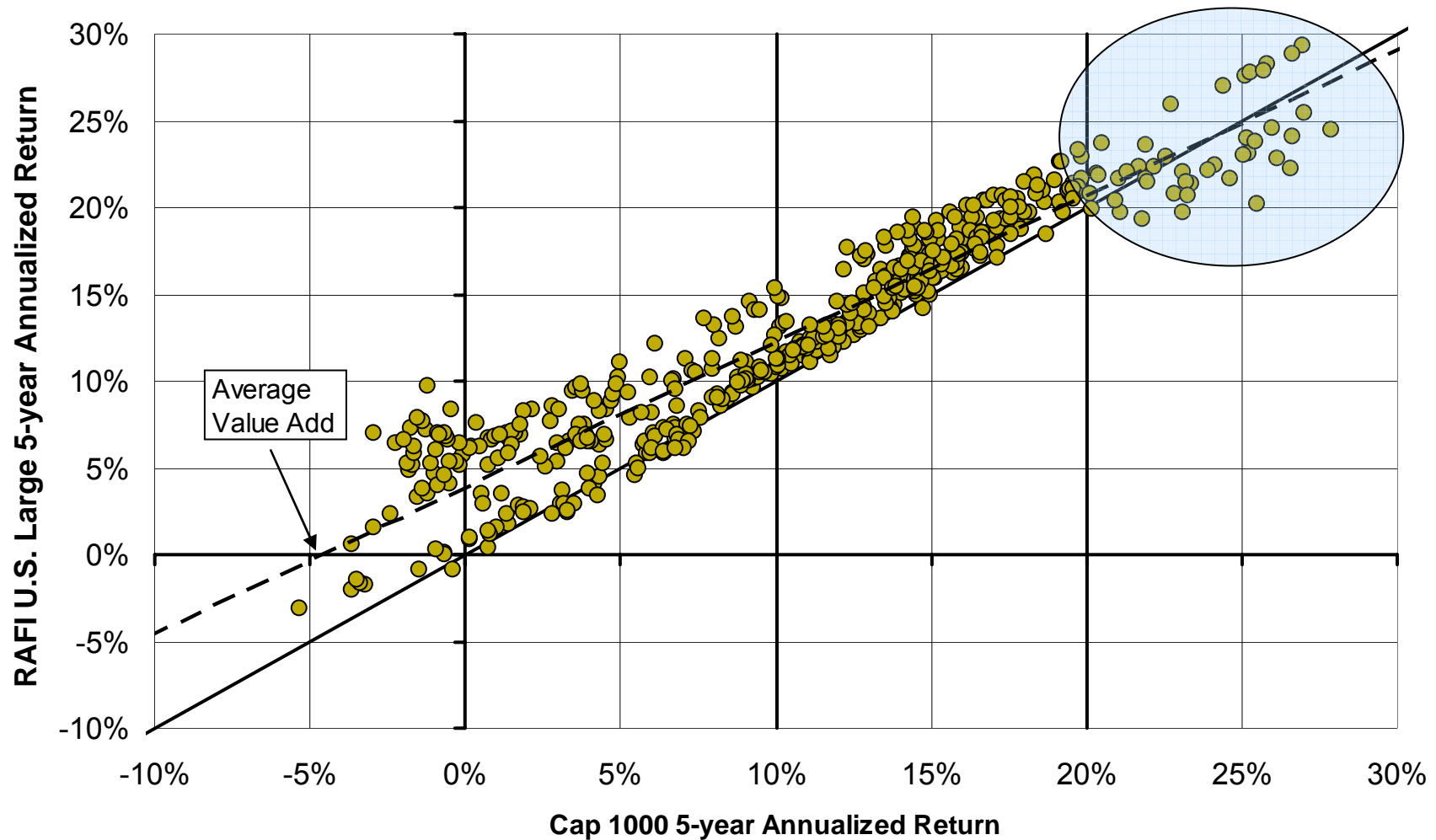
# 2% Per Annum Adds Up Over Time, 1962–2007



Hypothetical or simulated performance results have certain inherent limitations. Unlike actual performance records, simulated results do not represent actual trading.

Source: Research Affiliates, LLC.

# RAFI vs. Cap-Weight: Different Return Environments, 1962–2007



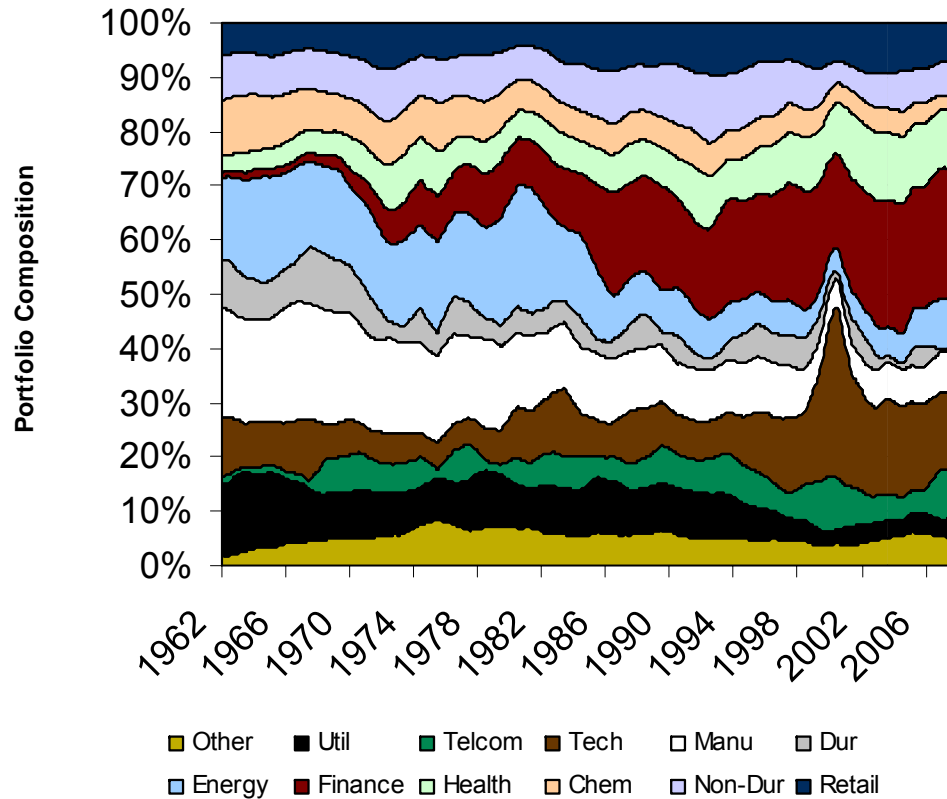
Source: Research Affiliates, LLC.



# RAFI<sup>®</sup> Applications Sectors

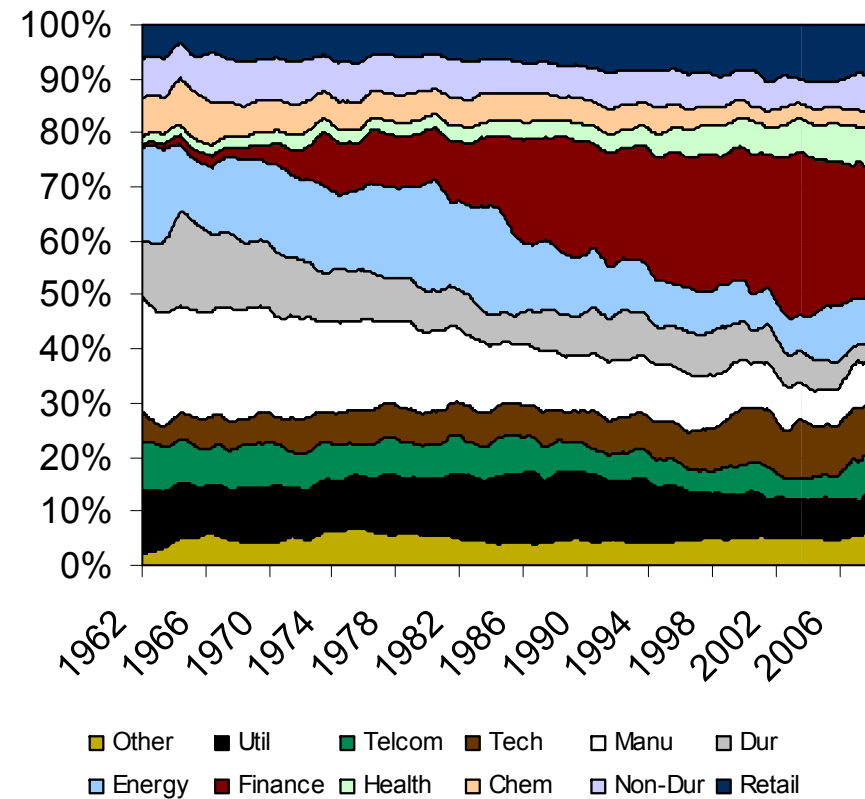
# Sector Weights: Which is the Passive Strategy?

## Cap Weighted



Where's the rebalancing?  
Chasing the winners?

## Fundamental Index



Systematic rebalancing  
Buy low, sell high

Source: Research Affiliates, LLC.



# **RAFI® Applications Span the Equity Markets**

# RAFI Concept Works Globally

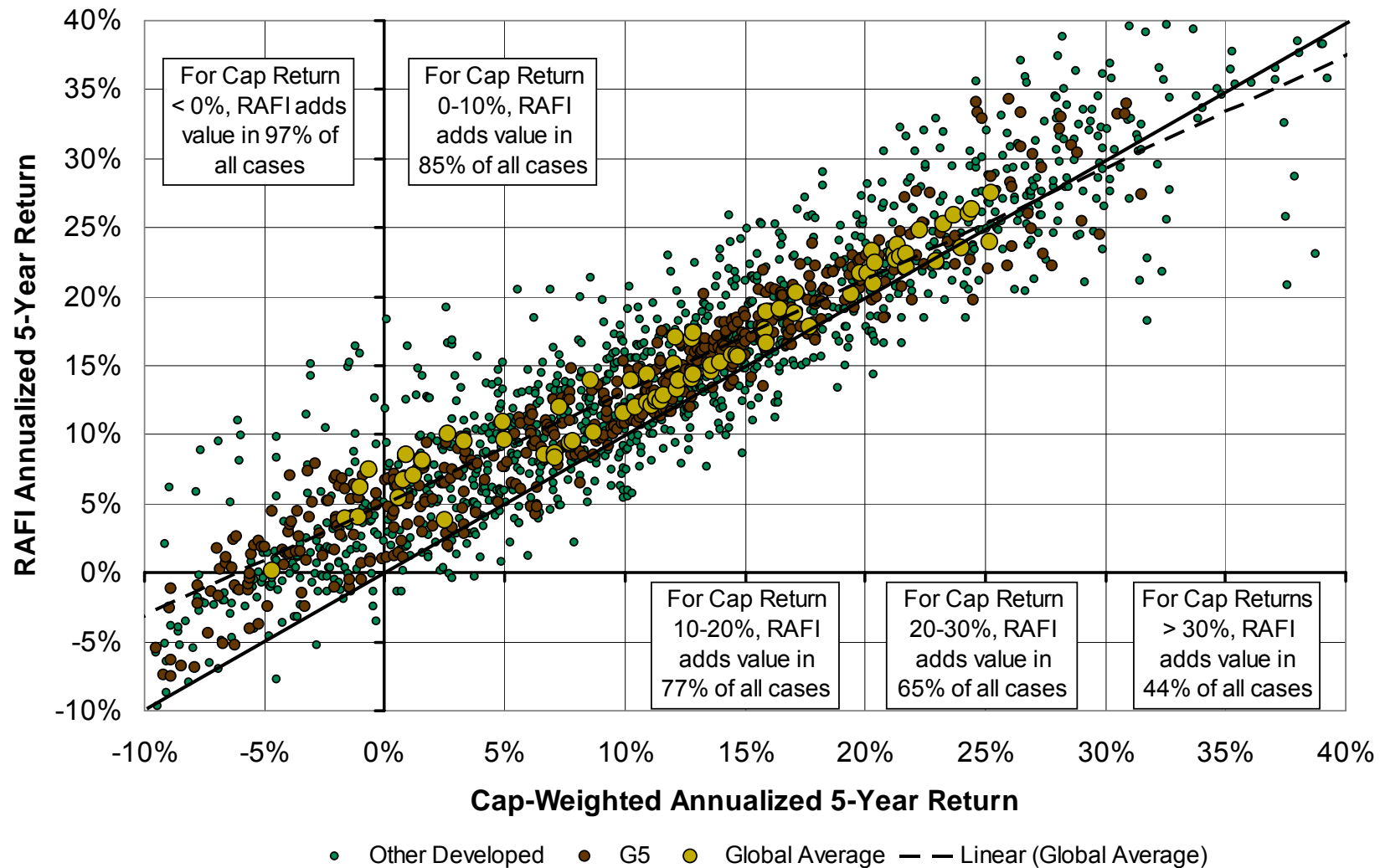
23 Country Return Statistics through 2007

Country	RAFI Return	MSCI Return	Value Added	Risk Adjusted Alpha	Tracking Error	Info Ratio	Alpha t-statistic	Start Date
Ireland	17.6%	9.6%	7.9%	8.6%	9.1%	0.87	4.50	1988
Austria	17.8%	12.5%	5.4%	6.4%	9.7%	0.55	3.44	1984
Norway	17.5%	13.3%	4.2%	4.3%	6.5%	0.64	3.23	1984
Portugal	13.2%	9.2%	4.0%	4.6%	8.3%	0.48	2.64	1989
France	16.9%	12.9%	3.9%	4.4%	7.1%	0.56	3.08	1984
United Kingdom	15.0%	12.1%	3.0%	3.1%	4.4%	0.68	3.45	1984
Japan	7.1%	4.3%	2.8%	2.8%	5.4%	0.52	2.58	1984
United States	14.4%	12.4%	2.0%	2.7%	4.7%	0.42	2.90	1984
Belgium	15.5%	14.0%	1.5%	2.3%	5.6%	0.26	2.17	1984
Finland	15.8%	14.7%	1.1%	5.1%	20.3%	0.06	1.59	1988
Netherlands	14.0%	12.8%	1.1%	1.5%	6.6%	0.17	1.09	1984
New Zealand	7.2%	6.8%	0.4%	0.4%	8.7%	0.05	0.20	1988
Switzerland	11.6%	12.0%	-0.4%	-0.2%	4.3%	-0.09	-0.24	1984
<b>23-Country Average</b>	<b>17.0%</b>	<b>14.4%</b>	<b>2.6%</b>	<b>3.1%</b>	<b>2.9%</b>	<b>0.90</b>	<b>5.50</b>	

Source: Research Affiliates, LLC.

# RAFI vs. Reference Cap

## Rolling Five –Year Returns, 23 Countries



Source: Research Affiliates, LLC.

# RAFI in “Less Efficient” Markets

## What happens to the return drag of cap weighting in “less efficient” markets?

- Less efficient markets will see greater mispricing, both in magnitude of error and frequency
  - U.S. Small Company
  - International Small
  - Emerging Markets

## The end result

- Excess return benefits in line with active management expectations
- Capacity, liquidity, and low turnover expected of index fund investing

# International Region Performance through 2007

	<b>Start Date</b>	<b>Return</b>	<b>Volatility</b>	<b>Value Add</b>	<b>Percent 3-Year Wins</b>
RAFI U.S. Large	1962	12.3%	14.4%	2.0%	73.9%
S&P 500	(46 years)	10.3%	14.6%		
RAFI Japan	1984	7.2%	19.1%	2.8%	90.1%
MSCI Japan	(24 Years)	4.3%	19.4%		
RAFI Europe	1984	17.8%	16.2%	3.0%	93.7%
MSCI Europe	(24 Years)	14.8%	16.1%		
RAFI Global ex US	1984	15.6%	15.7%	3.3%	88.5%
MSCI EAFE	(24 Years)	12.3%	16.7%		
RAFI US Small	1979	16.2%	18.6%	3.4%	99.7%
Russell 2000	(29 Years)	12.8%	19.0%		
RAFI Global ex US Small	1999	17.1%	13.3%	4.2%	94.5%
MSCI EAFE Small	(9 Years)	12.9%	15.2%		
RAFI AP ex Japan	1988	17.2%	21.1%	4.5%	70.7%
MSCI Pacific ex Japan	(20 Years)	12.7%	19.3%		
RAFI EM	1994	19.4%	23.3%	10.7%	100.0%
MSCI EM	(14 Years)	8.7%	22.4%		

Source: Research Affiliates, LLC.

# RAFI Sector Performance

	U.S. (1989-2007)			Global (1995-2007)		
	RAFI Sector Return	S&P Sector Return	Value Added	RAFI Sector Return	MSCI Sector Return	Value Added
Information Technology	13.3%	11.0%	<b>2.3%</b>	12.3%	10.3%	<b>1.9%</b>
Health Care	14.6%	12.3%	<b>2.3%</b>	13.6%	12.2%	<b>1.4%</b>
Financials	13.9%	11.7%	<b>2.2%</b>	12.9%	9.3%	<b>3.6%</b>
Consumer Staples	13.9%	11.7%	<b>2.2%</b>	12.8%	11.3%	<b>1.5%</b>
Utilities	11.7%	9.5%	<b>2.1%</b>	14.0%	11.7%	<b>2.2%</b>
Industrials	12.8%	11.0%	<b>1.8%</b>	11.8%	8.6%	<b>3.2%</b>
Energy	16.3%	14.8%	<b>1.5%</b>	17.5%	16.7%	<b>0.8%</b>
Materials	10.8%	9.4%	<b>1.5%</b>	13.6%	10.9%	<b>2.7%</b>
Telecommunications	7.1%	6.7%	<b>0.4%</b>	12.8%	7.8%	<b>5.1%</b>
Consumer Discretionary	7.7%	8.5%	<b>-0.8%</b>	9.6%	6.9%	<b>2.7%</b>

- RAFI strategy outperforms in 9 out of 10 U.S. economic sectors
- RAFI strategy outperforms in 10 out of 10 Global economic sectors

Source: Research Affiliates, LLC.



***None of these results is  
consistent with EMH or CAPM.***

***But they are far too powerful  
to be lightly dismissed!***

# Closing Observations

# Where Else Does Theory Lead Us Astray?

## The Efficient Market Hypothesis

- Conflicts with Behavioral Finance
- Contradicted by countless empirical tests
- At odds with observed reality (e.g., Black)
- Fails the “€100 note” paradox

# Where Else Does Theory Lead Us Astray?

## The Efficient Market Hypothesis

### Modern Portfolio Theory

- Exquisitely sensitive to the inputs
- Estimates of return and covariance matrix must be accurate

# Where Else Does Theory Lead Us Astray?

## **The Efficient Market Hypothesis**

## **Modern Portfolio Theory**

## **Capital Asset Pricing Model**

- Assumes investors are rational and fully informed
- Assumes borrowing and lending at same rate
- Assumes short and long without limit
- Assumes positive risk premium
- Assumes like risk tolerance among Investors
- Ignores taxes and trading costs

# Where Else Does Theory Lead Us Astray?

**The Efficient Market Hypothesis**

**Modern Portfolio Theory**

**Capital Asset Pricing Model**

**Arbitrage Pricing Theory**

- Many of the same assumptions as CAPM

# Where Else Does Theory Lead Us Astray?

**The Efficient Market Hypothesis**

**Modern Portfolio Theory**

**Capital Asset Pricing Model**

**Arbitrage Pricing Theory**

**Miller-Modigliani**

- Ignores taxes
- Assumes rational investors
- Assumes management acting in shareholders' best interests

# Where Else Does Theory Lead Us Astray?

**The Efficient Market Hypothesis**

**Modern Portfolio Theory**

**Capital Asset Pricing Model**

**Arbitrage Pricing Theory**

**Miller-Modigliani**

**Black Scholes**

- Assumes log-normal price behavior
- Assumes well-defined risk free rate
- Assumes that risk (volatility) is known

# Where Else Does Theory Lead Us Astray?

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**Miller-Modigliani**

**Black Scholes**

**Cox-Ingersoll-Ross**

- Assumes fixed normal short rate, as anchor for mean reversion
- Assumes no other factors influence yield curve shape
- Assumes volatility is solely a function of the short rate

# Where Else Does Theory Lead Us Astray?

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**Black Scholes**

**Cox-Ingersoll-Ross**

***None of these is consistent with empirical data!***

# Where Else Does Theory Lead Us Astray?

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**Behavioral Finance**

- Provides few tools for the practitioner
- Does not provide a model for market equilibrium
- Does not provide specific descriptors for market behavior

# Enough of the Past ... How about the Future?

## **Paul Samuelson:**

**“Only the smallest fraction of economic writings, theoretical and applied, has been concerned with the derivation of operationally meaningful theorems. In part at least, this has been the result of the bad preconception that economic laws deduced from a priori assumptions possessed rigor and validity independently of any empirical human behavior. But only very few economists have gone so far as this. The majority would have been glad to enunciate meaningful theorems if any had occurred to them.”**

- 1. Theory is not fact. It describes an ideal world.**
- 2. Empiricism which contradicts theory may be right.**
- 3. Theory is improved by acknowledging its flaws and finding improvement, not by rejecting contradictory evidence.**