

# Pure Quintile Portfolios

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# Summary

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- We present a new portfolio construction framework called Pure Quintile Portfolios
- They overcome the drawback of naive quintile portfolios, i.e. not having pure factor exposures
- They have the same exposures to the target factor as naive quintile portfolios, but zero exposures to other factors
  - More accurately reflect pure factor returns
- They create more efficient factor premia for a set of widely used equity factors
  - Pure quintile portfolios have lower risks than naive quintile portfolios
  - Pure Q1-Q5 portfolios have lower risks, higher returns and higher Sharpe ratios than naive Q1-Q5 portfolios

# Book-to-Price Quintile Portfolios and Their Average Returns

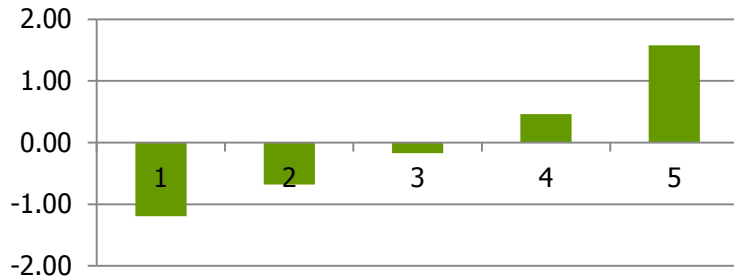


\* Average standardized Book-to-Price score from 1979 to 2014; Russell 1000 universe.

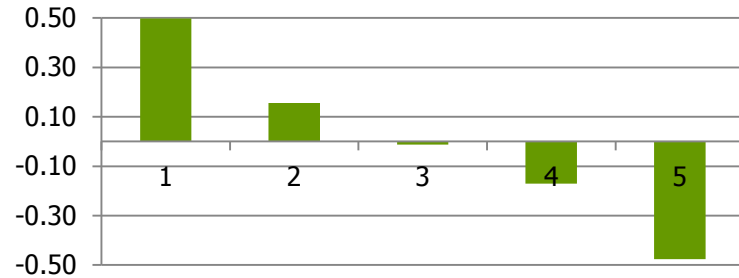
\*\* Simulated historical average return in excess of equal-weighted market return; quintile portfolios are created monthly; returns are annualized and before transaction costs.

# Book-to-Price Quintile Portfolios and Their Factor Exposures

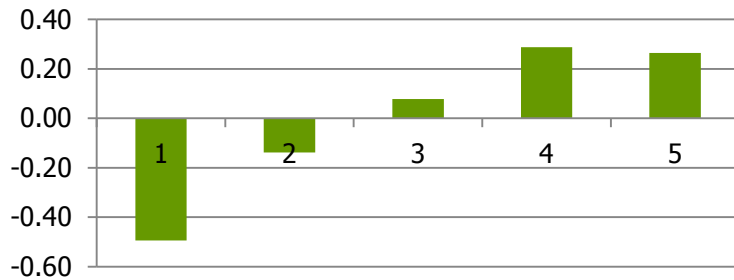
### Standardized Book-to-Price Score



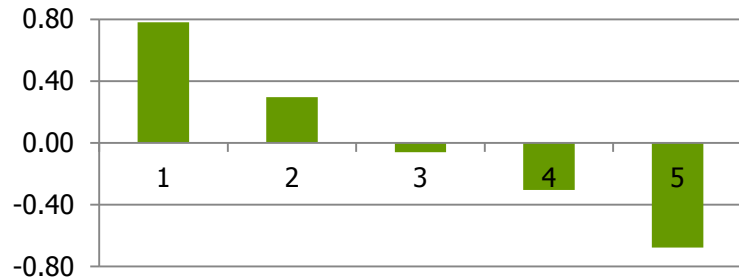
### Standardized Momentum Score



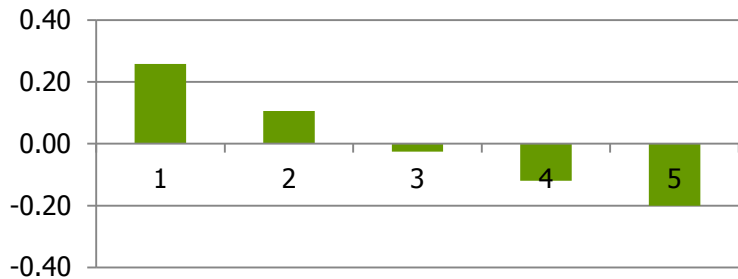
### Standardized Earning-to-Price Score



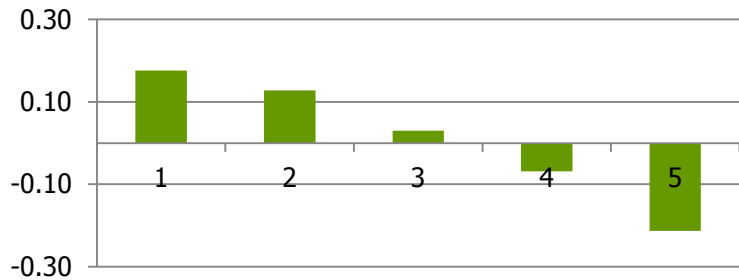
### Standardized RoE Score



### Standardized BSA Score



### Standardized Log Market Cap



# Creating Pure Quintile Portfolios via Optimization

## ■ Two-way sort

- Does not generalize to multiple factors: with 5 factors it would create 3125 buckets
- Does not disentangle factors completely

## ■ Factor-mimicking portfolios / Multivariate regressions

- Only creates one (typically long-short) portfolio with a unit of standardized exposure
- But we are interested in evaluating a spectrum of pure factor exposures
- We adapt and extend the optimization used to create factor-mimicking portfolios

$$\text{Minimize } w'w \tag{3.1}$$

Subject to:

$$w \geq 0 \tag{3.2}$$

$$e'w = 1, \tag{3.3}$$

$$x_i'w = \text{exp}, \quad \text{for the target factor } i \tag{3.4}$$

$$x_i'w = 0, \quad \text{for other non-targeted factors } i \tag{3.5}$$

$$\text{The number of stocks is the same as in the naïve quintile, i.e. about } n/5 \tag{3.6}$$

# Focusing on Standard Well-Known Factors

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- Value: book-to-price
- Size: natural log of market cap
- Price Momentum: 11 month past price return lagged by 1 month
- Profitability: return on equity
- Earnings Quality: balance sheet accruals
- Use simple factor definitions
- Not trying to fine-tune factors for better economic intuition or performance

# Notes on Backtest

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- Winsorize raw factor values at 5% level
- Standardize factor values (i.e. calculate z-scores) to make them comparable
- “Market” is the equal weighted portfolio of all stocks
- Flip the signs of Size and Earnings Quality exposure so that higher exposures mean higher expected returns for all factors
- Quintile 1 highest exposure; quintile 5 lowest exposure
- Portfolios are created at the beginning of each month; returns are calculated through the end of the month
- US (Russell 1000, 1979-2014), International Developed (MSCI World ex. USA, 1995-2014), and Emerging Markets (MSCI EM, 1999-2014)

# Naive and Pure Quintile Portfolio Factor Exposures

Value Naive Quintiles						Value Pure Quintiles					
	Value	Size	Price Momentum	Profitability	Earnings Quality		Value	Size	Price Momentum	Profitability	Earnings Quality
Q1	1.58	0.21	-0.48	-0.68	0.20	Q1	1.58	0.00	0.00	0.00	0.00
2	0.46	0.07	-0.17	-0.31	0.12	2	0.46	0.00	0.00	0.00	0.00
3	-0.17	-0.03	-0.01	-0.06	0.03	3	-0.17	0.00	0.00	0.00	0.00
4	-0.68	-0.13	0.16	0.30	-0.11	4	-0.68	0.00	0.00	0.00	0.00
Q5	-1.19	-0.18	0.50	0.78	-0.26	Q5	-1.19	0.00	0.00	0.00	0.00

Size Naive Quintiles						Size Pure Quintiles					
	Value	Size	Price Momentum	Profitability	Earnings Quality		Value	Size	Price Momentum	Profitability	Earnings Quality
Q1	0.21	1.17	-0.30	-0.21	-0.04	Q1	0.00	1.17	0.00	0.00	0.00
2	0.06	0.70	0.02	-0.08	-0.03	2	0.00	0.70	0.00	0.00	0.00
3	-0.03	0.20	0.10	-0.03	-0.03	3	0.00	0.20	0.00	0.00	0.00
4	-0.03	-0.47	0.08	0.05	0.05	4	0.00	-0.47	0.00	0.00	0.00
Q5	-0.21	-1.59	0.09	0.26	0.05	Q5	0.00	-1.59	0.00	0.00	0.00

Price Momentum Naive Quintiles						Price Momentum Pure Quintiles					
	Value	Size	Price Momentum	Profitability	Earnings Quality		Value	Size	Price Momentum	Profitability	Earnings Quality
Q1	-0.50	-0.05	1.53	0.19	-0.10	Q1	0.00	0.00	1.53	0.00	0.00
2	-0.16	-0.15	0.42	0.13	0.04	2	0.00	0.00	0.42	0.00	0.00
3	0.04	-0.11	-0.11	0.05	0.08	3	0.00	0.00	-0.11	0.00	0.00
4	0.20	-0.01	-0.58	-0.04	0.05	4	0.00	0.00	-0.58	0.00	0.00
Q5	0.43	0.27	-1.27	-0.30	-0.06	Q5	0.00	0.00	-1.27	0.00	0.00

Profitability Naive Quintiles						Profitability Pure Quintiles					
	Value	Size	Price Momentum	Profitability	Earnings Quality		Value	Size	Price Momentum	Profitability	Earnings Quality
Q1	-0.86	-0.26	0.22	1.40	-0.15	Q1	0.00	0.00	0.00	1.40	0.00
2	-0.37	-0.15	0.10	0.43	-0.10	2	0.00	0.00	0.00	0.43	0.00
3	0.12	0.01	0.02	-0.01	-0.01	3	0.00	0.00	0.00	-0.01	0.00
4	0.59	0.07	-0.12	-0.42	0.07	4	0.00	0.00	0.00	-0.42	0.00
Q5	0.58	0.26	-0.24	-1.41	0.18	Q5	0.00	0.00	0.00	-1.41	0.00

Earnings Quality Naive Quintiles						Earnings Quality Pure Quintiles					
	Value	Size	Price Momentum	Profitability	Earnings Quality		Value	Size	Price Momentum	Profitability	Earnings Quality
Q1	0.14	0.06	0.00	-0.34	1.16	Q1	0.00	0.00	0.00	0.00	1.16
2	0.21	-0.10	-0.03	-0.04	0.55	2	0.00	0.00	0.00	0.00	0.55
3	0.08	-0.12	-0.03	0.08	0.19	3	0.00	0.00	0.00	0.00	0.19
4	-0.11	-0.06	-0.03	0.17	-0.29	4	0.00	0.00	0.00	0.00	-0.29
Q5	-0.29	0.11	0.05	0.12	-1.60	Q5	0.00	0.00	0.00	0.00	-1.60

Russell 1000 universe; 1979 to 2014.



# Value Naive and Pure Quintile Portfolio Performance

Value Naive Quintiles					Value Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover
Q1	2.6%	8.7%	0.30	153%	Q1	3.0%	7.7%	0.39	319%
2	0.4%	4.4%	0.10	248%	2	2.2%	3.9%	0.56	612%
3	-0.8%	3.1%	-0.25	255%	3	0.0%	2.9%	0.01	670%
4	-1.2%	4.0%	-0.29	220%	4	-2.0%	3.9%	-0.52	582%
Q5	-1.1%	8.2%	-0.14	130%	Q5	-2.7%	7.2%	-0.37	211%
Q1-Q5	3.7%	15.7%	0.24	282%	Q1-Q5	5.7%	12.3%	0.46	530%

Russell 1000 universe; 1979 to 2014; Returns are before transaction costs and include dividends; Q1 to Q5 returns are in excess of the market; returns and risks are annualized; For Q1 to Q5, the return-to-risk ratio is the Sharpe ratio of long each quintile and short the market; for Q1-Q5 it is the Sharpe ratio of long Q1 and short Q5.

## Size Naive and Pure Quintile Portfolio Performance

Size Naive Quintiles					Size Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover
Q1	2.8%	9.0%	0.31	195%	Q1	3.6%	6.1%	0.59	264%
2	0.2%	3.1%	0.06	225%	2	0.4%	3.7%	0.11	746%
3	-0.6%	2.8%	-0.22	185%	3	-0.5%	2.4%	-0.19	566%
4	-0.4%	3.3%	-0.11	135%	4	-1.2%	3.3%	-0.38	652%
Q5	-2.0%	5.8%	-0.35	69%	Q5	-2.2%	5.0%	-0.44	98%
Q1-Q5	4.8%	14.1%	0.34	265%	Q1-Q5	5.8%	10.3%	0.56	362%

Russell 1000 universe; 1979 to 2014; Returns are before transaction costs and include dividends; Q1 to Q5 returns are in excess of the market; returns and risks are annualized; For Q1 to Q5, the return-to-risk ratio is the Sharpe ratio of long each quintile and short the market; for Q1-Q5 it is the Sharpe ratio of long Q1 and short Q5.

# Momentum Naive and Pure Quintile Portfolio Performance

Price Momentum Naive Quintiles					Price Momentum Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover
Q1	3.7%	10.9%	0.34	328%	Q1	4.2%	10.0%	0.43	398%
2	0.7%	5.4%	0.13	604%	2	0.2%	4.6%	0.04	736%
3	-0.3%	4.3%	-0.08	664%	3	-0.5%	3.3%	-0.15	865%
4	-1.3%	4.6%	-0.27	606%	4	-1.5%	4.5%	-0.34	818%
Q5	-2.8%	13.2%	-0.21	335%	Q5	-3.2%	11.4%	-0.28	378%
Q1-Q5	6.5%	22.3%	0.29	664%	Q1-Q5	7.4%	19.4%	0.38	776%

Russell 1000 universe; 1979 to 2014; Returns are before transaction costs and include dividends; Q1 to Q5 returns are in excess of the market; returns and risks are annualized; For Q1 to Q5, the return-to-risk ratio is the Sharpe ratio of long each quintile and short the market; for Q1-Q5 it is the Sharpe ratio of long Q1 and short Q5.

# Profitability Naive and Pure Quintile Portfolio Performance

Profitability Naive Quintiles					Profitability Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover
Q1	1.4%	4.7%	0.31	103%	Q1	3.3%	5.6%	0.60	245%
2	1.0%	4.0%	0.24	150%	2	2.2%	3.7%	0.58	576%
3	0.2%	4.0%	0.06	173%	3	-0.7%	3.3%	-0.21	743%
4	-0.4%	3.5%	-0.11	168%	4	-1.5%	2.9%	-0.52	527%
Q5	-2.3%	9.9%	-0.23	132%	Q5	-3.0%	6.7%	-0.44	188%
Q1-Q5	3.7%	13.4%	0.28	235%	Q1-Q5	6.3%	9.3%	0.68	433%

Russell 1000 universe; 1979 to 2014; Returns are before transaction costs and include dividends; Q1 to Q5 returns are in excess of the market; returns and risks are annualized; For Q1 to Q5, the return-to-risk ratio is the Sharpe ratio of long each quintile and short the market; for Q1-Q5 it is the Sharpe ratio of long Q1 and short Q5.

# Quality Naive and Pure Quintile Portfolio Performance

Earnings Quality Naive Quintiles					Earnings Quality Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Return-to-Risk Ratio	Annual One-Way Turnover
Q1	3.4%	4.5%	0.76	183%	Q1	3.6%	3.3%	1.09	208%
2	2.5%	4.3%	0.58	253%	2	1.4%	3.2%	0.43	610%
3	1.0%	3.4%	0.28	267%	3	0.9%	3.0%	0.30	619%
4	-1.1%	2.9%	-0.39	241%	4	-1.3%	2.6%	-0.52	606%
Q5	-5.8%	8.1%	-0.71	169%	Q5	-5.0%	5.4%	-0.92	202%
Q1-Q5	9.2%	11.0%	0.84	352%	Q1-Q5	8.6%	7.8%	1.11	411%

Russell 1000 universe; 1979 to 2014; Returns are before transaction costs and include dividends; Q1 to Q5 returns are in excess of the market; returns and risks are annualized; For Q1 to Q5, the return-to-risk ratio is the Sharpe ratio of long each quintile and short the market; for Q1-Q5 it is the Sharpe ratio of long Q1 and short Q5.

## Pure Quintile Portfolios Have Better Performance Net of T-Costs . . .

<b>Naive Q1-Q5 Portfolios</b>	Gross of T-Cost Excess Return	Net of T-Cost Excess Return	Annualized Risk	Net of T-Cost IR		<b>Pure Q1-Q5 Portfolios</b>	Gross of T-Cost Excess Return	Net of T-Cost Excess Return	Annualized Risk	Net of T-Cost IR
Value	3.7%	2.0%	15.7%	0.13		Value	5.7%	2.5%	12.3%	0.21
Size	4.8%	3.2%	14.1%	0.23		Size	5.8%	3.6%	10.3%	0.35
Momentum	6.5%	2.5%	22.3%	0.11		Momentum	7.4%	2.8%	19.4%	0.14
Profitability	3.7%	2.3%	13.4%	0.17		Profitability	6.3%	3.7%	9.3%	0.40
Quality	9.2%	7.1%	11.0%	0.65		Quality	8.6%	6.1%	7.8%	0.79

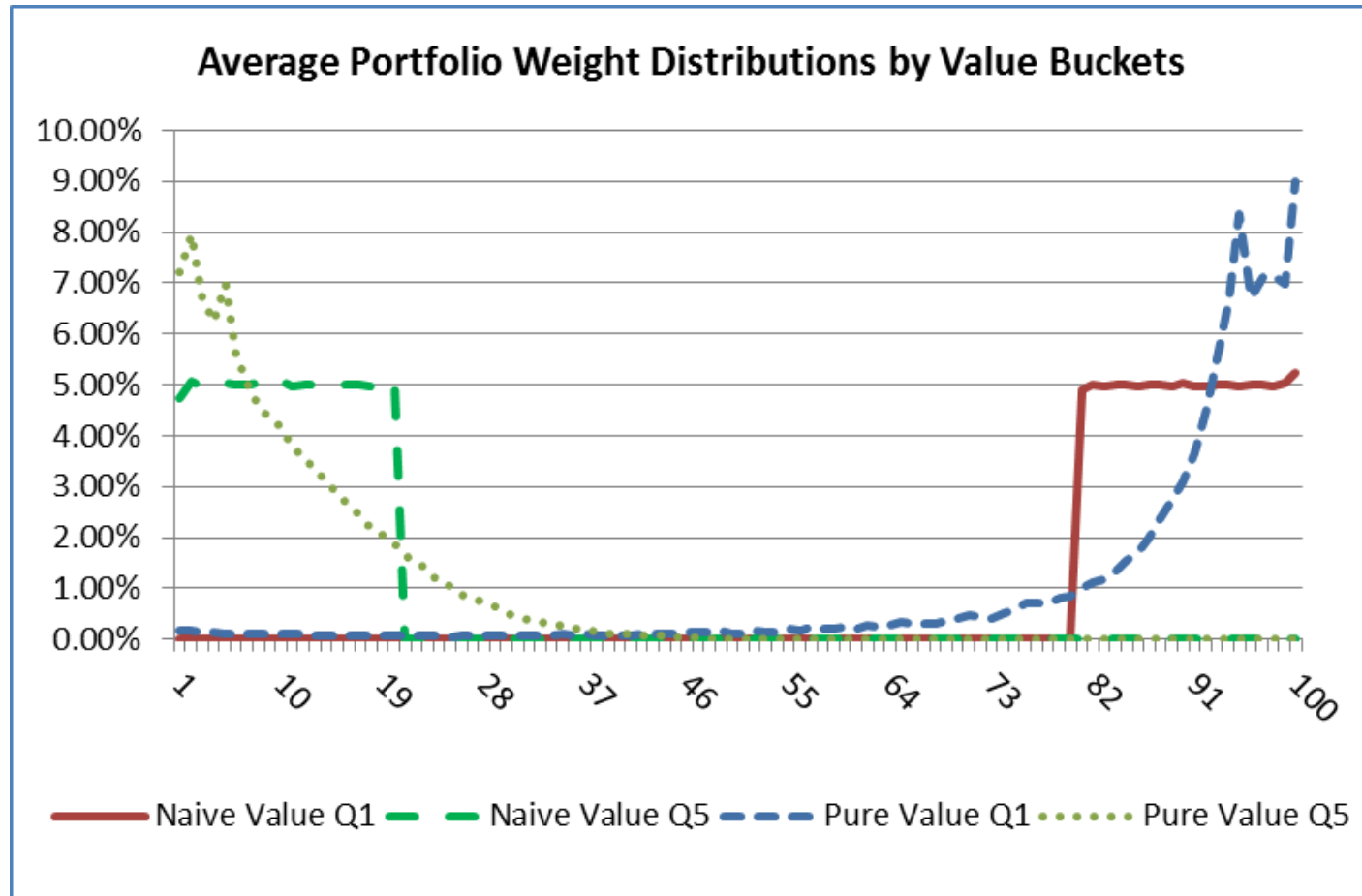
Transaction costs are assumed to be 30bps per trade one-way; returns and risks are annualized.

## . . . or Rebalanced Quarterly

<b>Naive Q1-Q5 Portfolios</b>	Gross of T-Cost Excess Return	Net of T-Cost Excess Return	Annualized Risk	Net of T-Cost IR		<b>Pure Q1-Q5 Portfolios</b>	Gross of T-Cost Excess Return	Net of T-Cost Excess Return	Annualized Risk	Net of T-Cost IR
Value	2.1%	1.1%	17.7%	0.06		Value	3.3%	1.7%	13.8%	0.12
Size	3.7%	2.8%	14.8%	0.19		Size	4.7%	3.5%	10.8%	0.32
Momentum	6.3%	4.1%	23.2%	0.17		Momentum	7.4%	4.9%	19.1%	0.26
Profitability	3.1%	2.0%	14.4%	0.14		Profitability	4.4%	2.8%	10.4%	0.27
Quality	9.0%	7.3%	11.1%	0.66		Quality	7.9%	6.1%	7.6%	0.81

Transaction costs are assumed to be 30bps per trade one-way; returns and risks are annualized. Each quintile portfolio return is calculated as the average of 3 sub-portfolios created at the beginning of January, February and March of 1979 respectively. Each sub-portfolio is recreated every 3 months, and its return is calculated through the end of the 3-month period.

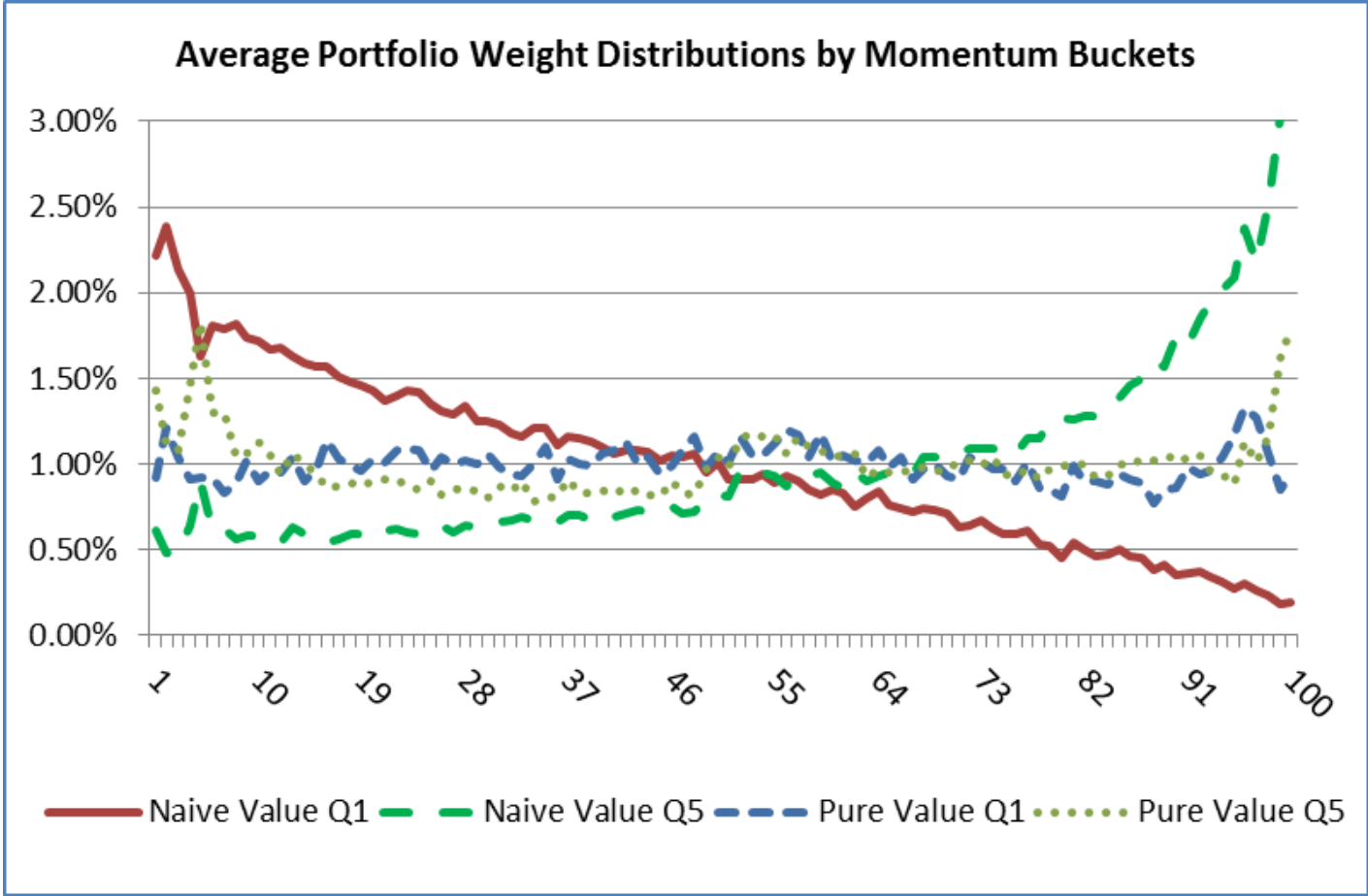
# Pure and Naive Value Q1 & Q5 Portfolio Bucket Weights



This chart shows average weight distributions of naive and pure Value Q1 & Q5 in buckets sorted by Value. Every month we sort by each factor and create 100 buckets, with bucket 1 having the lowest exposure and bucket 100 having the highest exposure. For each quintile portfolio we calculate the total percentage of its weights from each bucket in each month, and average over all months.

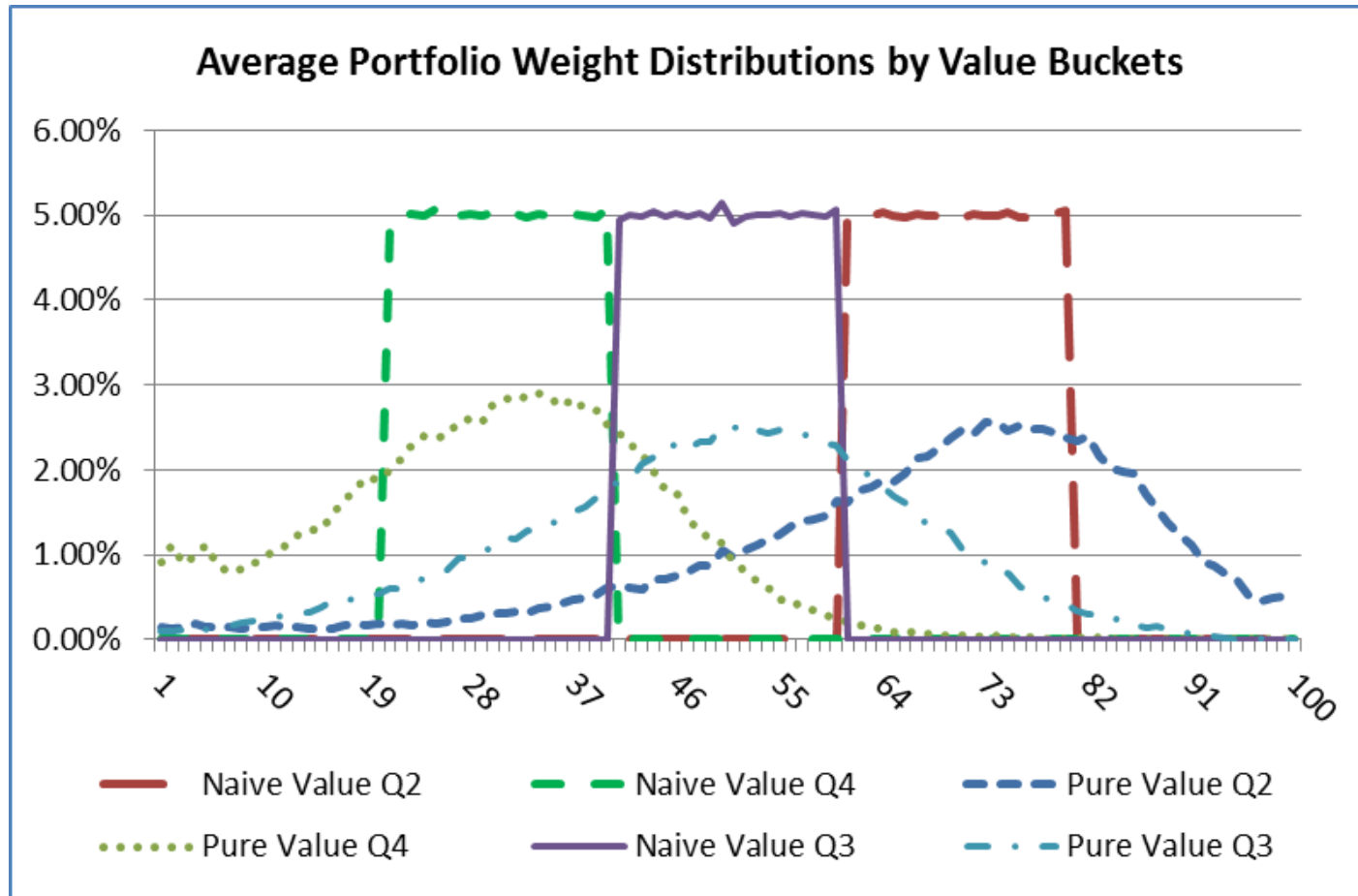


# Pure Value Q1 & Q5 Portfolios Have Little Momentum Exposures



This chart shows average weight distributions of naive and pure Value Q1 & Q5 in buckets sorted by Price Momentum.

# Pure and Naive Value Q2/Q3/Q4 Portfolio Bucket Weights



This chart shows average weight distributions of naive and pure Value Q2, Q3 & Q4 in buckets sorted by Value.

# Pure Quintile Portfolios also Have Better Performance on International Developed Stocks . . .

Value Naive Quintiles					Value Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	3.9%	8.4%	0.47	156%	Q1	6.4%	8.6%	0.75	323%
2	0.7%	3.6%	0.21	261%	2	2.1%	3.4%	0.60	590%
3	-1.3%	2.8%	-0.48	265%	3	-0.8%	2.7%	-0.32	665%
4	-2.0%	3.6%	-0.57	212%	4	-2.9%	3.6%	-0.80	491%
Q5	-1.2%	7.0%	-0.17	115%	Q5	-3.9%	7.1%	-0.56	195%
Q1-Q5	5.1%	14.4%	0.35	271%	Q1-Q5	10.4%	12.8%	0.81	518%
Size Naive Quintiles					Size Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	1.4%	6.0%	0.23	128%	Q1	0.4%	4.7%	0.09	156%
2	-0.1%	3.1%	-0.03	178%	2	0.4%	3.6%	0.12	663%
3	-0.4%	2.5%	-0.17	166%	3	0.4%	3.4%	0.13	681%
4	-0.5%	2.5%	-0.20	127%	4	0.0%	2.8%	-0.01	640%
Q5	-0.4%	4.8%	-0.09	67%	Q5	0.0%	4.6%	-0.01	99%
Q1-Q5	1.8%	9.9%	0.18	195%	Q1-Q5	0.4%	7.8%	0.06	255%

Price Momentum Naive Quintiles					Price Momentum Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	2.3%	8.4%	0.27	324%	Q1	2.9%	7.9%	0.36	385%
2	1.4%	4.8%	0.29	612%	2	2.1%	4.4%	0.48	780%
3	0.7%	3.4%	0.20	665%	3	0.7%	2.8%	0.23	895%
4	-0.8%	3.7%	-0.21	606%	4	-1.9%	3.8%	-0.49	825%
Q5	-3.6%	11.7%	-0.30	324%	Q5	-4.1%	10.9%	-0.37	383%
Q1-Q5	5.8%	19.1%	0.30	648%	Q1-Q5	6.9%	17.6%	0.39	767%
Profitability Naive Quintiles					Profitability Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	1.9%	5.4%	0.35	93%	Q1	4.5%	6.7%	0.68	240%
2	1.8%	4.3%	0.41	140%	2	2.4%	3.2%	0.76	611%
3	0.6%	3.0%	0.19	157%	3	-1.2%	4.0%	-0.29	765%
4	-1.5%	4.2%	-0.35	151%	4	-2.2%	4.0%	-0.55	602%
Q5	-2.6%	7.7%	-0.34	120%	Q5	-5.0%	5.5%	-0.92	179%
Q1-Q5	4.5%	12.3%	0.37	213%	Q1-Q5	9.6%	10.6%	0.90	419%
Earnings Quality Naive Quintiles					Earnings Quality Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	1.6%	3.6%	0.43	134%	Q1	1.4%	3.1%	0.46	159%
2	1.4%	3.5%	0.39	149%	2	1.2%	3.1%	0.38	634%
3	0.2%	3.1%	0.08	156%	3	1.4%	2.6%	0.52	530%
4	-0.3%	2.6%	-0.11	149%	4	-0.5%	2.2%	-0.24	566%
Q5	-2.9%	5.4%	-0.54	127%	Q5	-3.1%	4.4%	-0.69	164%
Q1-Q5	4.5%	7.5%	0.60	261%	Q1-Q5	4.5%	5.9%	0.76	323%

# . . . and Emerging Markets Stocks

Value Naive Quintiles					Value Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	5.9%	10.1%	0.59	175%	Q1	9.6%	8.5%	1.14	287%
2	1.9%	4.2%	0.46	286%	2	1.3%	4.2%	0.32	685%
3	-1.4%	3.0%	-0.48	299%	3	-1.7%	4.2%	-0.41	714%
4	-2.5%	4.9%	-0.52	251%	4	-4.5%	5.6%	-0.80	551%
Q5	-3.7%	7.9%	-0.46	140%	Q5	-9.2%	9.4%	-0.98	231%
Q1-Q5	9.6%	16.9%	0.57	316%	Q1-Q5	18.8%	14.7%	1.27	518%
Size Naive Quintiles					Size Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	1.9%	10.9%	0.17	155%	Q1	0.9%	9.0%	0.11	187%
2	0.5%	3.8%	0.12	229%	2	-0.6%	4.7%	-0.13	554%
3	0.1%	3.7%	0.02	218%	3	-1.1%	3.3%	-0.33	579%
4	-0.2%	4.4%	-0.04	172%	4	1.2%	4.3%	0.28	716%
Q5	-1.8%	5.3%	-0.33	93%	Q5	-0.3%	5.3%	-0.05	98%
Q1-Q5	3.7%	15.0%	0.24	248%	Q1-Q5	1.2%	12.3%	0.10	286%

Price Momentum Naive Quintiles					Price Momentum Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	5.2%	9.2%	0.56	319%	Q1	6.6%	9.3%	0.71	356%
2	1.6%	5.9%	0.26	601%	2	1.7%	5.0%	0.33	812%
3	-0.3%	4.8%	-0.07	661%	3	-1.2%	4.1%	-0.29	824%
4	-3.2%	4.5%	-0.71	610%	4	-3.9%	5.0%	-0.79	780%
Q5	-3.2%	12.5%	-0.26	340%	Q5	-6.9%	11.4%	-0.60	396%
Q1-Q5	8.4%	19.5%	0.43	659%	Q1-Q5	13.5%	18.5%	0.73	752%
Profitability Naive Quintiles					Profitability Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	1.9%	6.0%	0.32	119%	Q1	2.9%	7.2%	0.40	236%
2	0.2%	4.1%	0.05	175%	2	2.9%	4.7%	0.62	601%
3	1.0%	4.0%	0.24	189%	3	1.6%	4.2%	0.38	694%
4	0.4%	3.1%	0.12	180%	4	-1.8%	3.8%	-0.46	565%
Q5	-3.4%	9.3%	-0.37	140%	Q5	-7.1%	7.9%	-0.90	182%
Q1-Q5	5.3%	14.0%	0.38	259%	Q1-Q5	10.0%	12.0%	0.83	418%
Earnings Quality Naive Quintiles					Earnings Quality Pure Quintiles				
	Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover		Avg. Annual Excess Return	Annualized Risk	Information Ratio	Annual One-Way Turnover
Q1	0.3%	5.2%	0.05	140%	Q1	0.0%	4.0%	0.00	164%
2	1.5%	3.9%	0.38	154%	2	-0.3%	4.3%	-0.07	709%
3	1.4%	3.4%	0.41	162%	3	0.7%	3.2%	0.21	571%
4	-0.5%	3.5%	-0.15	159%	4	-0.8%	4.0%	-0.19	660%
Q5	-2.6%	6.3%	-0.41	142%	Q5	-2.3%	5.7%	-0.41	178%
Q1-Q5	2.8%	10.0%	0.28	281%	Q1-Q5	2.3%	8.4%	0.28	342%

# Conclusion

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- A common way to evaluate factors is to sort and create quintile portfolios
  - Does not control for exposures to other factors; does not reflect the efficacy of pure factor exposures
  - Existing techniques to disentangle factors either do not generalize to multiple factors, or do not extend to a spectrum of pure factor exposures
- We propose a new framework “Pure Quintile Portfolios” to address these issues
  - Adapt and extend the optimization used to create factor-mimicking portfolios
  - Each pure quintile portfolio has the same exposure to the target factor and the same number of stocks as the naive quintile portfolio, but has zero exposures to other factors
  - Strong evidence in the US that pure quintile portfolios have lower risks, and pure Q1-Q5 portfolios have lower risks, higher returns and higher Sharpe ratios than their naïve counterparts
  - The results hold after transaction costs
  - Similar but somewhat weaker results with International Developed and Emerging Market stocks

Thank You!

## Are the Sharpe Ratio Differences Statistically Significant?

	Gross of T-Cost				Net of T-Cost		
	Pure minus Naive SR (Monthly)	Standard Error of SR Difference	T-Stat of SR Difference		Pure minus Naive SR (Monthly)	Standard Error of SR Difference	T-Stat of SR Difference
Value	6.5%	3.8%	1.69		2.2%	3.9%	0.56
Size	6.4%	2.5%	2.50		3.5%	2.5%	1.38
Profitability	11.5%	4.1%	2.82		6.5%	4.0%	1.64
Momentum	2.6%	1.4%	1.95		0.9%	1.3%	0.66
Quality	7.8%	2.4%	3.32		4.3%	2.2%	1.96

- "Comparing Sharpe Ratios: So where are the p-values?" by J.D. Opdyke, *Journal of Asset Management*, 8(5), Dec. 2007
- "The Statistics of Sharpe Ratios" by Andrew Lo, *Financial Analyst Journal*, Vol. 58, No. 4, July/August 2002