



**Time Series Variation in Factor Premia:  
The Influence of the Business Cycle**  
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# Agenda



- Understanding factor fundamentals, cyclicity and sensitivity to cash-flow news
- Moving from static to dynamic multifactor portfolios
- Designing a forward-looking macro regime framework to implement dynamic factor rotation
- Results

# FTSE Russell Equity Factors

Factor definitions consistently applied through market segments and regions



Factor	Description	FTSE Russell Factor Definition	FTSE Russell Factor Index
<b>Value</b>	Stocks that appear cheap tend to perform better than stocks that appear expensive.	Equally weighted composite of cash flow yield, earnings yield and price-to-sales ratio	Russell 1000 Value Factor Index
<b>Quality</b>	Higher-quality companies tend to perform better than lower-quality companies.	Equally weighted composite of profitability (return on assets, change in asset turnover, accruals) & leverage ratio	Russell 1000 Quality Factor Index
<b>Size</b>	Smaller companies tend to perform better than larger companies.	Inverse of full market capitalization index weights <sup>1</sup>	Russell 1000 Size Factor Index
<b>Low Volatility</b>	Stocks that exhibit low volatility tend to perform better than stocks with higher volatility.	Standard deviation of 5 years of weekly total returns	Russell 1000 Volatility Factor Index
<b>Momentum</b>	Stocks that rise or fall in price tend to continue rising or falling in price.	Cumulative 11-month return (last 12 months excluding the most recent month)	Russell 1000 Momentum Factor Index
<b>Yield</b>	Higher-yielding stocks (those that pay higher dividends) tend to perform better than stocks with lower yields	12-month trailing dividend yield <sup>2</sup>	Russell 1000 Yield Factor Index

1. Measured as the natural logarithm of the full market capitalization

2. Measured as the natural logarithm of the 12 month trailing dividend yield

# Motivating the Construction of Multifactor Portfolios



## Correlation of Monthly Hypothetical Excess Returns: Russell 1000 Factor Indexes Jul. 2001 – Dec. 2018

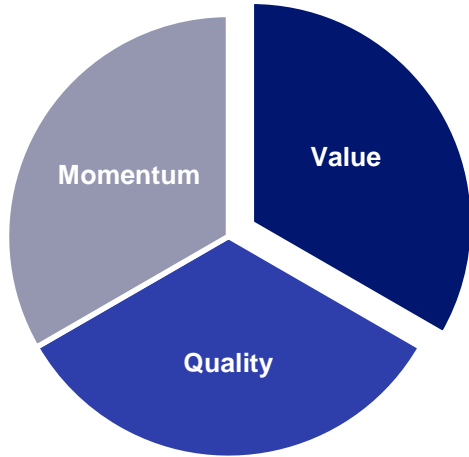
Investment	Value	Yield	Low Vol.	Quality	Size	Momentum
Russell 1000 Value Factor Index	1.00					
Russell 1000 Yield Factor Index	0.38	1.00				
Russell 1000 Volatility Factor Index	-0.02	0.82	1.00			
Russell 1000 Quality Factor Index	-0.32	0.22	0.51	1.00		
Russell 1000 Size Factor Index	0.35	-0.35	-0.61	-0.46	1.00	
Russell 1000 Momentum Factor Index	-0.29	-0.01	0.17	0.49	-0.08	1.00

Source: FTSE Russell, as of 12/31/18. Sample 7/31/01 - 12/31/18. An investor cannot invest directly in an index. **Data presented is provided for illustrative purposes and reflects hypothetical historical performance, which provides no assurance of future results.** Past performance is not a guarantee of future results. Index returns do not reflect fund fees. See Appendix for important information regarding back-tested data.

# Factor Combination: Top-Down vs. Bottom-Up

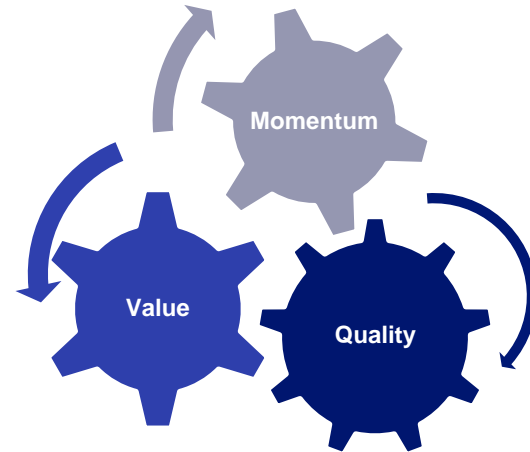


**Top-Down**  
Combine single factor index 'sleeves'



Although easier to implement, focusing on individual factor objectives in silos may result in a final portfolio with reduced exposure to desired factors.

**Bottom-Up**  
Stock level approach



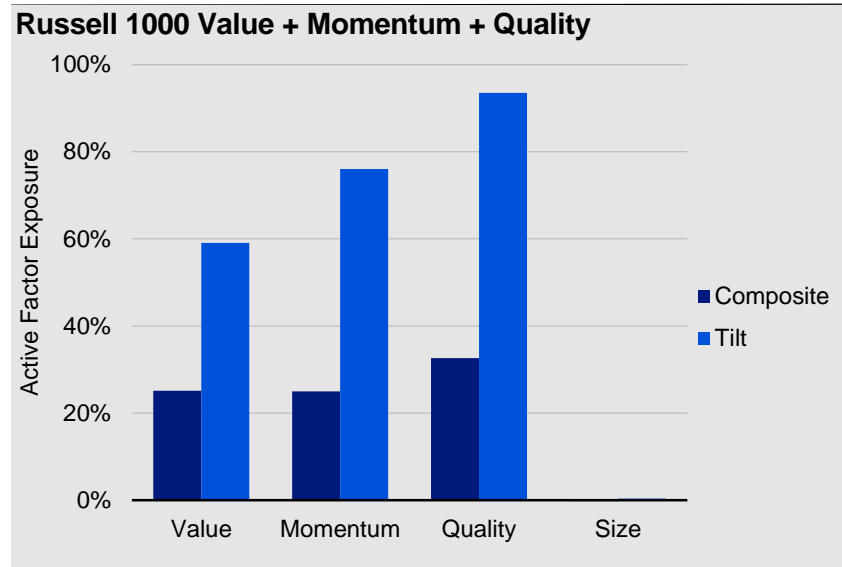
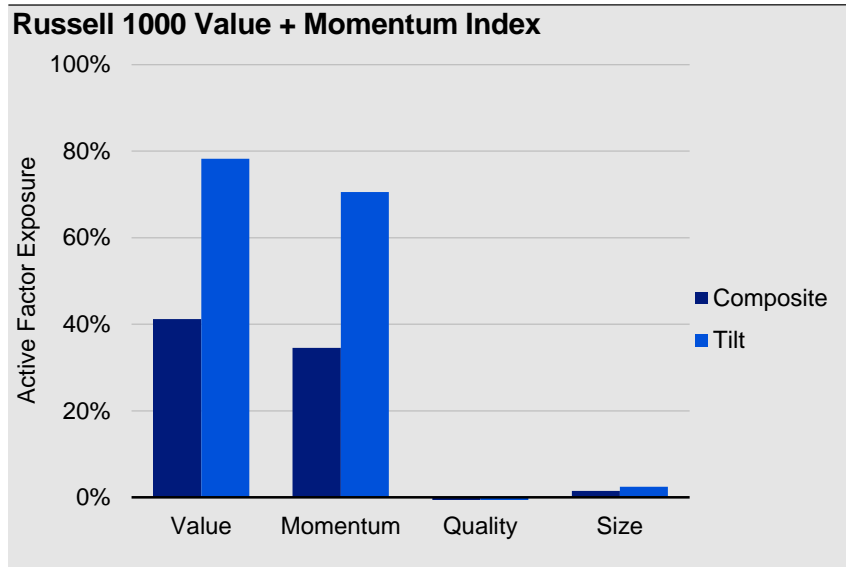
Bottom-up construction targets a portfolio of securities that have optimal exposure to all targeted factors by taking into account how the security scores in each factor.

# Bottom-Up Improves Factor Exposure



- Each graph shows the factor exposure within the multifactor index as a percentage of single factor index exposure

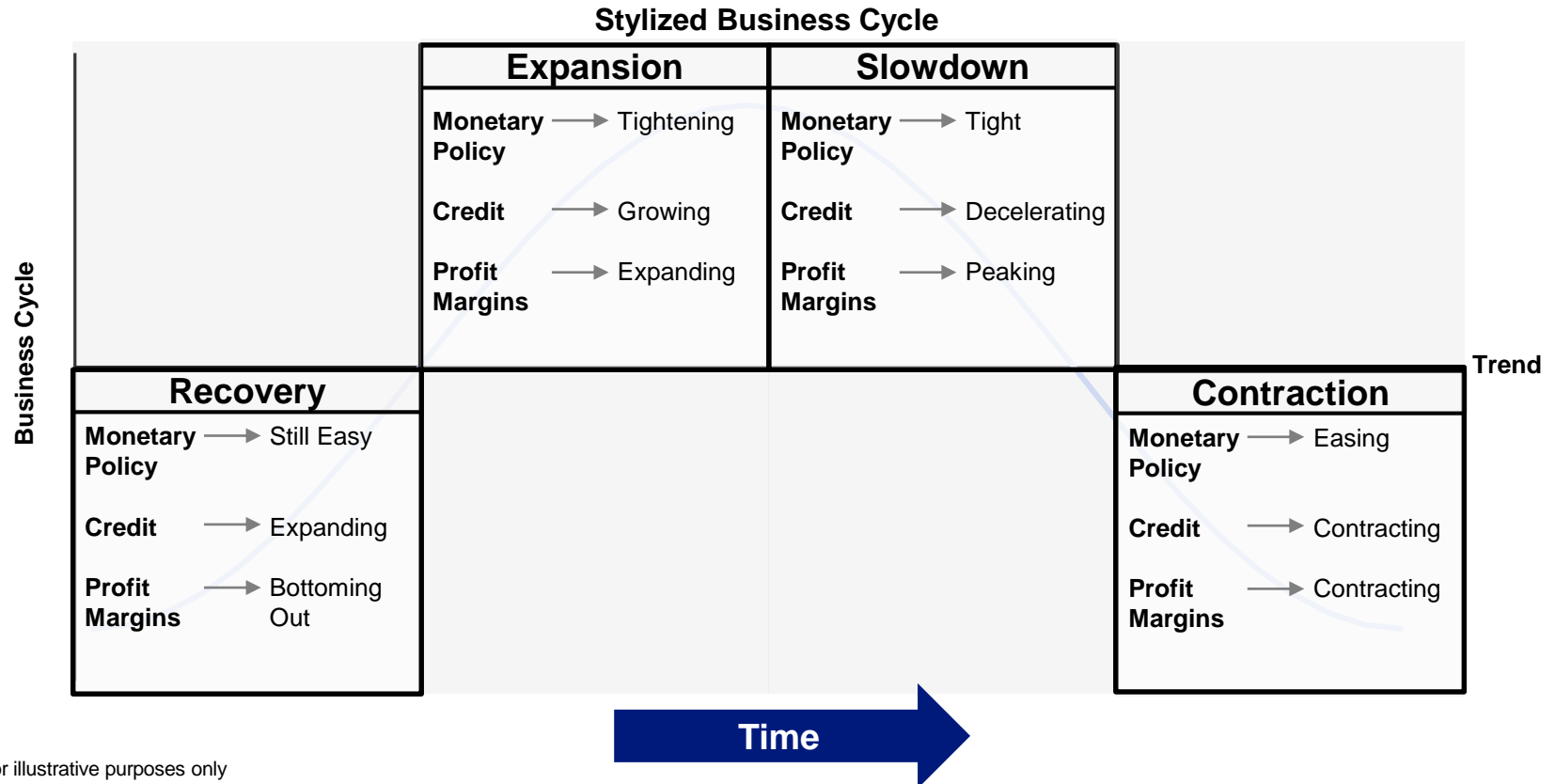
## Illustrative Example



- The top down indexes yield the average of the exposures of their single factor index components, which leads to offsetting factor exposure
- The bottom-up methodology generates higher factor exposures as additional factors are added
- Bottom-up construction identifies stocks that display optimal combination of desired factors

Information on this slide is for illustrative purposes only

# Understanding the Business Cycle



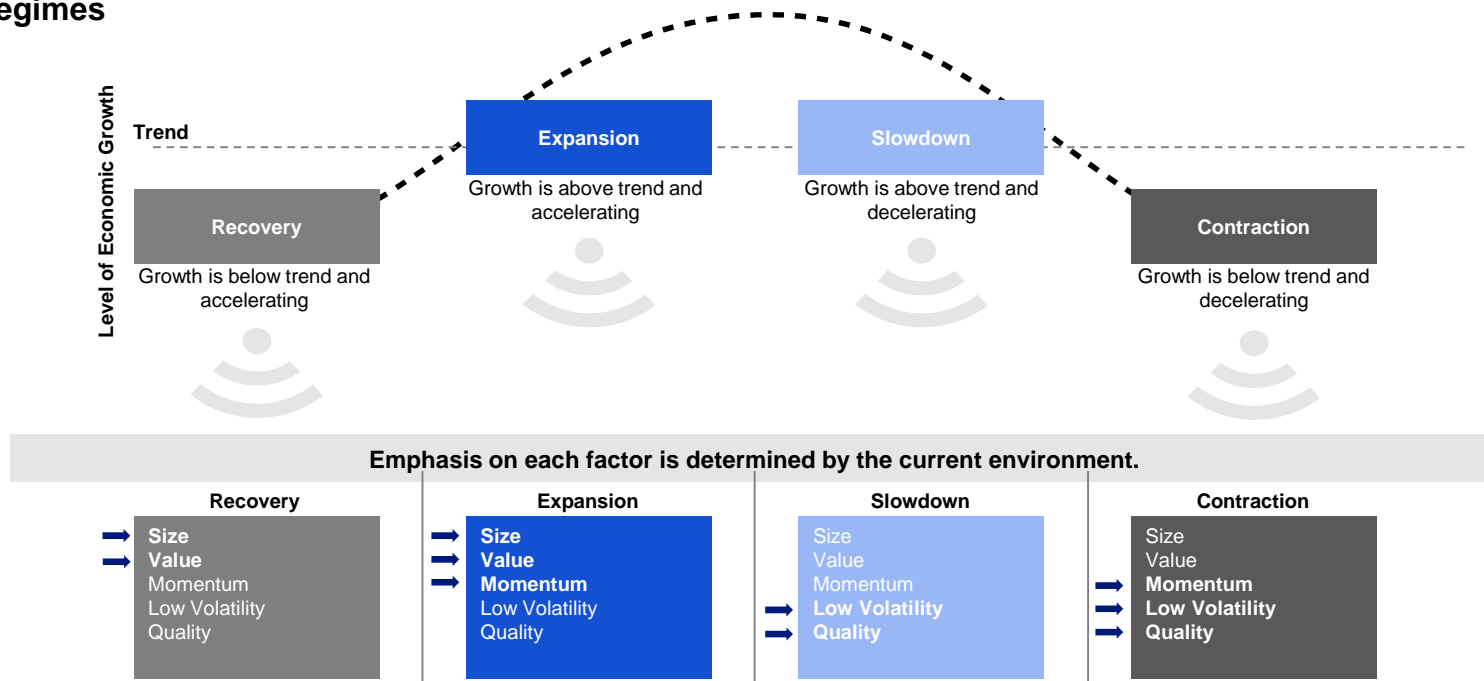
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# Macro Regimes and Factor Cyclicity



Factor returns vary under different macro environments

## Four Regimes



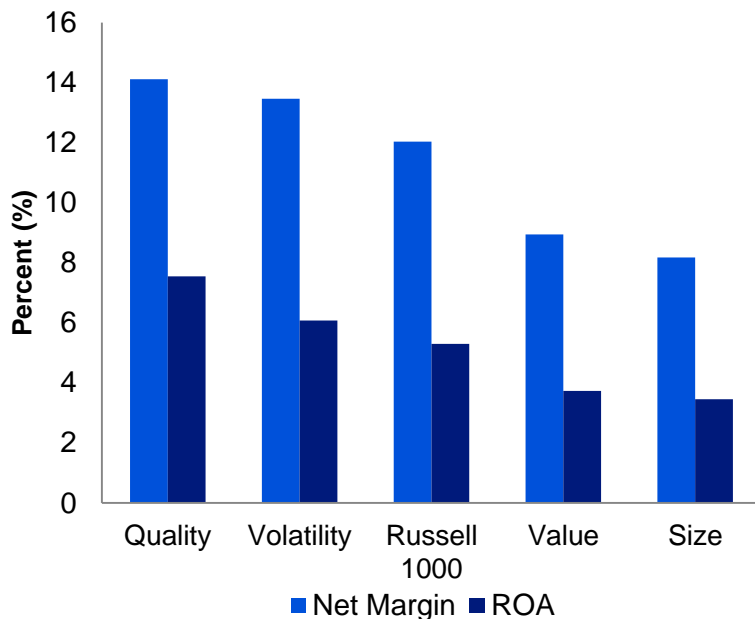
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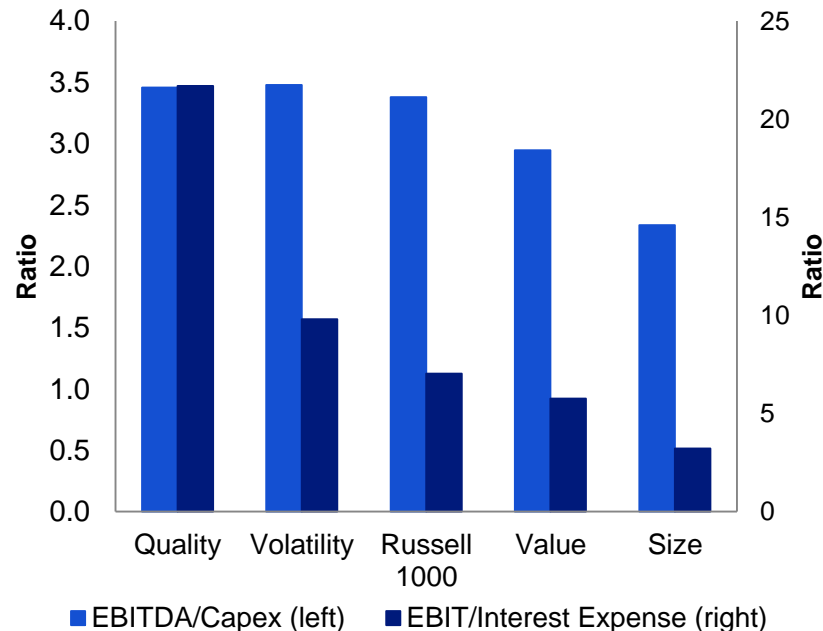
# Factor Fundamentals and Cyclicity



## Profitability and Margins



## Capex and Interest Coverage Ratios



Source: FactSet 12/31/2018. FTSE Russell single factor indices used as proxies for calculation purposes. Chart shows average ratios between 6/30/2001-12/31/2018. An investment cannot be made into an index.

# Estimating Factor Sensitivity to Aggregate Cash-Flow News



- Campbell and Shiller's (1988a) insight that returns on the market portfolio are comprised of two components: a cash-flow news component and a discount rate news component.
- Campbell and Shiller (1988a) and Campbell (1991) show how unexpected log returns on an asset may be decomposed written as follows:

$$\begin{aligned} r_{t+1} - E_t r_{t+1} &= (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \Delta r_{t+1+j} \\ &= N_{CF,t+1} - N_{DR,t+1}, \end{aligned}$$

$N_{CF,t+1}$  reflects news about future cash flows,  $N_{DR,t+1}$  reflects news about future expected returns, and  $\rho$  is a discount coefficient determined by the average log dividend yield.

Footnote: Note that this decomposition is simply an accounting identity and not a behavioral model, taking no stance on whether variation in expected returns is rational or irrational.

# Estimating Factor Sensitivity to Aggregate Cash-Flow News



$$R_{p,t+1} = a + \sum_{k=0}^2 \beta_p N_{CF,t+1-k} + \epsilon_{p,t+1}$$

## Single Factor Exposure to Aggregate Cash-Flow News

	Constant	Cash Flow News Sensitivity	R <sup>2</sup>
<b>Russell 1000</b>	0.01 (5.28)	0.97 (6.98)	0.19
<b>Russell 1000 Comprehensive Factor Index</b>	0.01 (6.75)	0.91 (6.79)	0.16
<b>Low Volatility</b>	0.01 (5.83)	0.75 (6.06)	0.15
<b>Quality</b>	0.01 (5.41)	0.94 (6.69)	0.18
<b>Value</b>	0.01 (5.55)	0.99 (7.14)	0.17
<b>Size</b>	0.01 (5.37)	1.16 (7.45)	0.18

Source: FTSE Russell as of 6/30/18. Sample 7/31/80 - 6/30/18.

The Comprehensive Factor Index represents a static multifactor portfolio, using the tilt-tilt FTSE Russell bottom-up portfolio construction methodology. We report *t* statistics in parentheses. Sample time-period dictated by data availability for factor indices and cash-flow news series.

# Momentum Factor: Sensitivity to Aggregate Cash-Flow News



## Momentum Factor: Excess Returns Sensitivity to Cash Flow News by Regime

	Constant	Cash-Flow News Sensitivity	R <sup>2</sup>
<b>Unconditional</b> (N=354)	0.00	0.01	0.00
	(1.17)	(-0.48)	
<b>Recovery</b> (N=43)	0.00	-0.04	0.02
	(0.35)	(-0.54)	
<b>Expansion</b> (N=124)	0.00	0.05	0.00
	(1.04)	(1.06)	
<b>Slowdown</b> (N=131)	0.00	0.03	0.00
	(0.51)	(0.74)	
<b>Contraction</b> (N=56)	0.00	-0.09	0.07
	(0.04)	(-2.24)	

Source: FTSE Russell as of 6/30/18. Sample 1/31/89 - 6/30/18.

We report *t* statistics in parentheses. Sample time-period dictated by data availability for factor indices and cash-flow news series.

# Factor tilts for each regime portfolio



- Building four regime-specific portfolios, with factor tilts that incorporate considerations for liquidity, capacity, diversification and turnover

## Factor Tilts for Given Regime Portfolios

	Low Volatility	Size	Value	Momentum	Quality
Recovery	0	2	2	0	0
Expansion	0	1	1	2	0
Slowdown	2	0	0	0	2
Contraction	2	0	0	2	2

## Reference Portfolio Factor Tilts

Russell 1000	0	0	0	0	0
R1 Comprehensive	1	1	1	1	1

Source: Factor tilts as characteristic weights in the standard FTSE Russell methodology (FTSE Russell 2017)

# Regime Portfolios: Cash-Flow Sensitivity



## Cash-Flow Sensitivity by Regime Portfolio

	Constant	Cash-Flow News Sensitivity	R <sup>2</sup>
<b>Recovery Portfolio (R)</b>	0.01 (5.90)	1.09 (6.95)	0.16
<b>Expansion Portfolio (E)</b>	0.01 (5.97)	1.09 (7.46)	0.18
<b>Slowdown Portfolio (S)</b>	0.01 (6.32)	0.74 (6.03)	0.15
<b>Contraction Portfolio (C)</b>	0.01 (5.94)	0.82 (6.12)	0.14
<b>0.5*(R+E) - 0.5*(S+C)</b>	0.00 (1.39)	0.31 (3.81)	0.03

Portfolios designed to have more cyclical exposures (i.e. beta >1) when growth is accelerating and more defensive exposures (i.e. beta <1) when growth is decelerating

Source: FTSE Russell as of 6/30/18. Sample 7/31/80 - 6/30/18. We report *t* statistics in parentheses.

# Macro Regimes Identification Using Leading Economic Indicators and Global Risk Appetite



Combining U.S. Leading Economic Indicator and Global Market Sentiment to Identify Economic Regimes

## U.S. Leading Economic Indicator (LEI)

Equally weighted:

- Manufacturing business surveys
- Consumer sentiment surveys
- Monetary conditions
- Housing/Construction activity
- Manufacturing activity
- Labor market activity



## Global Risk Appetite Cycle Indicator (GRACI)\*

Equally weighted:

- Country-level total return indices across equity, credit and fixed income markets
- Developed and emerging markets
- Global benchmark providers: FTSE Russell, MSCI, Barclays, JPMorgan, Credit Suisse

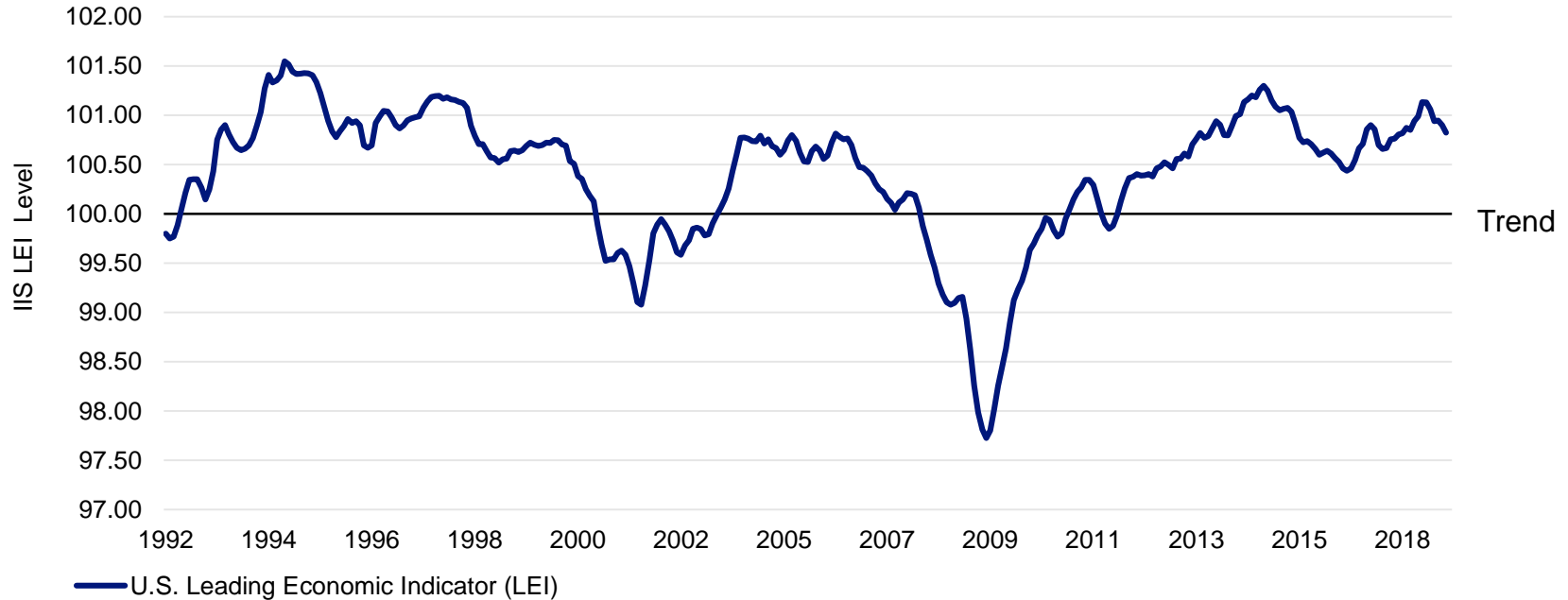
\* Footnote: The global risk appetite indicator measures the incremental returns received by investors for an incremental unit of risk taken in global financial markets (see for example Kumar and Persaud (2002), and Polk, Thompson and Vuolteenaho (2006))

# US Leading Economic Indicator Through Time



## Invesco Investment Solutions (IIS) - U.S. Leading Economic Indicator (LEI)

Jan. 1992 – Dec. 2018



Sources: Bloomberg, Federal Reserve, Invesco's research and calculations, 12/31/2018. **Past performance does not guarantee future results.**



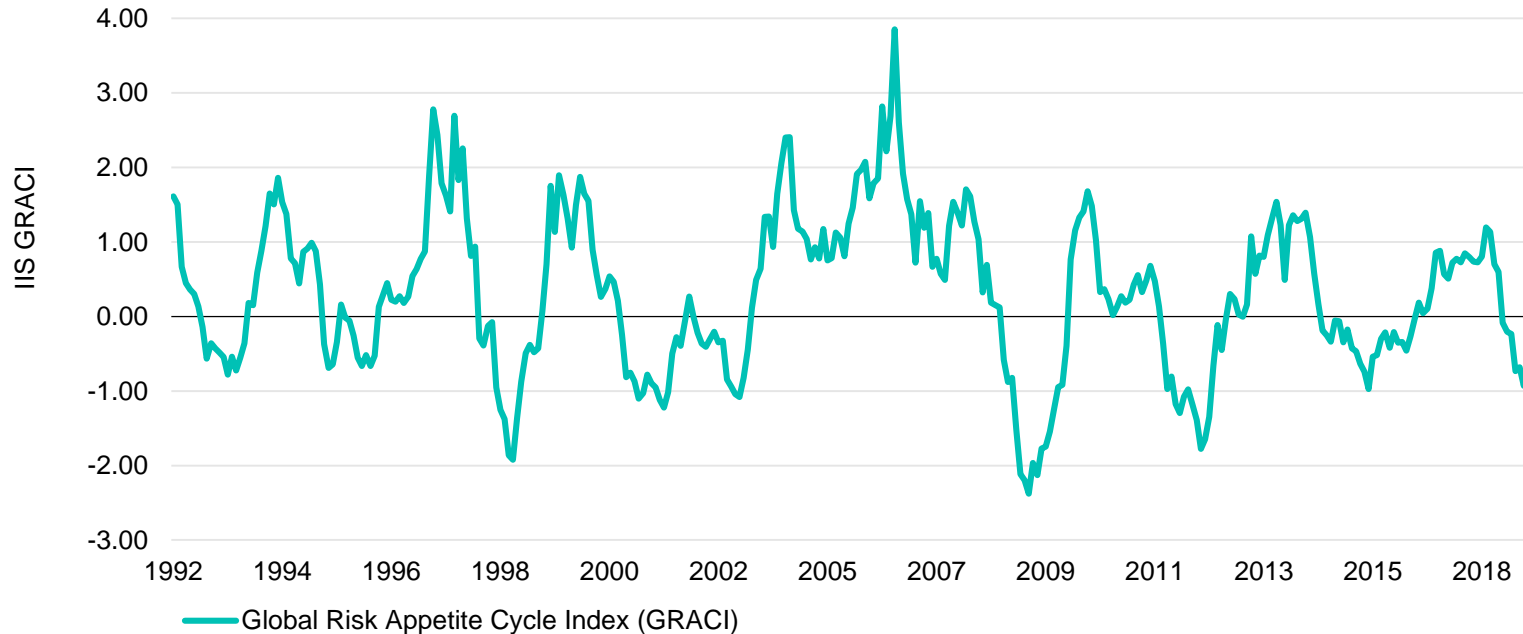
# Global Risk Appetite Cycle Through Time

Measuring the incremental returns received by investors for an incremental unit of risk taken in global financial markets



## Invesco Investment Solutions (IIS) - Global Risk Appetite Cycle Indicator (GRACI)

Jan. 1992 – Dec. 2018



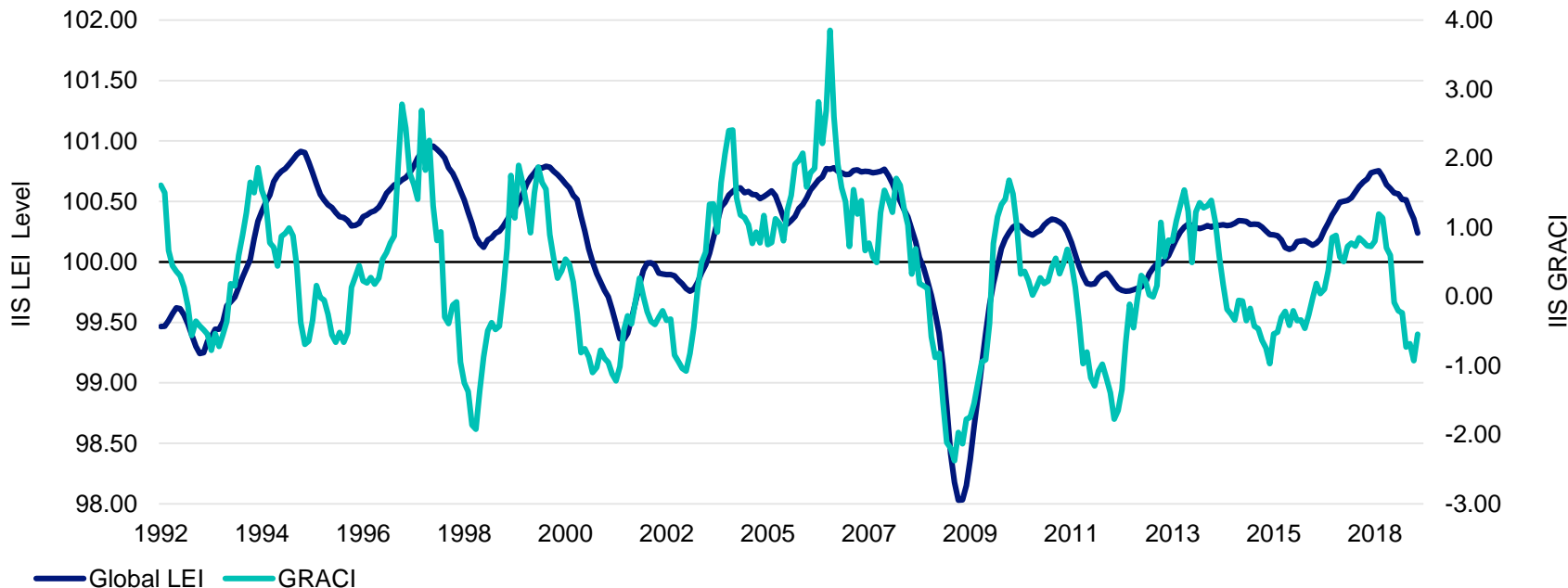
Sources: Bloomberg, MSCI, Citi, Barclays, JPMorgan, Invesco's research and calculations, 12/31/2018. **Past performance does not guarantee future results.**

# Risk Appetite as a Leading Indicator of the Global Business Cycle



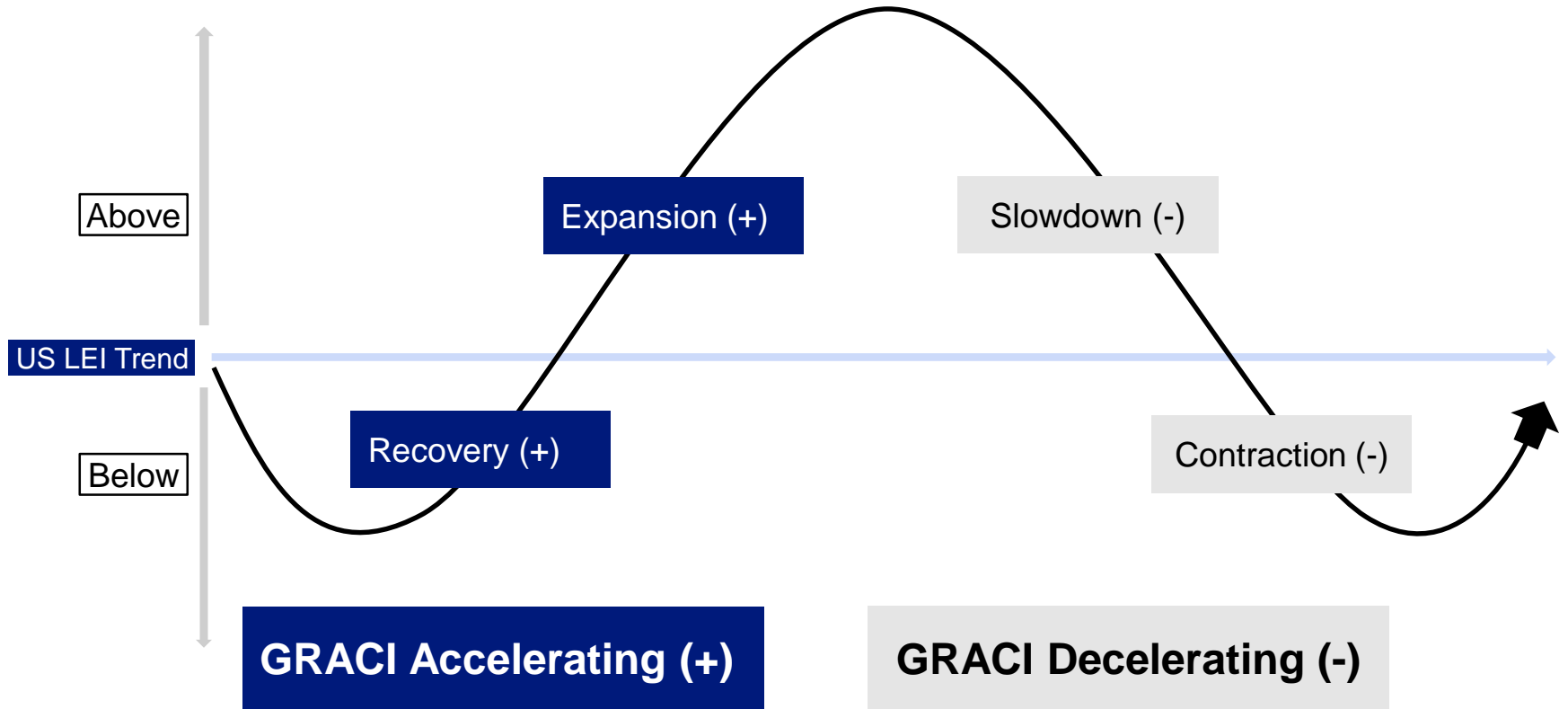
- Exploiting the insight in de Longis and Ellis (2019), using risk appetite as a leading indicator of turning points in global growth to define macro regimes

Jan. 1992 – Dec. 2018



Sources: Bloomberg, MSCI, Citi, Barclays, JPMorgan, Invesco's research and calculations, 12/31/2018. **Past performance does not guarantee future results.**

# Forecasting Regimes with US LEI and Global Risk Appetite



For illustrative purposes only

# Russell 1000 Dynamic Factor Strategy Performance



## Mean Returns, before transaction costs, and *t* statistic (Jan. 1989 – Sept. 2018)

	Mean Monthly Return	Mean Monthly Excess Return over Russell 1000 Index	Mean Monthly Excess Return over R1000 Comprehensive Factor Index
<b>Russell 1000</b>	0.94%		
	(4.32)		
<b>Russell Comprehensive Factor Index</b>	1.11%	0.17%	
	(5.43)	(2.11)	
<b>Russell 1000 Dynamic Multifactor Strategy</b>	1.26%	0.33%	0.16%
	(6.15)	(3.71)	(1.97)

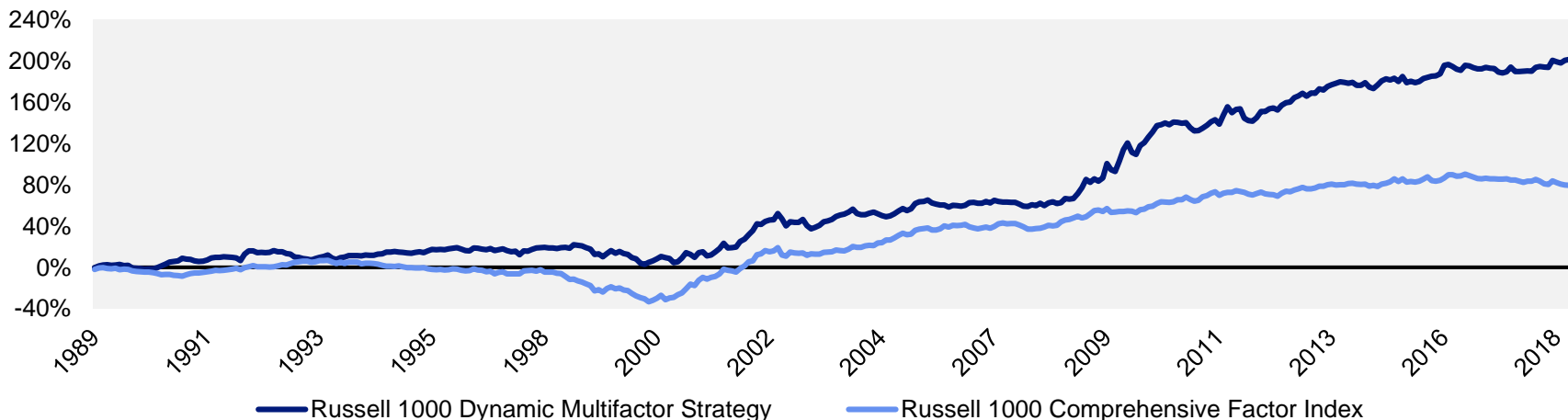
Source: FTSE Russell and Bloomberg as of 9/30/18. Mean monthly returns, non-annualized. We report *t* statistics in parentheses. Results do not include transaction costs. Sample dictated by data availability. The Russell Comprehensive Factor Index uses a common methodology to achieve controlled exposure to five target factors, whilst considering levels of diversification and capacity.

# Russell 1000 Dynamic Factor Strategy Performance



	Return	Standard Deviation	Excess Return	Sharpe Ratio	Information Ratio	Max Drawdown	Skewness
<b>Russell 1000 Dynamic Multifactor Strategy</b>	15.23%	13.45%	4.52%	0.92	0.78	-43.25%	-0.29
<b>Russell 1000 Comprehensive Factor Index</b>	13.12%	13.33%	2.41%	0.77	0.46	-45.53%	-0.71
<b>Russell 1000 Index</b>	10.71%	14.20%	-	0.55	0.00	-51.13%	-0.65

## Cumulative Excess Returns over Russell 1000 Index (Jan.1989 – Sept. 2018)



Source: FTSE Russell and Bloomberg as of 9/30/18. Results do not include transaction costs. The Russell Comprehensive Factor Index uses a common methodology to achieve controlled exposure to five target factors, whilst considering levels of diversification and capacity.

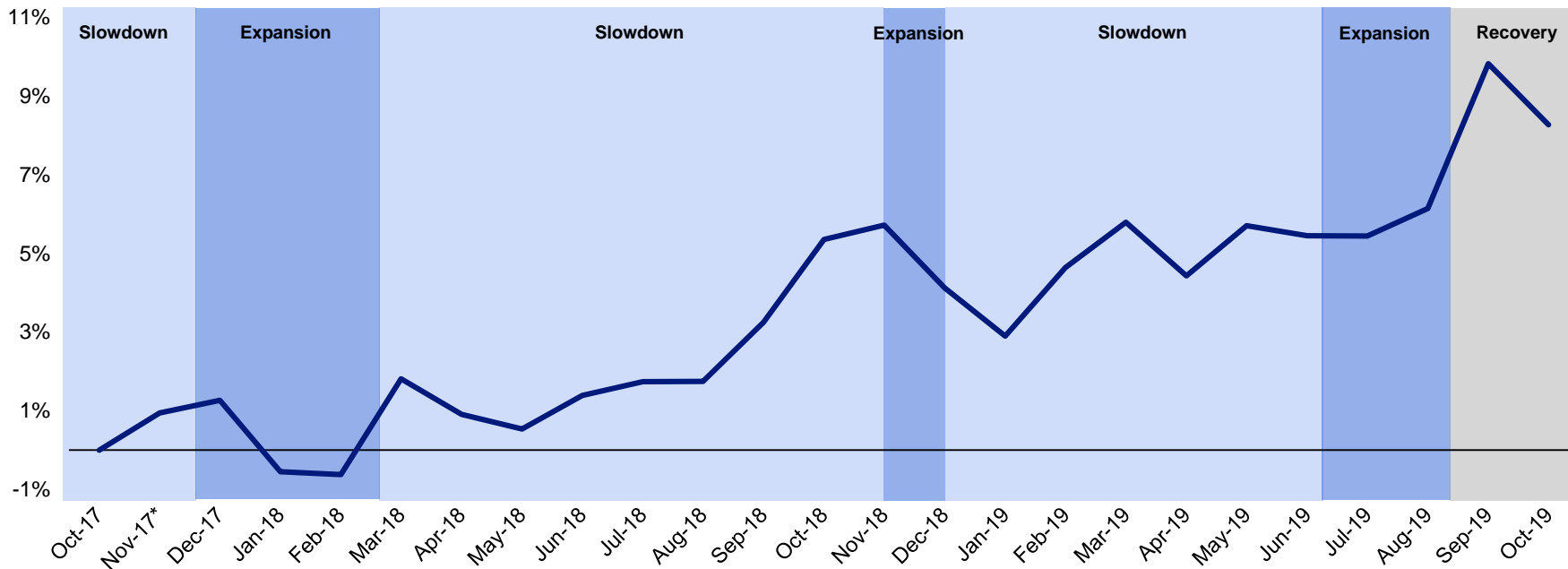
# US Large Cap Strategy - Since Inception Performance



## Cumulative Excess Return:

Russell 1000 Invesco Dynamic Multifactor Index vs. Russell 1000 Index

**+827 bps  
(through Oct. 2019)**



\* Inception was 11/8/2017

Source: Morningstar Direct. As of 10/31/19. Index returns do not represent fund returns. \* An investor cannot invest directly in an index. **Past performance is not a guarantee of future results.**

# Conclusions



- Factor cyclicalities can be analyzed in the context of factor sensitivity to cash-flow news, and linked to factor fundamentals such as operating leverage, profitability, default risk, etc.
- Factors have meaningfully different exposures to economic risks, which can be exploited to design dynamic factor rotation strategies using forward-looking macro regime frameworks.
- Results are statistically and economically significant after controlling for liquidity, capacity, turnover and transaction costs.
- Results are robust across market cap segments and regions (additional results available in the forthcoming *Journal of Investment Management* paper)

# References



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# Appendix



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# Estimating Factor Sensitivity to Aggregate Cash-Flow News



- Campbell, Giglio, Polk and Turley (2018) estimate a heteroskedastic VAR with six state variables

$$x_{t+1} = \bar{x} + \Gamma(x_t - \bar{x}) + \sigma_t u_{t+1}$$

where  $x_{t+1}$  is the  $n \times 1$  vector of state variables with

- rM : aggregate wealth as the log real return on the market
- EVAR: Expected market variance
- PE: log price-to-earnings ratio
- TERM: yield curve spread
- DEF: default spread
- VS: small-stock value spread

# Estimating Factor Sensitivity to Aggregate Cash-Flow News



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$$x_{t+1} = \bar{x} + \Gamma(x_t - \bar{x}) + \sigma_t u_{t+1}$$

where  $x_{t+1}$  is the  $n \times 1$  vector of state variables with  $rM$  as the first element,  $\sigma_{t+1}^2$  as the second element,  $\bar{x}$  and  $\Gamma$  as parameters, and  $u_{t+1}$  a vector of shocks with constant variance-covariance matrix,  $\Sigma$ , where element 11 is equal to 1.

CGPT define an  $n \times 1$  vector  $e_1$  with zero elements except for a unit first element. Their structure implies

$$N_{DR,t+1} = e_1' \rho \Gamma (I - \rho \Gamma)^{-1} \sigma_t u_{t+1} \quad (4)$$

$$N_{CF,t+1} = ((e_1' + e_1' \rho \Gamma (I - \rho \Gamma)^{-1}) \sigma_t u_{t+1}) \quad (5)$$

CGPT follow previous academic research and set  $\rho$  to an annualized value of 0.95.

# Disclosures



## About Risk

As with all investments there are associated inherent risks. Factor investing is an investment strategy in which securities are chosen based on certain characteristics and attributes through an alternative and selection index based methodology that seeks to outperform a benchmark or reduce portfolio risk. Factor investing strategies may underperform cap-weighted benchmarks and increase portfolio risk. Diversification does not guarantee a profit or eliminate the risk of loss. Past performance is not indicative of future results. This does not constitute a recommendation of any investment strategy for a particular investor.

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