



Special Report | Research  
Quantitative Portfolio Strategy



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# Performance and Characteristics of Carry-Based Risk Parity Portfolios

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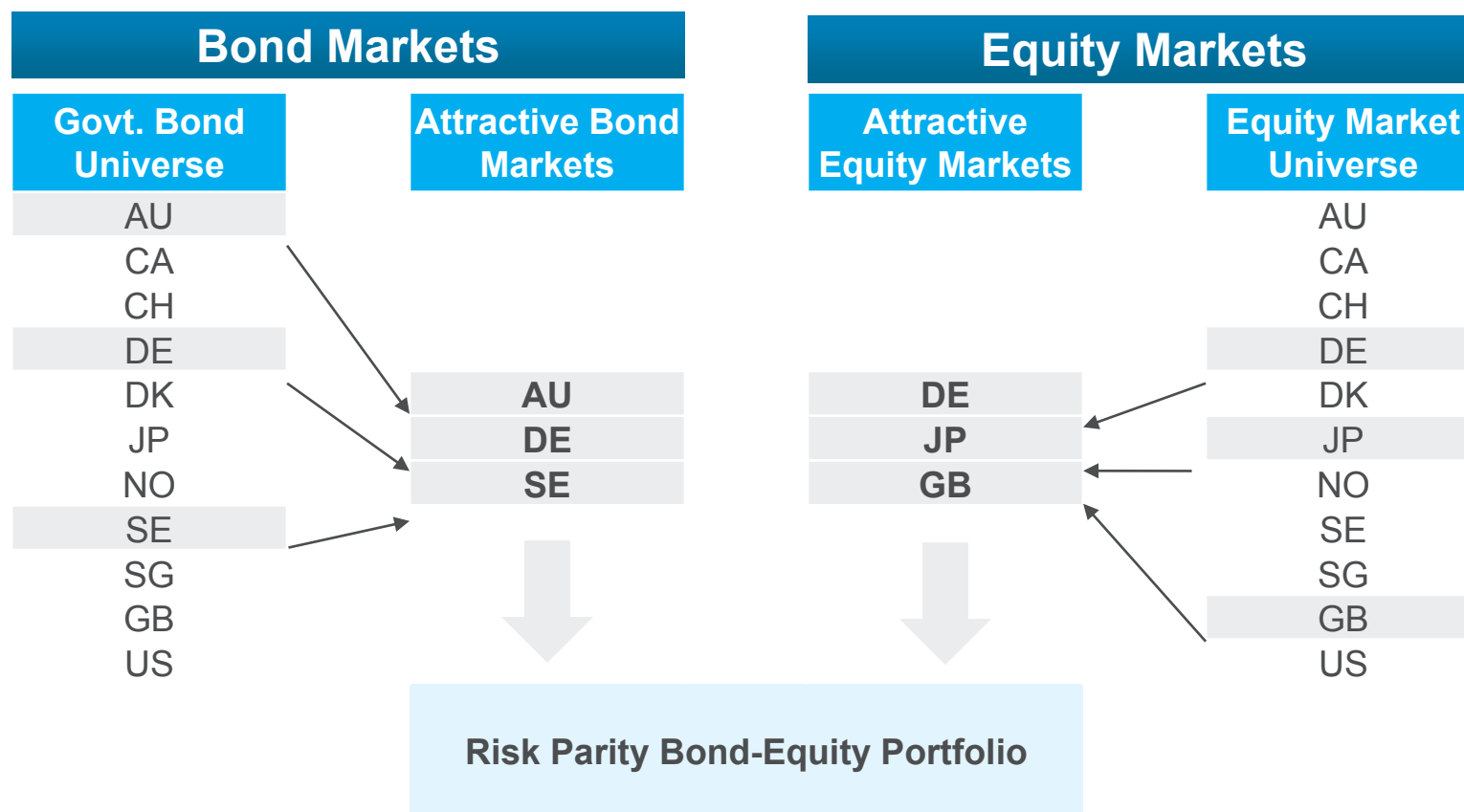
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# Motivation

- We use market selection signals to enhance the performance of multi-asset portfolios:
  - Select attractive markets within bond and equity universes
  - Combine selected bond and equity markets into a risk parity portfolio



Source: Barclays Research

# Introduction

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- We use informative signals to select bond and equity markets, and use them to build risk-parity (RP) portfolios
- Our methodology includes two steps
  - Select markets with attractive carry characteristics within bond and equity universes
  - Combine selected bond and equity markets into a risk-parity portfolio
- Bond markets are selected using an adjusted carry measure called GRACE (Global Rates Adjusted Carry) developed by Barclays Research
- Equity markets are selected using an informative signal that combines
  - growth-adjusted carry and
  - market environment variables
- Carry-based risk parity (RP) portfolios outperformed passive RP portfolios investing in US Treasury bonds and US equities in a historical simulation starting in 2001
- Long-short RP portfolios had attractive risk-adjusted returns

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# Selecting Bond Markets

# Selecting Bond Markets Using Carry-Based Signals

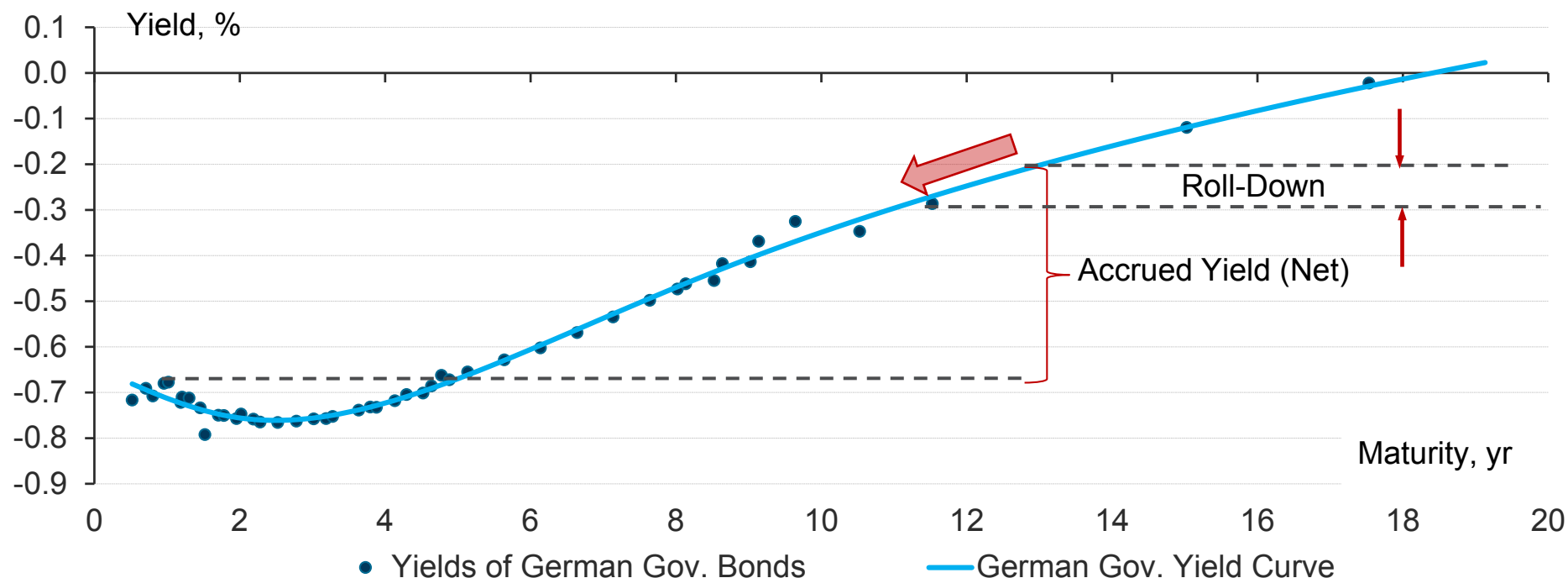
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- Carry investing style has been popular in different asset classes, see [Carry, Koijen et Al., 2018](#)
- Carry can be defined as the return of a security assuming that market conditions remain unchanged over time
- In [Carry Strategies in Global Rates Markets](#), June 2017 we document the performance of carry strategies in global rates markets
- We publish a quantitative [Global Rate Adjusted Carry \(GRACE\) Scorecard](#) to provide security-level carry signals in G11 government bond markets
- A strategy that buys markets with high GRACE signals and sells markets with low GRACE signals has exhibited an information ratio close to 1 in a historical simulation starting in 2001

# Government Bond Carry

- We define *carry* as the return of a bond when the yield curve remains unchanged
- Bond carry includes two components: *accrued yield* and *curve roll-down*
  - Accrued yield is the interest accrued over time (e.g. bond yield)
  - Curve roll-down is the return earned as maturity declines
  - Roll-down is proportional to the bond duration and the slope of the curve

## Carry Components: German Government Curve, June 2019



Source: Barclays Research

# The GRACE Scorecard

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- Barclays QPS publishes a quantitative scorecard called GRACE (Global Rates Adjusted Carry) to measure the bond-level carry properties of global government bonds. See [Introducing GRACE: The Global Rates Adjusted Carry Scorecard](#), March 2018
- In addition to the carry measure implied by bond characteristics, GRACE includes an adjustment to anticipate changes in interest rates in each market considered
  - Several factors help derive unobservable “target rates” based on indicators of
    - Inflation
    - Economic activity
  - This is similar to central bank target rates implied by the Taylor rule, see [Discretion versus policy rules in practice, Taylor, 1993](#)
  - Rates are assumed to gradually converge to the “target rates” implied by the macroeconomic variables

# Ranking Bond Markets with GRACE

- GRACE measures adjusted carry (net of funding cost) of individual bonds in G11 markets
- Government bonds are grouped by country and by maturity bucket
- Within each maturity bucket, markets are sorted according to adjusted carry

## Country Ranking According to the GRACE Scorecard (June 2019)

	Country Rank by Adjusted Carry (GRACE)					Change in Rank over Last Month				
Rank	1-3Y	3-5Y	5-7Y	7-10Y	10+Y	1-3Y	3-5Y	5-7Y	7-10Y	10+Y
<b>1 - Top</b>	SG	SG	SG	GB	SG	↑ +1	↑ +2	↑ +3	↑ +3	↑ +5
<b>2</b>	CH	CH	CH	SG	GB	↓ -1	↓ -1	↓ -1	↑ +4	↑ +3
<b>3</b>	NO	NO	AU	AU	DE	↑ +1	↑ +1	↑ +6	↑ +4	↓ -2
<b>4</b>	AU	AU	GB	DE	JP	↑ +5	↑ +5	↑ +1	↓ -2	↓ -2
<b>5</b>	GB	DK	DK	CH	AU	↑ +2	↓ -3	↓ -3	↓ -2	↑ +2
<b>6</b>	JP	GB	DE	DK	DK	↓ -3	↑ +2	↓ -3	↓ -5	↓ -3
<b>7</b>	DK	SE	NO	JP	CH	↓ -2	=	↓ -1	↓ -2	↓ -3
<b>8</b>	SE	JP	SE	NO	US	↓ -2	↓ -3	=	↑ +1	↑ +2
<b>9</b>	CA	DE	JP	SE	SE	↑ +1	↓ -3	↓ -2	↓ -1	↓ -1
<b>10</b>	DE	CA	US	US	NO	↓ -2	↑ +1	=	=	↓ -1
<b>11 - Bottom</b>	US	US	CA	CA	CA	=	↓ -1	=	=	=

Source: Bloomberg, Barclays Research



# Evaluating the Performance of the GRACE Scorecard

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- A hypothetical long-short portfolio illustrates the performance of GRACE
  - The GRACE long portfolio includes the top three markets sorted on adjusted carry (GRACE score) within each maturity bucket
  - The GRACE short portfolio includes the bottom three markets sorted on adjusted carry (GRACE score) within each maturity bucket
  - The long and short allocations across maturity buckets are kept identical to the one of the G11 market index, ensuring that long and short portfolios have similar durations
  - GRACE long and short portfolios therefore have similar risk profiles
  - GRACE portfolios are rebalanced monthly using updated GRACE signals
- The GRACE long portfolio has outperformed GRACE short portfolio by 1.92%/yr in 2001-2019
- The information ratio of the GRACE long-short strategy is close to 1

# GRACE Scorecard Performance

- Returns are shown in excess of 1-month USD Libor and are currency-hedged into USD

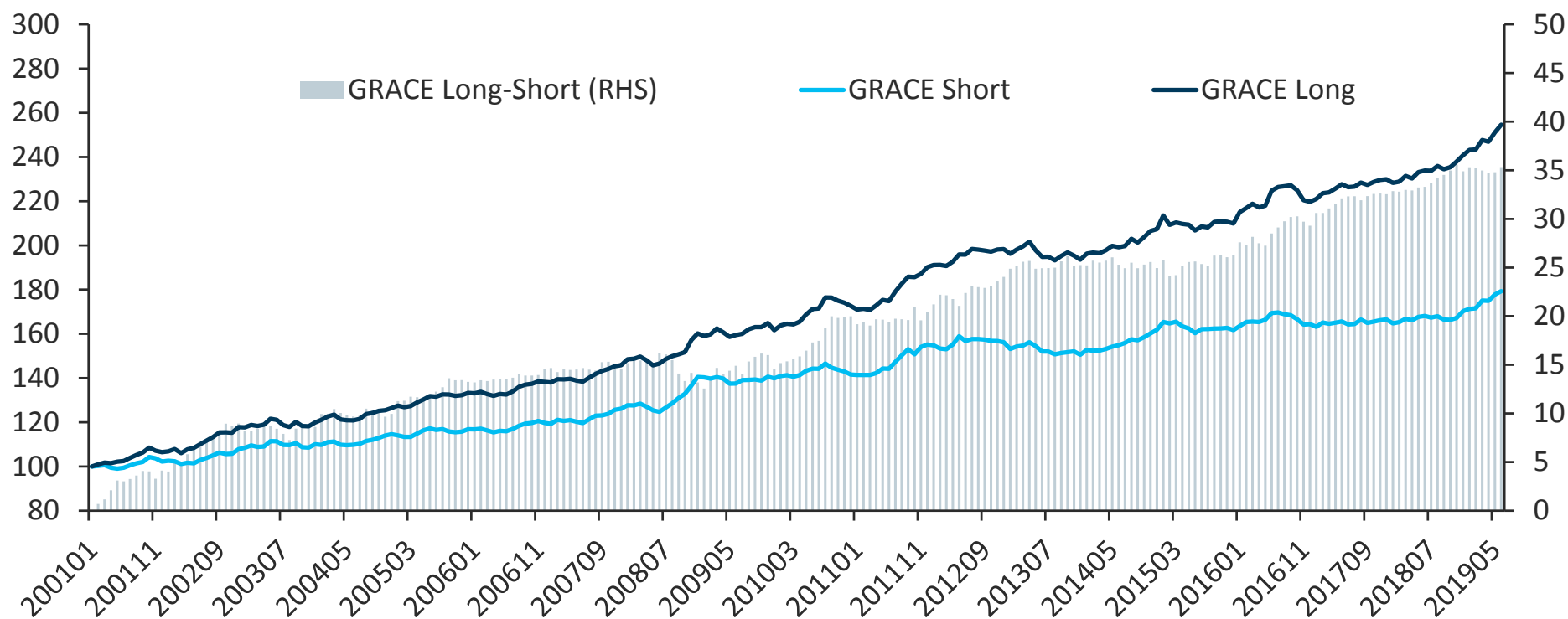
Performance of GRACE Portfolios in Different Periods (USD Hedged)				
	Bloomberg Barclay US Treasury Index	Long (top 3)	GRACE Short (btm 3)	Long-Short
Feb 2001-Jun 2019				
Avg. Return, %/yr	2.52	3.46	1.55	1.92
Volatility	4.37	3.46	3.22	1.93
Sharpe/Inf. Ratio	0.58	1.00	0.48	<b>0.99</b>
Beta wrt US Tsy. Index	1.00	0.70	0.59	0.11
Feb 2001-Dec 2009				
Avg. Return, %/yr	2.54	2.67	1.03	1.63
Volatility, %/yr	5.20	3.44	3.26	1.94
Sharpe / Inf Ratio	0.49	0.77	0.32	<b>0.84</b>
Beta wrt US Tsy. Index	1.00	0.60	0.49	0.11
Jan 2010-Jun 2019				
Avg. Return, %/yr	2.50	4.21	2.03	2.19
Volatility, %/yr	3.43	3.47	3.20	1.93
Sharpe / Inf Ratio	0.73	1.21	0.63	<b>1.13</b>
Beta wrt US Tsy. Index	1.00	0.92	0.80	0.13

Source: Bloomberg, Barclays Research

# Cumulative Performance of the GRACE Scorecard

- The cumulative total returns of GRACE long and short portfolios have diverged over time
- The performance of the GRACE long-short strategy has been persistently positive

## Cumulative Total Return Performance of GRACE Portfolios (USD Hedged)



Source: Bloomberg, Barclays Research

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# Selecting Equity Markets

# Forming an Equity Market Selection Signal

- The equity market selection signal includes two components
  - Carry adjusted for growth, which comprises of
    - Dividend carry
    - Retained earnings scaled according to recent PMI
  - Market environment:
    - Trends in local interest rates and in FX rates
- Adjusted carry and market environment are combined into a single signal

## Building Blocks of Equity Market Selection Signal

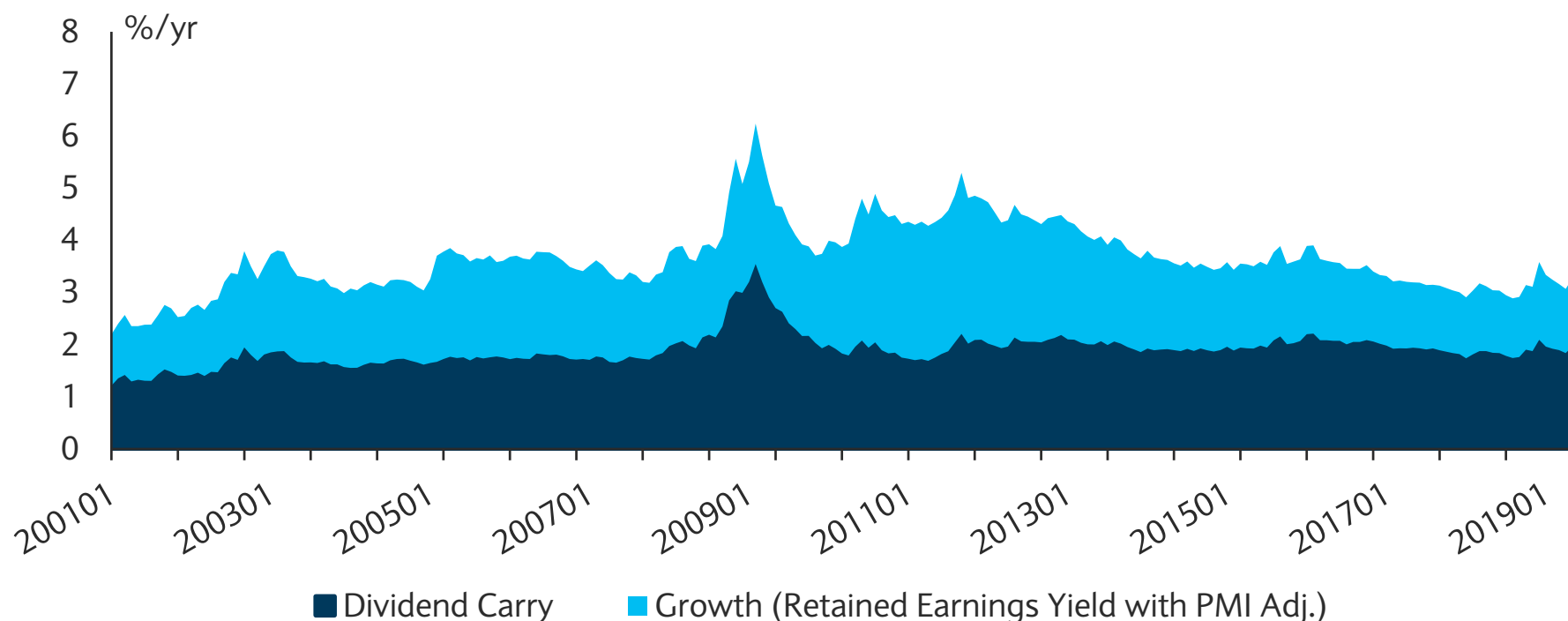
Component	Motivation	Measure	Implementation
Dividend Carry	Anchor expected returns, assuming unchanged prices	Dividend Yield	Dividends/Stock Price
Growth Adjustment	Dividends can grow depending on corporate investment and business conditions	Retained Earnings PMI	Earnings Yield - Dividend Yield Moving Average in PMI
Market Environment	The equity market performance of a country is function of cost of capital and terms of trade	Rates FX	Trend in Interest Rates Trend in FX Rates

Source: Barclays Research

# Building a Carry-Based Signal in Equity Markets

- We observe carry as dividend yield for individual country indices
- We adjust carry for expected growth which we estimate as a function of
  - Retained earnings and
  - PMI (forward-looking indicator of economic growth)

## Dividend Carry and Expected Growth Estimate (MSCI US Index)



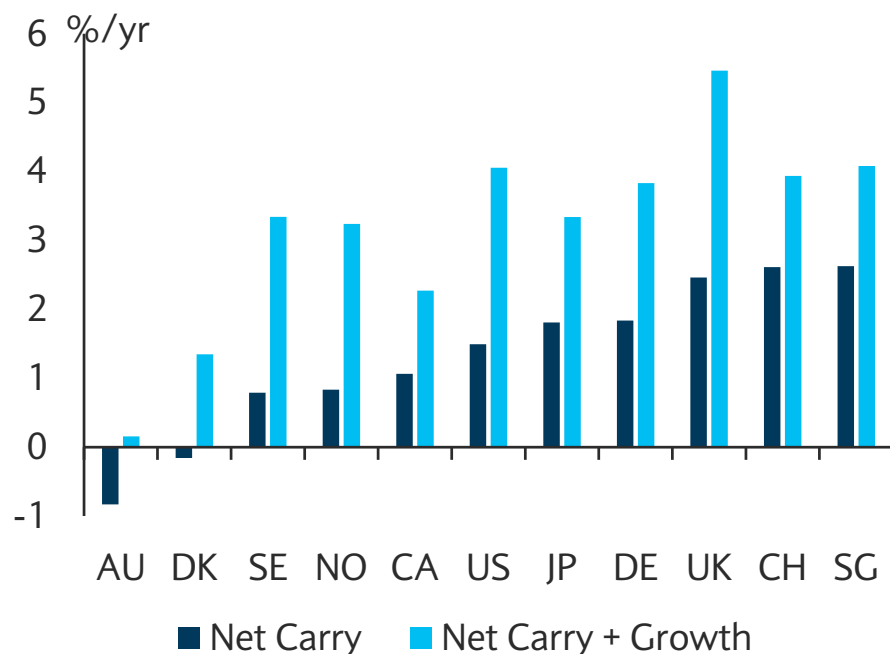
Source: Bloomberg, MSCI, Barclays Research

# Adjusted Carry Across G11 Equity Markets

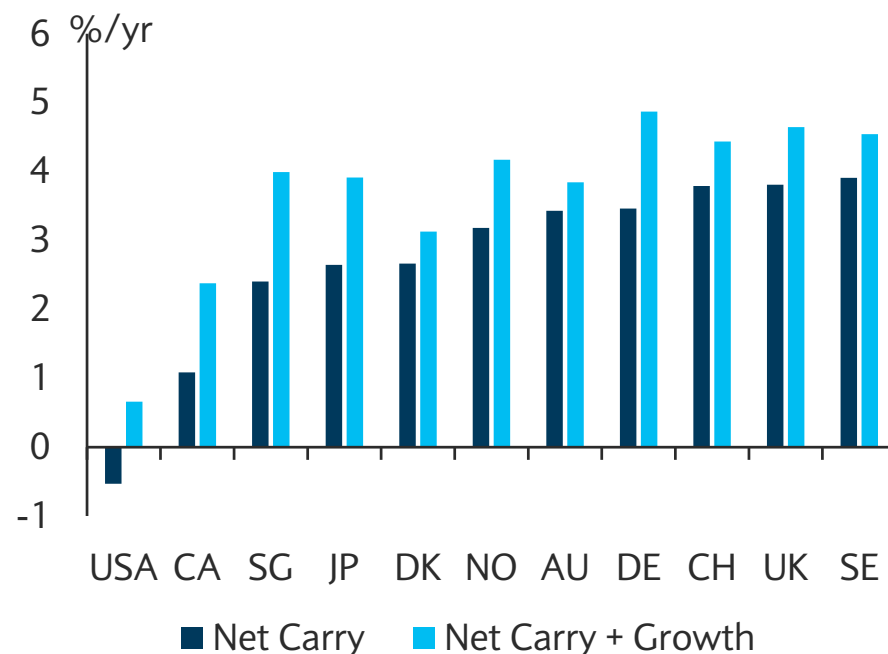
- We calculate carry net of funding for 11 country-specific equity indices
- Net carry signal can vary considerably across countries and periods
- Growth adjustment can impact relative market ranking

## Net Carry and Growth-Adjusted Net Carry for G11 Equity Markets

December 2010



June 2019



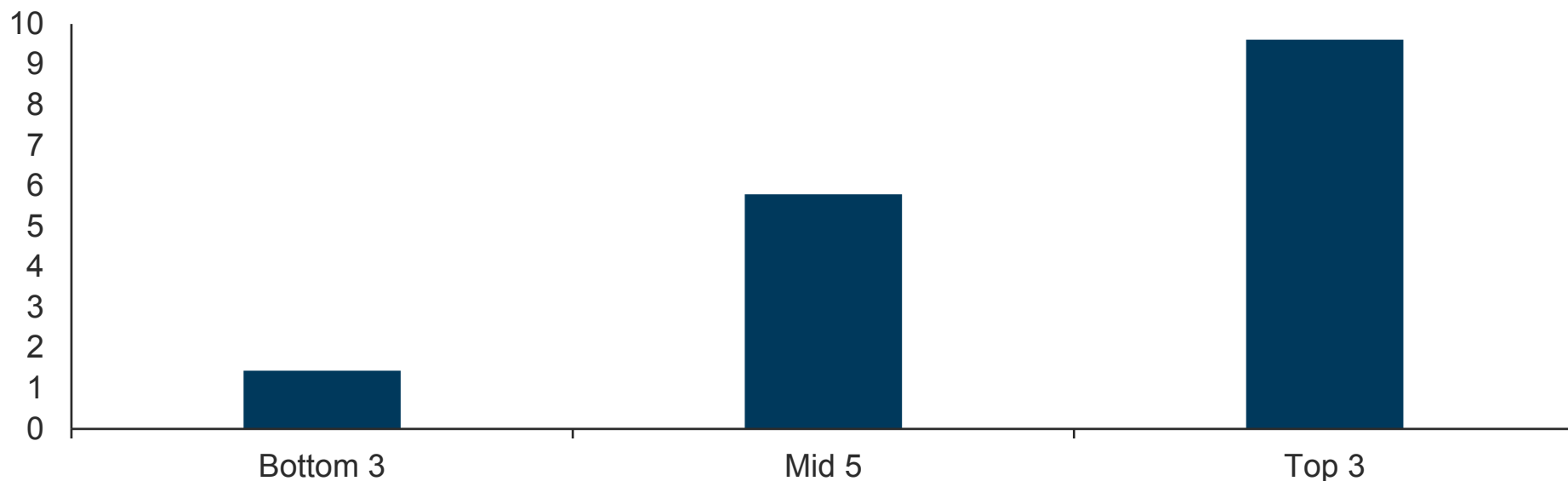
Source: Bloomberg, MSCI, Barclays Research

Source: Bloomberg, MSCI, Barclays Research

# Evaluating Signal Performance

- Equity indices are sorted every month according to signal strength
  - Equity market selection signals combine adjusted carry and market environment
- Country indices are grouped into portfolios according to their rank.
  - Country indices are equally-weighted in each portfolio
- Realized return is highest for the portfolio of top-ranked countries

## Average Return of Rank-Based Portfolios net of 1M US Libor (%/y, 2001-2019, USD Hedged)



Source: Bloomberg, MSCI, Barclays Research



# Performance of Long-Only Equity Portfolios

- Top portfolios have performed consistently better than Bottom portfolios
- Top 3 and Bottom 3 portfolios exhibit similar risk characteristics

Portfolio Performance Net of 1M US Libor (USD Hedged)								
Signal:	Carry		Adjusted Carry		Market Environment (ME)		Adjusted Carry + ME	
	Top 3	Btm 3	Top 3	Btm 3	Top 3	Btm 3	Top 3	Btm 3
<b>Feb 2001-Jun 2019</b>								
Avg. Return, %/yr	7.11	1.97	8.55	2.12	9.28	2.43	9.61	1.43
Volatility, %/yr	14.74	14.84	15.46	13.78	14.20	15.72	15.66	14.80
Sharpe / Inf Ratio	0.48	0.13	0.55	0.15	0.65	0.15	0.61	0.10
MSCI-World US Beta	0.80	0.88	0.87	0.80	0.83	0.91	0.90	0.87
<b>Feb 2001-Dec 2009</b>								
Avg. Return, %/yr	4.96	-3.97	6.99	-4.33	4.95	-1.72	7.38	-4.25
Volatility, %/yr	18.05	17.46	18.96	16.14	16.46	19.44	18.73	17.69
Sharpe / Inf Ratio	0.27	-0.23	0.37	-0.27	0.30	-0.09	0.39	-0.24
MSCI-World US Beta	0.90	0.95	0.98	0.86	0.91	1.02	1.00	0.95
<b>Jan 2010-Jun 2019</b>								
Avg. Return, %/yr	9.13	7.54	10.02	8.17	13.35	6.33	11.70	6.77
Volatility, %/yr	10.80	11.71	11.32	10.91	11.64	11.13	12.16	11.30
Sharpe / Inf Ratio	0.85	0.64	0.89	0.75	1.15	0.57	0.96	0.60
MSCI-World US Beta	0.67	0.80	0.74	0.70	0.72	0.75	0.77	0.75

Source: Bloomberg, MSCI, Barclays Research

# Performance of Long-Short Equity Portfolios

- Long-short strategies have exhibited only marginal directionality on the MSCI US Equity Index
- Long-short strategies based on carry, adjusted carry or market environment signals taken in isolation have delivered positive returns: each signal component adds value

## Performance of Long-Short (Top 3 - Bottom 3) Carry Portfolios (USD hedged)

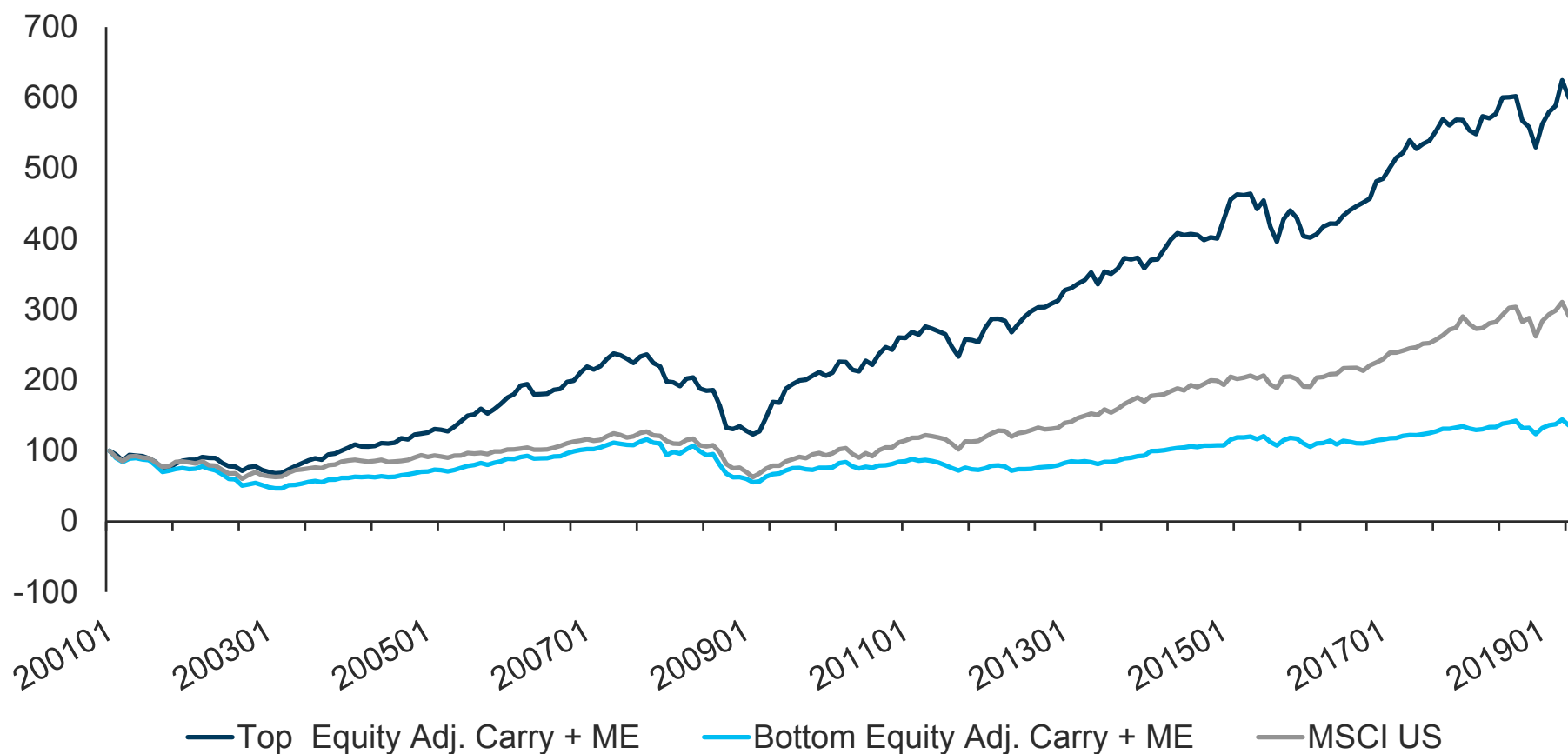
	Carry	Adjusted Carry	Market Environment (ME)	Adjusted Carry + ME
<b>Feb 2001-Jun 2019</b>				
Avg. Return, %/yr	5.15	6.44	6.86	8.18
Volatility, %/yr	7.95	8.76	8.62	8.17
Sharpe / Inf Ratio	0.65	0.74	0.80	<b>1.00</b>
Beta to MSCI US	-0.08	0.07	-0.07	0.03
<b>Feb 2001-Dec 2009</b>				
Avg. Return, %/yr	8.93	11.32	6.68	11.63
Volatility, %/yr	9.35	9.97	9.76	8.97
Sharpe / Inf Ratio	0.96	1.13	0.68	<b>1.30</b>
Beta to MSCI US	-0.04	0.12	-0.11	0.05
<b>Jan 2010-Jun 2019</b>				
Avg. Return, %/yr	1.60	1.86	7.02	4.93
Volatility, %/yr	6.23	7.23	7.43	7.25
Sharpe / Inf Ratio	0.26	0.26	0.95	<b>0.68</b>
Beta to MSCI US	-0.12	0.04	-0.03	0.02

Source: Bloomberg, MSCI, Barclays Research

# Cumulative Performance of Equity Portfolios

- We plot the cumulative performance of Top 3 and Bottom 3 portfolios
- The Top 3 portfolio has significantly outperformed the MSCI US Index and the Bottom 3 portfolio since 2001

## Cumulative Total Return Performance of Equity Portfolios (USD Hedged)



Source: Bloomberg, MSCI, Barclays Research

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# Carry-Based Risk-Parity Portfolios

# Forming Carry-Based Risk-Parity (RP) Portfolios

- We rank bond and equity indices of 11 markets according to carry-based signals
  - The top 3 bond and top 3 equity markets are included in the Top portfolio
  - The bottom 3 bond and bottom 3 equity markets are included in the Bottom portfolio
- Bond and equity portfolios are weighted using the risk parity (RP) approach
  - Leverage is used to match isolated volatilities of bond and equity components
- Signals are updated monthly and portfolios are rebalanced every month-end

## Countries Ranked by Carry-Based Signals, June 2019

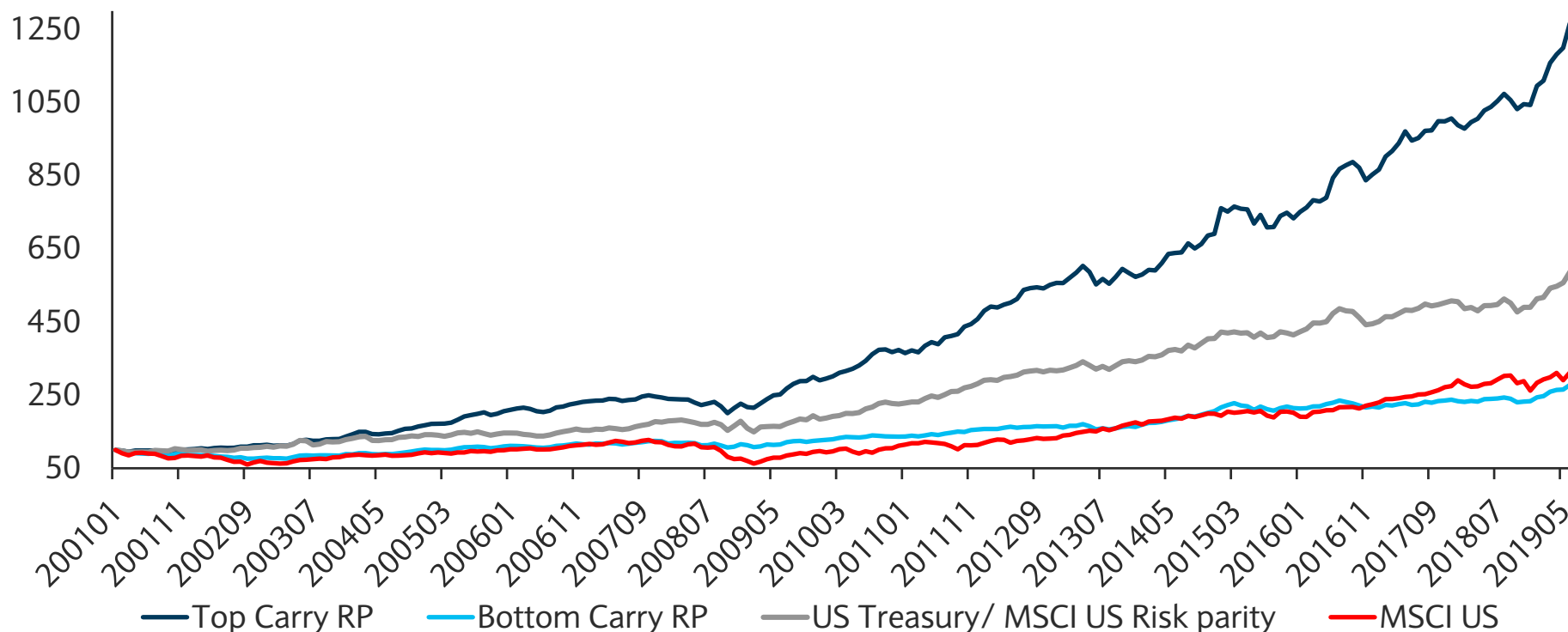
Rank	Country Ranks by Bond Carry (GRACE)					Country Rank By Equity Adj. Carry + ME
	1-3Y	3-5Y	5-7Y	7-10Y	10+Y	
1 - Top	SG	SG	SG	GB	SG	DE
2	CH	CH	CH	SG	GB	SE
3	NO	NO	AU	AU	DE	AU
4	AU	AU	GB	DE	JP	UK
5	GB	DK	DK	CH	AU	CH
6	JP	GB	DE	DK	DK	NO
7	DK	SE	NO	JP	CH	DK
8	SE	JP	SE	NO	US	JP
9	CA	DE	JP	SE	SE	SG
10	DE	CA	US	US	NO	CA
11 - Bottom	US	US	CA	CA	CA	US

Source: Bloomberg, MSCI, Barclays Research

# Cumulative Performance of Carry-Based RP Portfolios

- We form a risk-parity allocation benchmark for bond-equity portfolios as a combination of the MSCI US and Bloomberg Barclays US Treasury indices
- The top carry-based RP portfolios outperformed the benchmark allocation since 2001
- RP portfolios use a leverage factor of 4.5 for bonds

## Cumulative Total Returns of Long-Only Risk Parity Portfolios



Source: Bloomberg, MSCI, Barclays Research

# Performance Summary

- The simulated Top carry-based RP portfolios delivered higher risk-adjusted returns than the RP benchmark or the Bottom carry-based RP portfolios
- Returns are reported net of 1-month USD LIBOR

## Performance of Carry-Based RP Portfolios

	MSCI US Equity Index	RP Benchmark: US Tsy./ MSCI US	Carry-Based RP Long Only	
			Top	Bottom
<b>Feb 2001-Jun 2019</b>				
Avg. Return, %/yr	5.58	9.24	12.60	4.20
Volatility, %/yr	14.68	8.96	9.26	8.09
Sharpe / Information Ratio	<b>0.38</b>	<b>1.03</b>	<b>1.36</b>	<b>0.52</b>
Beta US Tsy./ MSCI US Risk-Parity	1.21	1.00	0.86	0.70
<b>Feb 2001-Dec 2009</b>				
Avg. Return, %/yr	-1.82	4.27	9.69	0.20
Volatility, %/yr	16.25	9.94	9.86	8.88
Sharpe / Information Ratio	<b>-0.11</b>	<b>0.43</b>	<b>0.98</b>	<b>0.02</b>
Beta US Tsy./ MSCI US Risk-Parity	1.22	1.00	0.86	0.74
<b>Jan 2010 - Jun 2019</b>				
Avg. Return, %/yr	12.52	13.90	15.33	7.94
Volatility, %/yr	12.78	7.73	8.64	7.13
Sharpe / Information Ratio	<b>0.98</b>	<b>1.80</b>	<b>1.77</b>	<b>1.11</b>
Beta US Tsy./ MSCI US Risk-Parity	1.16	1.00	0.88	0.64

Source: Bloomberg, MSCI, Barclays Research

# Performance of Long-Short RP Portfolios

- We report the performance of long (Top)-short (Bottom) RP portfolios
- Long-short RP portfolios have delivered high risk-adjusted returns and benefitted from bond-equity risk diversification:
  - Lower volatility than for the corresponding bond- or equity-only portfolios
  - Information ratios above 1.2

## Performance of Long-Short Carry-Based Portfolios (USD Hedged)

	Leveraged Bonds	Equities	Risk Parity (RP)
<b>Feb 2001-Jun 2019</b>			
Avg. Return, %/yr	8.63	8.18	8.40
Volatility, %/yr	8.71	8.17	6.20
Sharpe / Inf Ratio	0.99	1.00	<b>1.36</b>
<b>Feb 2001-Dec 2009</b>			
Avg. Return, %/yr	7.35	11.63	9.49
Volatility, %/yr	8.74	8.97	6.53
Sharpe / Inf Ratio	0.84	1.30	<b>1.45</b>
<b>Jan 2010 - Jun 2019</b>			
Avg. Return, %/yr	9.83	4.93	7.38
Volatility, %/yr	8.70	7.25	5.88
Sharpe / Inf Ratio	1.13	0.68	<b>1.26</b>

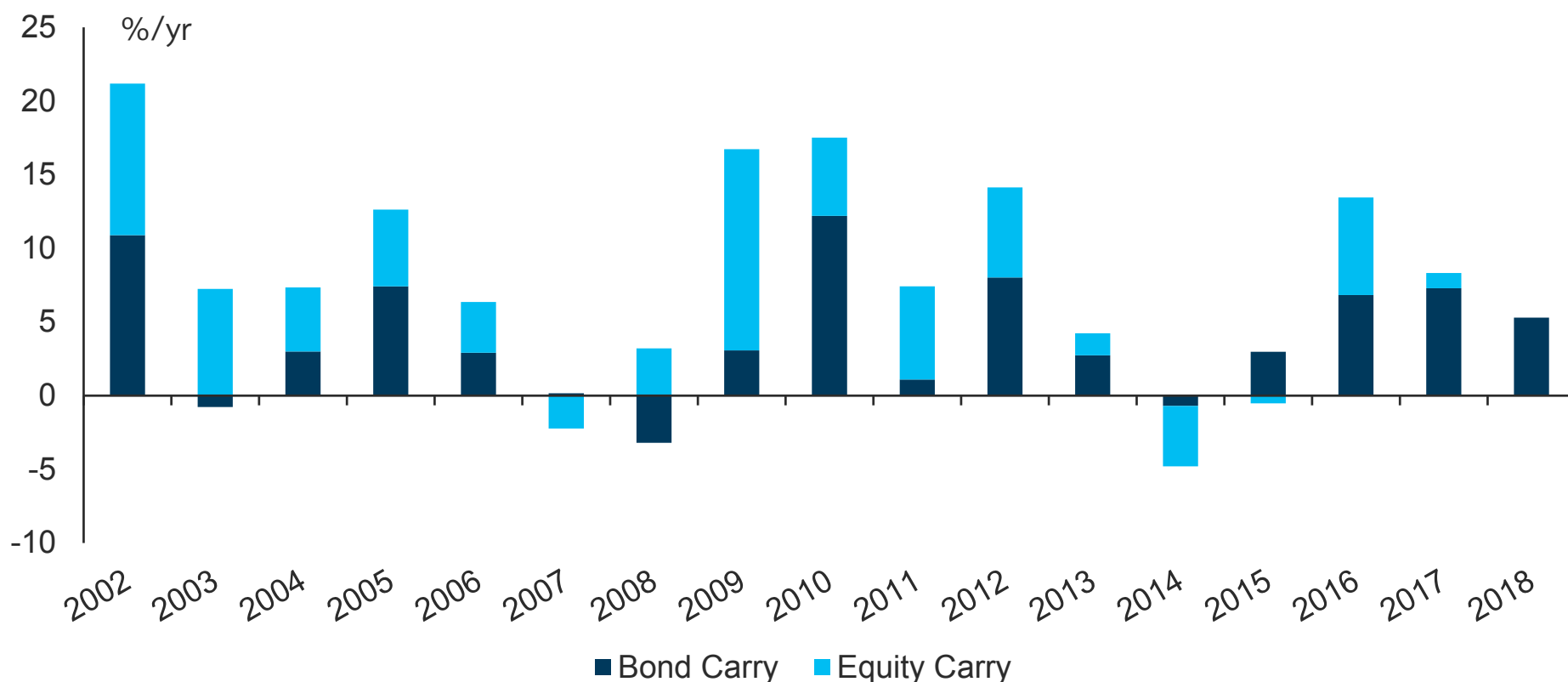
Source: Bloomberg, MSCI, Barclays Research



# Performance by Calendar Year

- The simulated long-short RP strategy had positive returns in 15 out of 17 calendar years
- The relative contributions of bond and equity components varies over time but are overall of a similar magnitude

## Annual Returns of Long-Short Carry-Based RP Portfolios (USD Hedged)



Source: Bloomberg, MSCI, Barclays Research

# Conclusion

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- Active market selection in bond and in equity markets can benefit multi-asset risk parity portfolios
- Combining Top 3 bond markets and Top 3 equity markets according to carry-based signals delivered attractive performances in historical simulations starting in 2001
  - A carry-adjusted (GRACE) signal in bond market helps select markets with attractive carry characteristics
  - A combined signal that includes dividend yield helps select better performing equity markets
  - Combining selected bond and equity markets in risk parity portfolios provides risk diversification and leads to attractive risk-adjusted performance

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