BARCLAYS

Equity Research
26 September 2019

#investmentsciences

Investment Sciences

Quantamental factors for Consumer Staples

Consumer Staples investment decisions can benefit from a "quantamental" approach – mixing quantitative and discretionary investment approaches. A back-tested score-weighted basket that combines multiple factors beats the MSCI Global Consumer Staples benchmark by 122bps per year with an information ratio of 0.34.

Our approach to constructing a quantamental score includes a number of steps:

- **We begin by constructing scores for a wide variety of investment factors thought to work in other contexts.** Each quarter, a total of 19 candidate factors are utilised across a variety of styles, including value, momentum, size, and quality.
- **We use a statistical technique (L1 regularization) to eliminate redundant factors.** We seek the simplest combination of factors to make it easier to understand what factors are driving performance, and to reduce the potential for overfitting. Factors have many variations (for example, value can be measured as Price / Earnings, Price / Book, EV/EBITDA), but preferential attention is paid to the most useful in predicting returns. After applying this step, 13 factors remain that are most useful for explaining company-level outperformance versus the market.
- **We use a regression to estimate the optimal mix of factors.** This allows measurement of the factor-level contribution to a quantamental score.
- **We back-test the score, finding that companies in the top quintile have outperformed across various market conditions since 2008.** Of course, it doesn't always work: Year-to-date in 2019 the top 20% of scoring securities have underperformed the MSCI Global Consumer Staples index by almost 3%, possibly due to value growth rotation.

Several other insights emerge from our analysis, further discussed in our accompanying report published today "A quant approach to Staples selection" in collaboration with the Consumer Staples team.

Historically, Price to Book and PEG ratios have been more predictive of returns than Price to Earnings. The statistical technique to slim the factor herd to the most predictive members drops P/E, but retains P/B and PEG. That suggests that once those (and the other factors) have been accounted for, there's little to learn from P/E.

Factor importance shifts over time: Quality factors, most noticeably FCF, are strongly important, with returns to shareholders, organic sales and debt rising in significance recently. Value, led by Price to Book and market value, have also risen in the mix since 2016.

INDUSTRY FOCUS

Investment Sciences

Investment Sciences
Ben McSkelly
+44 (0)20 3555 3606
ben.mcskelly@barclays.com
Barclays, UK

Ryan Preclaw
+1 212 412 2249
ryan.preclaw@barclays.com
BCI, US

European Consumer Staples
Iain Simpson
+44 (0)20 7773 3616
iain.simpson@barclays.com
Barclays, UK

U.S. CHPC & Beverages
Lauren R. Lieberman
+1 212 526 3112
lauren.lieberman@barclays.com
BCI, US

U.S. Food
Andrew Lazar
+1 212 526 4668
andrew.lazar@barclays.com
BCI, US

Completed: 25-Sep-19, 16:46 GMT Released: 26-Sep-19, 04:00 GMT Restricted - External

A Quantamental Approach Can Help Pick Outperformers in Consumer Staples

Factor theory posits that securities have underlying characteristics that influence their returns and risks; these factors can be proxied (somewhat imperfectly) by accounting and market data. Factor-based quant investors typically try to isolate the factor returns, so they can be used to generate portfolios with well understood risk and return characteristics.

Framing a factor approach for discretionary investors

This note aims to use factors to frame a quantamental approach to investing in Consumer Staples stocks. There are a number of ways that fundamental discretionary investors could make use of factors:

- An integrated factor score can help identify groups of stocks that are likely to outperform in the near term;
- To understand which factors have historically been most useful in predicting returns;
- To take a view about which factors have been rewarded more (or less) recently;
- Investor portfolios can be examined through the lens of their factor loadings, to understand with more nuance what views a portfolio manager is expressing (whether on purpose or unintentionally).

Measuring excess return wrt the index, normalized by its volatility

Our goal in this analysis is finding outperformers amongst consumer staples companies, and hence focus on predicting excess returns of global consumer staples stocks versus the MSCI Global Consumer Staples Index. Excess risk, as measured by the volatility of excess returns, is also considered in evaluating the performance of our framework.

Result 1: Companies with High Integrated Factor Scores Have Historically Beat Their Benchmark

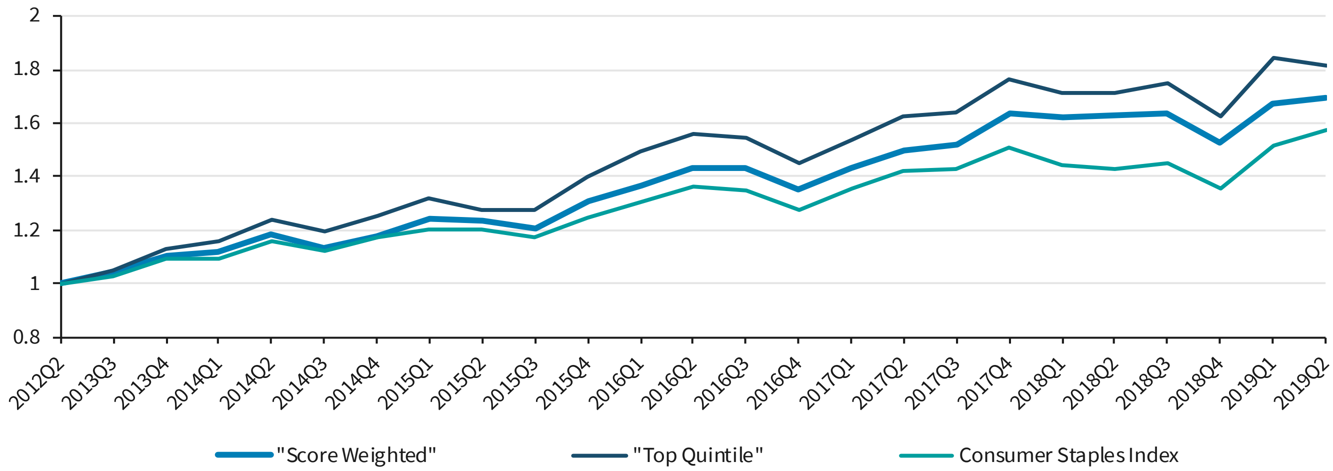
One way to approach "quantamental" investing (mixing quantitative and discretionary investment approaches) is to combine factors into a score that can be input into the investment decision mosaic. This process started with a large group of candidate factors, slimming them down to the most informative ones, and using a regression to create the optimized weights. Back testing is performed on both a "score-weighted" basket, where security weights are determined by regression score and a "top quintile" where the top 20% of scoring securities in each quarter are combined.

Robust testing assumes investors can't use the current model in the past

For this robust testing, at any point in the past, we train successive regressions on historical data only, with a minimum of five years. Hence, the model factor weights change over time as new data is incorporated. The "score-weighted" approach would have beaten the index by 122 bps annually with 70bps lower volatility, whilst the "top quintile" would have performed 260bps better, albeit with 92 extra bps of volatility (assuming quarterly trading, with no transaction costs).

FIGURE 1

Cumulative returns of "score-weighted" Consumer Staples securities at each point in time, training on point-in-time historical data. Also shown, returns of the top 20% of scored securities for each quarter and the Consumer Staples index. Annualised returns of 9.0%, 10.4% and 7.8% respectively.



Note: Assume quarterly rebalancing and do not account for transaction costs. Source: Barclays Research, Refinitiv, MSCI

Result 2: Price to Book and PEG Have Historically Been More Informative Than Price to Earnings

The commonly used PE ratio does not survive the initial factor selection by regression.

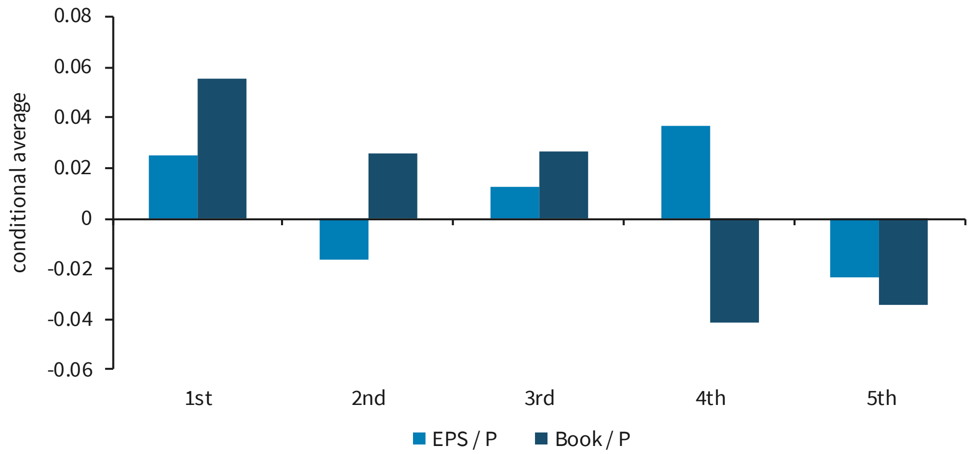
Figure 2 shows two dummy regressions of Book Value yield and Earnings yield respectively. Securities in the quarter are collected into 5 quintiles of performance, i.e. 5th contains the highest values. For each security at a PIT (Point In Time), the risk adjusted excess return is regressed against five dummy variables, each representing one of the quintiles. The dummy variable whose rank matches the security quintile is 1 and the rest are zero. This regression tests the relative risk return performance of the quintiles of the factor.

EPS yield has a less obvious linear relationship with return than Book yield

Of the two yield metrics, Book Value has a more steadily decreasing, or monotonic, series. Earnings yield is less monotonic; whilst large values clearly underperform, the 4th quintile appears to outperform. Furthermore, the p values for the dummy variables are higher than for Book yield, suggesting lower statistical significance in the observations. Whilst an overall inverse linear relationship between EPS yield and returns can be found, Book Value yield appears a stronger indicator.

FIGURE 2

Expected risk adjusted excess return from single factor regressions of quintile ranked book and earnings yield. Regression intercepts 0.0348 and 0.0335 respectively



Source: Barclays Research, Refinitiv, MSCI

Lasso regression drops PE in favour of other factors

When presented with somewhat co-linear variables such as EPS yield, Book Value Yield and PEG ratios, a lasso regression technique selects the most predictive factors and rejects others in order to reduce over-fitting. Hence, in part due to its non-monotonic nature, EPS yield is not a final factor used in scoring.

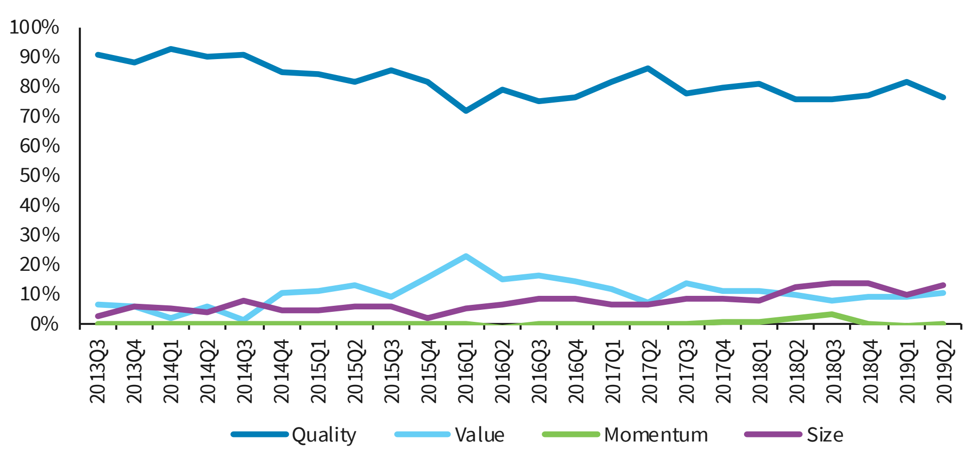
Result 3: Quality still dominates, although waning; FCF's importance rotating into returns to shareholders, organic growth and debt

In order to ascertain how factor influence has changed over time, the score contribution over time is shown below. This "score contribution" for each factor is calculated as the mean factor score of securities in the top quintile, minus the mean factor score for all securities in the index. It shows the proportional impact each factor has in placing securities in the top quintile. Figure 3 shows the relative importance of Quality factors, albeit decreasing with time.

FIGURE 3

Evolution of Score Contribution of factors over time

Score contribution=mean factor score of securities in the top quintile minus the mean factor score for all securities in the index



Source: Barclays Research, Refinitiv, MSCI

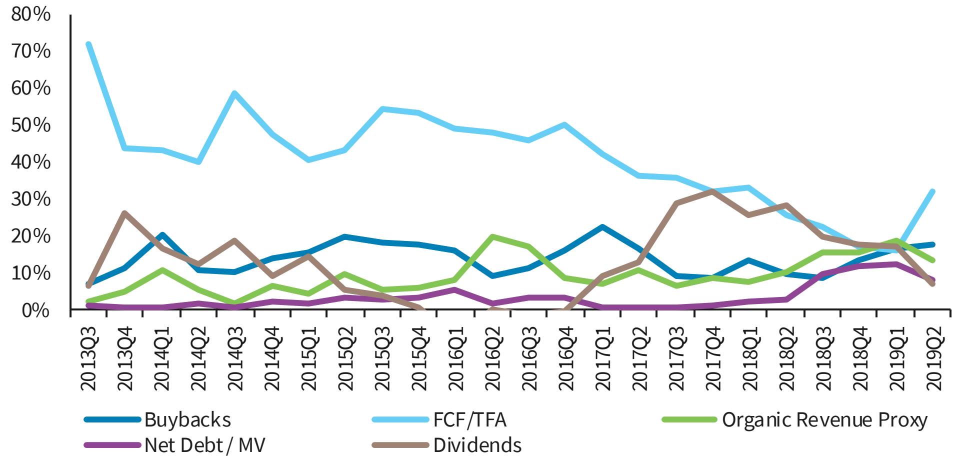
FCF / TFA historically powerful, but decreasing in mix

Figure 4 shows how selected Quality factors evolve in the mix. Free cash Flow / TFA (Tangible Fixed Assets), or the asset productivity, is the single most impactful factor, although it has decreased in importance since 2016. This decrease is partly made up by a rise in Size and Value factors, but also a rotation into other Quality factors. Returns to shareholders increase in importance, as does proxy organic revenue and indebtedness.

FIGURE 4

Evolution of Score Contribution of selected Quality factors over time

Score contribution=mean factor score of securities in the top quintile minus the mean factor score for all securities in the index



Source: Barclays Research, Refinitiv, MSCI

Building our Integrated Score Framework

The process began by considering a group of 19 factors. All but two of the factors fit into three categories: Value, Quality, or Momentum. Details of the calculation methods for each factor are in the appendix.

FIGURE 5

Table on factor completeness in raw data and data type. Free cash flow values are historical not forecasts

Factor	Factor Type	Data completeness	Data type
Market Capitalisation	Other	100%	Price only
Three month price volatility	Other	99.8%	Price only
1 year to 1 month price momentum	Momentum	98.9%	Price only
Buyback yield	Quality	100%	Historical actuals
FCF conversion	Quality	98.7%	Historical actuals
FCF yield	Value	98.7%	Historical actuals
Book Value / P	Value	98.1%	Historical actuals
Net Debt / MV	Quality	98.0%	Historical actuals
Cash yield	Quality	97.9%	Historical actuals
Dividend yield	Quality	97.9%	Historical actuals
FCF/ Tangible fixed Assets (TFA)	Quality	97.7%	Historical actuals
EV / EBITDA	Value	97.2%	Historical actuals
EPS yield (FY1)	Value	98.0%	Forecast
1 year forward revenue growth	Quality	97.7%	Forecast
PEG (1 year forward)	Value	97.6%	Forecast
PEG (2 year forward)	Value	97.2%	Forecast
PEG (3 year forward)	Value	96.3%	Forecast
Proxy Organic growth (yr 1 to yr 2 forecasts)	Quality	9.9%	Forecast
Three month ΔEPS	Momentum	95.4%	Forecast

Source: Barclays Research, Refinitiv

Normalising factors

Normalise factors, relative performance at any time is the driver

Factors are normalised because 1) these factors can have a wide range of magnitudes, and 2) Our aim is to predict relative performance within the consumer staples universe. At each quarter in the past 11 years, each factor was transformed from a raw measure to one that was adjusted for the average across all Consumer Staples names.

Use mean of absolute value in each period to normalise

For each quarter, the mean of the absolute values for a factor is taken as the normalisation factor. Hence, factors that are somewhat evenly spread around zero are not unduly inflated, whereas always positive factors are normalised such that the mean value is 1. Missing factor data points are filled to the mean of the quarter.

Reducing the Number of Factors – L1 Regularization (Lasso Regression)

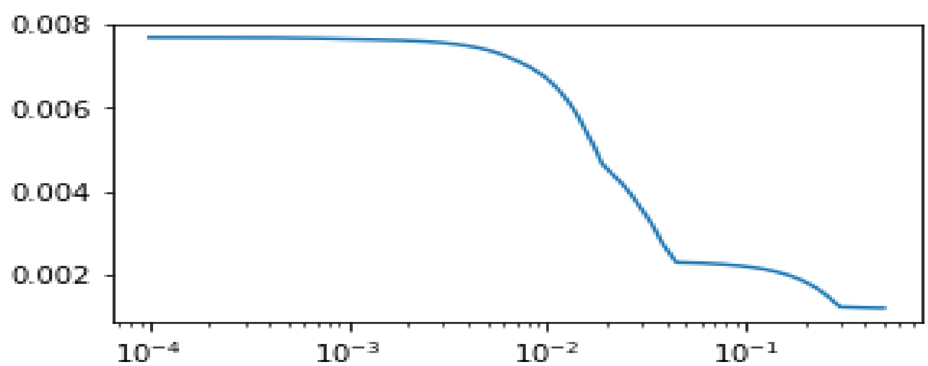
To build model scores and reject factors, the Scikit-learn Lasso/l1 regression implementation is used. This regression aims to reduce overfitting, by penalising the absolute magnitude of factor coefficients. Where a standard regression aims to minimise the Residual Sum of Squares (RSS), the lasso method minimises:

Choose level of regularization to balance model power and simplicity

RSS + α * **Σ** absolute value (coefficients) where α is the regularisation parameter. Figure 6 shows how differing values of this parameter effects the overall regression r^2. Smaller alpha values increase the r^2 and in turn the complexity of the model and number of factors used. To balance accuracy and simplicity an α of 10^{-2} is used.

FIGURE 6

Regression r^2 as a function of Lasso regularisation

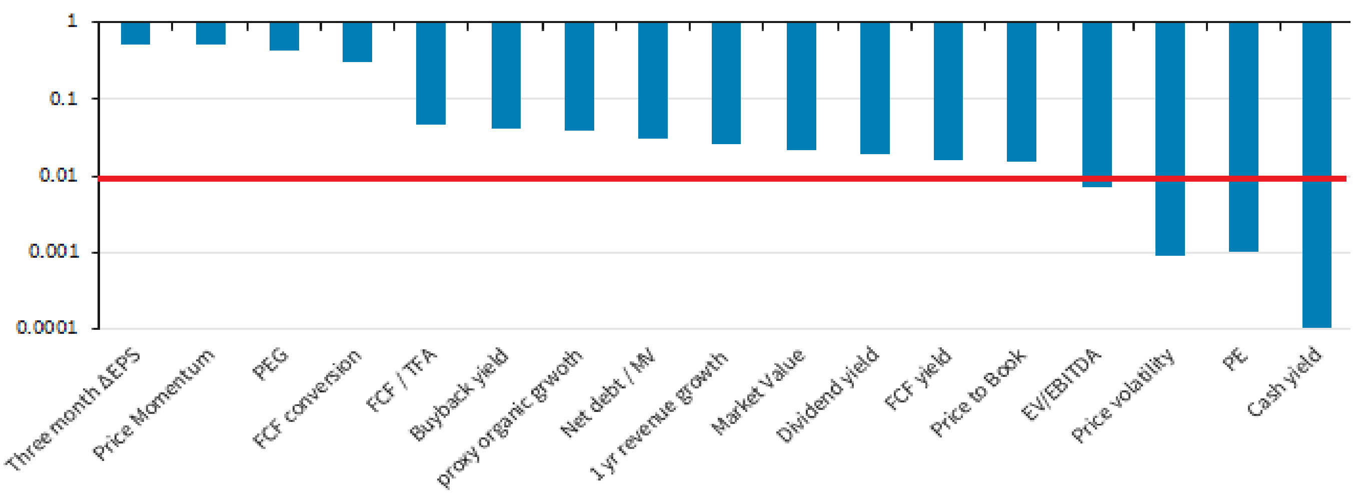


Source: Barclays Research, Refinitiv, MSCI

Figure 7 shows the maximum value of alpha for which each factor is still included in the regression, such that higher values show greater persistence. For example, cash yield has the lowest value, instead the model prefers utilising its two component parts, buyback and dividend yield.

FIGURE 7

Maximum alpha values for which each factor survives in all time lasso regression. Red line represents cut-off below which variables are rejected



Source: Barclays Research, Refinitiv

Creating and Back testing the Integrated Score

Our "score-weighted" approach weights securities at a PIT by their combined factor score, to form an alternative long only formulation of the index. An equal weighted portfolio of the best 20% scored securities at each PIT is also testing, the "top quintile" approach. The aim is to simulate how such a model would have performed historically, hence we use only the regression weights from historical data at that time. These weights change over time as behaviour of the securities in the index change.

The model is training on five years of initial data from 2008 before testing begins.

"Top quintile" approach may benefit from equal weight outperformance

Academic research suggests that equal-weighted portfolios have historically outperformed market-weighted portfolios. Our "top quintile" approach is calculated as the excess return of an equal-weighted choice of c23 securities, over a market capitalisation weighted index. Hence, the "top quintile" excess return may contain both selection and weighting components.

For testing, daily returns for each method are calculated, as well as daily excess returns. Quarterly excess returns and volatility thereof are calculated from the daily series, as shown in Figure 8.

FIGURE 8

Tests of return and excess return performance, of dynamic model training on past data only

	"Score-Weighted"	"Top Quintile"	Index
Annual Raw return	9.1%	10.4%	7.8%
Return volatility	8.6%	10.4%	9.5%
Sharpe ratio	1.1	1.0	0.8
Annual excess return	1.2%	2.6%	
Excess Return Volatility	3.6%	3.9%	
Information Ratio	0.34	0.67	

Note: Assumes quarterly re-selection and no transaction costs. Source: Barclays Research, Refinitiv, MSCI

Risks to the model

Rely on completeness and comparability of worldwide data

The model quality depends on the quality of historical data. There are a number of potential avenues for sub-optimal data. Data completeness, particularly for forecast variables, varies depending on geography and time period, possibly introducing bias. Furthermore, the global securities operate under differing accounting regimes and reporting standards, hence metrics (GAAP and adjusted) may not be like for like comparisons.

The relationships of factors to returns can change over time. Our approach is to train over the current cycle from 2008, but regime change can occur. Returns may be diluted if undue weight is placed on factors whose correlation has decreased. However, training over a smaller, more recent period introduces its own deficiencies. Firstly, the number of data points is lower, but additionally one may build a model trained on the recently benign low rates environment, which would underperform when the cycle turns.

The regression method used aims to reduce over-fitting and co-linear factors, but too much reduction will also remove accuracy and prediction power. Furthermore, in using strictly linear regressions, the model is limited for more nuanced factor relationships, such as two tailed distributions.

Applying a broad model to one security has a high failure rate

Finally, the model is based on broad outperformance of a basket of securities over multiple periods. Strictly implementing scores for small numbers of securities at one-time period will have a large failure rate.

Appendices

Factor Details

Details of the formulation of factors can be found in Figure 9.

FIGURE 9

Formulation of input factors

Factor	How it's formulated
1 year forward revenue growth	Next consensus Revenue / trailing Revenue -1
1 year to 1 month price momentum	% increase in price index from 12 months ago to 1 month ago
Book Value / P	Common equity / Market Capitalisation
Buyback yield	Cashflow repurchase of shares, normalised by share count / open price
Cash yield	Buyback yield + dividend yield
Dividend yield	Dividends per share / open price
EPS yield (FY1)	Next consensus EPS / open price
EV / EBITDA	(Market Capitalisation +Total Debt - Cash)/ next consensus EBITDA
FCF conversion	Trailing Free Cash Flow / Trailing Net Income
FCF yield[1]	Trailing Free Cash Flow per share / open price
FCF/ Tangible fixed Assets	Trailing Free Cash Flow / (Total Assets - Total Intangible Assets)
Market Capitalisation	Market Value of all listings converted to US$ at mid-rate
Net Debt / MV	(Total Debt - Cash)/ Market capitalisation
PEG (1 year forward)	PE 1 year forward / (annualised growth in earnings from FY0 to FY1)
PEG (2 year forward)	PE 2 year forward / (annualised growth in earnings from FY0 to FY2)
PEG (3 year forward)	PE 3 year forward / (annualised growth in earnings from FY0 to FY3)
Proxy Organic Growth	Consensus revenue growth FY2/ Consensus revenue growth FY1. A proxy for organic growth as two year forecasts typically do not contain M&A or currency implications.
Three month ΔEPS	EPS consensus for next annual period / (consensus for same period 3 months ago) -1
Three month price volatility	Standard deviation of price series adjusted for splits and reverse splits

Source: Barclays Research

Index Return Calculations

The security sample is the MSCI index constituents at the start of each quarter. For simplicity in return calculations, the index weightings are proportionate to dollar denominated market capitalisation at the opening of the quarter. Our index return also utilises these weights. We note that the MSCI index rebalancing dates are not quarterly, so our weights and index return calculations are approximate. Over the data period from 2008Q3 to 2019Q2, index cumulative return differs by 15bps.

[1] Completeness of FCF forecasts for a global basket of securities is poor, so we utilise exclusively historical data points only. Where available Worldscope's FCF per share metric is used and in other cases the IBES historical FCF data point is used.

For data, we utilise Refinitiv's QAD service to retrieve Datastream Pricing, Worldscope & Compustat historical financials and IBES consensus forecasts. Where database datapoints were presented in different currencies, pricing values were transformed using start of Quarter FX mid rates. For historical accounting periods, rates during the accounting period were used. Opening share prices are used throughout, adjusted for share splits and combinations.

No "annualisation" of reporting periods performed

For historical accounting data points, the last reported set of annual accounts available at the start of each quarter were used. Time periods on a less than annual basis suffer from global differences in reporting frequency and detail, as well as lack of forecast completeness. When utilising forecasts, this report refers to FY1 as the next annual financials to be reported. Factors are not annualised such that all securities have a common synthetic year end. This decision is part based on simplicity and to better allow for changes in reporting month.

Daily return indexes are retrieved for each security and converted into US$. A sub-portfolio Return Index (RI) is built from the weighted mean of each constituent; market value weights for the index, score weights for "score-weighted" and equal weights for "top quintile".

Due to differences in trading days over global exchanges, unique trading days exist. RI values are calculated for every day when at least one security trades. An excess return series is calculated as the RI of a portfolio over the index RI. Quarterly volatility is calculated as:

$(1+\text{daily volatility}) * \sqrt{(\text{trading days})}$

Risk normalised excess return is therefore the excess return over a quarter, normalised by quarterly excess return volatility.

De-listed securities and returns

Delistings are uncommon in the Consumer Staples sector, but do occur. When a delisting occurs, the return calculations assume investors receive in cash the last traded end of day price, which is reinvested in the index for the rest of the quarter. In the unlikely event of an insolvency, the true investor return and the calculated value would materially diverge. In an M&A context, when share considerations are used, the returns of the target are defined by the acquirer's returns post the merger. These effects are limited to a three-month time frame in the model.

ANALYST(S) CERTIFICATION(S):

We, Ben McSkelly, Ryan Preclaw and Iain Simpson, hereby certify (1) that the views expressed in this research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this research report and (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this research report.

IMPORTANT DISCLOSURES

Barclays Research is produced by the Investment Bank of Barclays Bank PLC and its affiliates (collectively and each individually, "Barclays"). All authors contributing to this research report are Research Analysts unless otherwise indicated. The publication date at the top of the report reflects the local time where the report was produced and may differ from the release date provided in GMT.

Availability of Disclosures:

Where any companies are the subject of this research report, for current important disclosures regarding those companies please refer to https://publicresearch.barclays.com or alternatively send a written request to: Barclays Research Compliance, 745 Seventh Avenue, 13th Floor, New York, NY 10019 or call +1-212-526-1072.

The analysts responsible for preparing this research report have received compensation based upon various factors including the firm's total revenues, a portion of which is generated by investment banking activities, the profitability and revenues of the Markets business and the potential interest of the firm's investing clients in research with respect to the asset class covered by the analyst.

Research analysts employed outside the US by affiliates of Barclays Capital Inc. are not registered/qualified as research analysts with FINRA. Such non-US research analysts may not be associated persons of Barclays Capital Inc., which is a FINRA member, and therefore may not be subject to FINRA Rule 2241 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst's account.

Analysts regularly conduct site visits to view the material operations of covered companies, but Barclays policy prohibits them from accepting payment or reimbursement by any covered company of their travel expenses for such visits.

Barclays Research Department produces various types of research including, but not limited to, fundamental analysis, equity-linked analysis, quantitative analysis, and trade ideas. Recommendations contained in one type of Barclays Research may differ from those contained in other types of Barclays Research, whether as a result of differing time horizons, methodologies, or otherwise.

In order to access Barclays Statement regarding Research Dissemination Policies and Procedures, please refer to https://publicresearch.barcap.com/S/RD.htm. In order to access Barclays Research Conflict Management Policy Statement, please refer to: https://publicresearch.barcap.com/S/CM.htm.

Risk Disclosure(s)

Master limited partnerships (MLPs) are pass-through entities structured as publicly listed partnerships. For tax purposes, distributions to MLP unit holders may be treated as a return of principal. Investors should consult their own tax advisors before investing in MLP units.

The MSCI sourced information is the exclusive property of MSCI Inc. (MSCI). Without prior written permission of MSCI, this information and any other MSCI intellectual property may not be reproduced, redisseminated or used to create any financial products, including any indices. This information is provided on an "as is" basis. The user assumes the entire risk of any use made of this information. MSCI, its affiliates and any third party involved in, or related to, computing or compiling the information hereby expressly disclaim all warranties of originality, accuracy, completeness, merchantability or fitness for a particular purpose with respect to any of this information. Without limiting any of the foregoing, in no event shall MSCI, any of its affiliates or any third party involved in, or related to, computing or compiling the information have any liability for any damages of any kind. MSCI and the MSCI indexes are services marks of MSCI and its affiliates.

Guide to the Barclays Fundamental Equity Research Rating System:

Our coverage analysts use a relative rating system in which they rate stocks as Overweight, Equal Weight or Underweight (see definitions below) relative to other companies covered by the analyst or a team of analysts that are deemed to be in the same industry (the "industry coverage universe").

In addition to the stock rating, we provide industry views which rate the outlook for the industry coverage universe as Positive, Neutral or Negative (see definitions below). A rating system using terms such as buy, hold and sell is not the equivalent of our rating system. Investors should carefully read the entire research report including the definitions of all ratings and not infer its contents from ratings alone.

Stock Rating

Overweight - The stock is expected to outperform the unweighted expected total return of the industry coverage universe over a 12-month investment horizon.

Equal Weight - The stock is expected to perform in line with the unweighted expected total return of the industry coverage universe over a 12-month investment horizon.

Underweight - The stock is expected to underperform the unweighted expected total return of the industry coverage universe over a 12-month investment horizon.

Rating Suspended - The rating and target price have been suspended temporarily due to market events that made coverage impracticable or to comply with applicable regulations and/or firm policies in certain circumstances including where the Investment Bank of Barclays Bank PLC is acting in an advisory capacity in a merger or strategic transaction involving the company.

Industry View

IMPORTANT DISCLOSURES CONTINUED

Positive - industry coverage universe fundamentals/valuations are improving.

Neutral - industry coverage universe fundamentals/valuations are steady, neither improving nor deteriorating.

Negative - industry coverage universe fundamentals/valuations are deteriorating.

Distribution of Ratings:

Barclays Equity Research has 1552 companies under coverage.

45% have been assigned an Overweight rating which, for purposes of mandatory regulatory disclosures, is classified as a Buy rating; 54% of companies with this rating are investment banking clients of the Firm; 76% of the issuers with this rating have received financial services from the Firm.

39% have been assigned an Equal Weight rating which, for purposes of mandatory regulatory disclosures, is classified as a Hold rating; 50% of companies with this rating are investment banking clients of the Firm; 69% of the issuers with this rating have received financial services from the Firm.

15% have been assigned an Underweight rating which, for purposes of mandatory regulatory disclosures, is classified as a Sell rating; 34% of companies with this rating are investment banking clients of the Firm; 65% of the issuers with this rating have received financial services from the Firm.

Guide to the Barclays Research Price Target:

Each analyst has a single price target on the stocks that they cover. The price target represents that analyst's expectation of where the stock will trade in the next 12 months. Upside/downside scenarios, where provided, represent potential upside/potential downside to each analyst's price target over the same 12-month period.

Top Picks:

Barclays Equity Research's "Top Picks" represent the single best alpha-generating investment idea within each industry (as defined by the relevant "industry coverage universe"), taken from among the Overweight-rated stocks within that industry. Barclays Equity Research publishes "Top Picks" reports every quarter and analysts may also publish intra-quarter changes to their Top Picks, as necessary. While analysts may highlight other Overweight-rated stocks in their published research in addition to their Top Pick, there can only be one "Top Pick" for each industry. To view the current list of Top Picks, go to the Top Picks page on Barclays Live (https://live.barcap.com/go/keyword/TopPicks).

To see a list of companies that comprise a particular industry coverage universe, please go to https://publicresearch.barclays.com.

Types of investment recommendations produced by Barclays Equity Research:

In addition to any ratings assigned under Barclays' formal rating systems, this publication may contain investment recommendations in the form of trade ideas, thematic screens, scorecards or portfolio recommendations that have been produced by analysts within Equity Research. Any such investment recommendations shall remain open until they are subsequently amended, rebalanced or closed in a future research report.

Disclosure of other investment recommendations produced by Barclays Equity Research:

Barclays Equity Research may have published other investment recommendations in respect of the same securities/instruments recommended in this research report during the preceding 12 months. To view all investment recommendations published by Barclays Equity Research in the preceding 12 months please refer to *https://live.barcap.com/go/research/Recommendations*.

Legal entities involved in producing Barclays Research:

Barclays Bank PLC (Barclays, UK)

Barclays Capital Inc. (BCI, US)

Barclays Bank Ireland PLC, Frankfurt Branch (BBI, Frankfurt)

Barclays Bank Ireland PLC, Paris Branch (BBI, Paris)

Barclays Bank Ireland PLC, Milan Branch (BBI, Milan)

Barclays Securities Japan Limited (BSJL, Japan)

Barclays Bank PLC, Hong Kong branch (Barclays Bank, Hong Kong)

Barclays Capital Canada Inc. (BCCI, Canada)

Barclays Bank Mexico, S.A. (BBMX, Mexico)

Barclays Securities (India) Private Limited (BSIPL, India)

Barclays Bank PLC, India branch (Barclays Bank, India)

Barclays Bank PLC, Singapore branch (Barclays Bank, Singapore)

DISCLAIMER:

This publication has been produced by Barclays Research Department in the Investment Bank of Barclays Bank PLC and/or one or more of its affiliates (collectively and each individually, "Barclays"). It has been prepared for institutional investors only and not for retail investors. It has been distributed by one or more Barclays affiliated legal entities listed below. It is provided to our clients for information purposes only, and Barclays makes no express or implied warranties, and expressly disclaims all warranties of merchantability or fitness for a particular purpose or use with respect to any data included in this publication. To the extent that this publication states on the front page that it is intended for institutional investors and is not subject to all of the independence and disclosure standards applicable to debt research reports prepared for retail investors under U.S. FINRA Rule 2242, it is an "institutional debt research report" and distribution to retail investors is strictly prohibited. Barclays also distributes such institutional debt research reports to various issuers, media, regulatory and academic organisations for their own internal informational news gathering, regulatory or academic purposes and not for the purpose of making investment decisions regarding any debt securities. Media organisations are prohibited from re-publishing any opinion or recommendation concerning a debt issuer or debt security contained in any Barclays institutional debt research report. Any such recipients that do not want to continue receiving Barclays institutional debt research reports should contact debtresearch@barclays.com. Barclays will not treat unauthorized recipients of this report as its clients and accepts no liability for use by them of the contents which may not be suitable for their personal use. Prices shown are indicative and Barclays is not offering to buy or sell or soliciting offers to buy or sell any financial instrument.

Without limiting any of the foregoing and to the extent permitted by law, in no event shall Barclays, nor any affiliate, nor any of their respective officers, directors, partners, or employees have any liability for (a) any special, punitive, indirect, or consequential damages; or (b) any lost profits, lost revenue, loss of anticipated savings or loss of opportunity or other financial loss, even if notified of the possibility of such damages, arising from any use of this publication or its contents.

Other than disclosures relating to Barclays, the information contained in this publication has been obtained from sources that Barclays Research believes to be reliable, but Barclays does not represent or warrant that it is accurate or complete. Barclays is not responsible for, and makes no warranties whatsoever as to, the information or opinions contained in any written, electronic, audio or video presentations of third parties that are accessible via a direct hyperlink in this publication or via a hyperlink to a third-party web site ('Third-Party Content'). Any such Third-Party Content has not been adopted or endorsed by Barclays, does not represent the views or opinions of Barclays, and is not incorporated by reference into this publication. Third-Party Content is provided for information purposes only and Barclays has not independently verified its accuracy or completeness.

The views in this publication are solely and exclusively those of the authoring analyst(s) and are subject to change, and Barclays Research has no obligation to update its opinions or the information in this publication. Unless otherwise disclosed herein, the analysts who authored this report have not received any compensation from the subject companies in the past 12 months. If this publication contains recommendations, they are general recommendations that were prepared independently of any other interests, including those of Barclays and/or its affiliates, and/or the subject companies. This publication does not contain personal investment recommendations or investment advice or take into account the individual financial circumstances or investment objectives of the clients who receive it. The securities and other investments discussed herein may not be suitable for all investors. Barclays is not a fiduciary to any recipient of this publication. Investors must independently evaluate the merits and risks of the investments discussed herein, consult any independent advisors they believe necessary, and exercise independent judgment with regard to any investment decision. The value of and income from any investment may fluctuate from day to day as a result of changes in relevant economic markets (including changes in market liquidity). The information herein is not intended to predict actual results, which may differ substantially from those reflected. Past performance is not necessarily indicative of future results. The information provided does not constitute a financial benchmark and should not be used as a submission or contribution of input data for the purposes of determining a financial benchmark.

United Kingdom: This document is being distributed (1) only by or with the approval of an authorised person (Barclays Bank PLC) or (2) to, and is directed at (a) persons in the United Kingdom having professional experience in matters relating to investments and who fall within the definition of "investment professionals" in Article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (the "Order"); or (b) high net worth companies, unincorporated associations and partnerships and trustees of high value trusts as described in Article 49(2) of the Order; or (c) other persons to whom it may otherwise lawfully be communicated (all such persons being "Relevant Persons"). Any investment or investment activity to which this communication relates is only available to and will only be engaged in with Relevant Persons. Any other persons who receive this communication should not rely on or act upon it. Barclays Bank PLC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority and is a member of the London Stock Exchange.

European Economic Area ("EEA"): This material is being distributed in the EEA by Barclays Bank PLC. Barclays Bank PLC is not registered in France with the Autorité des marchés financiers or the Autorité de contrôle prudentiel.

Americas: The Investment Bank of Barclays Bank PLC undertakes U.S. securities business in the name of its wholly owned subsidiary Barclays Capital Inc., a FINRA and SIPC member. Barclays Capital Inc., a U.S. registered broker/dealer, is distributing this material in the United States and, in connection therewith accepts responsibility for its contents. Any U.S. person wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of Barclays Capital Inc. in the U.S. at 745 Seventh Avenue, New York, New York 10019.

Non-U.S. persons should contact and execute transactions through a Barclays Bank PLC branch or affiliate in their home jurisdiction unless local regulations permit otherwise.

This material is distributed in Canada by Barclays Capital Canada Inc., a registered investment dealer, a Dealer Member of IIROC (www.iiroc.ca), and a Member of the Canadian Investor Protection Fund (CIPF).

This material is distributed in Mexico by Barclays Bank Mexico, S.A.

Japan: This material is being distributed to institutional investors in Japan by Barclays Securities Japan Limited. Barclays Securities Japan Limited is a joint-stock company incorporated in Japan with registered office of 6-10-1 Roppongi, Minato-ku, Tokyo 106-6131, Japan. It is a subsidiary of Barclays Bank PLC and a registered financial instruments firm regulated by the Financial Services Agency of Japan. Registered Number: Kanto Zaimukyokucho (kinsho) No. 143.

Asia Pacific (excluding Japan): Barclays Bank PLC, Hong Kong Branch is distributing this material in Hong Kong as an authorised institution regulated by the Hong Kong Monetary Authority. Registered Office: 41/F, Cheung Kong Center, 2 Queen's Road Central, Hong Kong.

All Indian securities-related research and other equity research produced by Barclays' Investment Bank are distributed in India by Barclays Securities (India) Private Limited (BSIPL). BSIPL is a company incorporated under the Companies Act, 1956 having CIN U67120MH2006PTC161063. BSIPL is registered and regulated by the Securities and Exchange Board of India (SEBI) as a Research Analyst: INH000001519; Portfolio Manager INP000002585; Stock Broker/Trading and Clearing Member: National Stock Exchange of India Limited (NSE) Capital Market INB231292732, NSE Futures & Options INF231292732, NSE Currency derivatives INE231450334, Bombay Stock Exchange Limited (BSE) Capital Market INB011292738, BSE Futures & Options INF011292738; Depository Participant (DP) with the National Securities & Depositories Limited (NSDL): DP ID: IN-DP-NSDL-299-2008; Investment Adviser: INA000000391. The registered office of BSIPL is at 208, Ceejay House, Shivsagar Estate, Dr. A. Besant Road, Worli, Mumbai – 400 018, India. Telephone No: +91 2267196000. Fax number: +91 22 67196100. Any other reports produced by Barclays' Investment Bank are distributed in India by Barclays Bank PLC, India Branch, an associate of BSIPL in India that is registered with Reserve Bank of India (RBI) as a Banking Company under the provisions of The Banking Regulation Act, 1949 (Regn No BOM43) and registered with SEBI as Merchant Banker (Regn No INM000002129) and also as Banker to the Issue (Regn No INBI00000950). Barclays Investments and Loans (India) Limited, registered with RBI as Non Banking Financial Company (Regn No RBI CoR-07-00258), and Barclays Wealth Trustees (India) Private Limited, registered with Registrar of Companies (CIN U93000MH2008PTC188438), are associates of BSIPL in India that are not authorised to distribute any reports produced by Barclays' Investment Bank.

This material is distributed in Singapore by the Singapore branch of Barclays Bank PLC, a bank licensed in Singapore by the Monetary Authority of Singapore. For matters in connection with this material, recipients in Singapore may contact the Singapore branch of Barclays Bank PLC, whose registered address is 10 Marina Boulevard, #23-01 Marina Bay Financial Centre Tower 2, Singapore 018983.

This material is distributed to persons in Australia by Barclays Bank PLC. None of Barclays Bank PLC, nor any other Barclays group entity, holds an Australian financial services licence and instead relies on an exemption from the requirement to hold such a licence. This material is intended to only be distributed to "wholesale clients" as defined by the Australian Corporations Act 2001.

Middle East: Nothing herein should be considered investment advice as defined in the Israeli Regulation of Investment Advisory, Investment Marketing and Portfolio Management Law, 1995 ("Advisory Law"). This document is being made to eligible clients (as defined under the Advisory Law) only. Barclays Israeli branch previously held an investment marketing license with the Israel Securities Authority but it cancelled such license on 30/11/2014 as it solely provides its services to eligible clients pursuant to available exemptions under the Advisory Law, therefore a license with the Israel Securities Authority is not required. Accordingly, Barclays does not maintain an insurance coverage pursuant to the Advisory Law.

This material is distributed in the United Arab Emirates (including the Dubai International Financial Centre) and Qatar by Barclays Bank PLC. Barclays Bank PLC in the Dubai International Financial Centre (Registered No. 0060) is regulated by the Dubai Financial Services Authority (DFSA). Principal place of business in the Dubai International Financial Centre: The Gate Village, Building 4, Level 4, PO Box 506504, Dubai, United Arab Emirates. Barclays Bank PLC-DIFC Branch, may only undertake the financial services activities that fall within the scope of its existing DFSA licence. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority. Barclays Bank PLC in the UAE is regulated by the Central Bank of the UAE and is licensed to conduct business activities as a branch of a commercial bank incorporated outside the UAE in Dubai (Licence No.: 13/1844/2008, Registered Office: Building No. 6, Burj Dubai Business Hub, Sheikh Zayed Road, Dubai City) and Abu Dhabi (Licence No.: 13/952/2008, Registered Office: Al Jazira Towers, Hamdan Street, PO Box 2734, Abu Dhabi). Barclays Bank PLC in the Qatar Financial Centre (Registered No. 00018) is authorised by the Qatar Financial Centre Regulatory Authority (QFCRA). Barclays Bank PLC-QFC Branch may only undertake the regulated activities that fall within the scope of its existing QFCRA licence. Principal place of business in Qatar: Qatar Financial Centre, Office 1002, 10th Floor, QFC Tower, Diplomatic Area, West Bay, PO Box 15891, Doha, Qatar. Related financial products or services are only available to Business Customers as defined by the Qatar Financial Centre Regulatory Authority.

Russia: This material is not intended for investors who are not Qualified Investors according to the laws of the Russian Federation as it might contain information about or description of the features of financial instruments not admitted for public offering and/or circulation in the Russian Federation and thus not eligible for non-Qualified Investors. If you are not a Qualified Investor according to the laws of the Russian Federation, please dispose of any copy of this material in your possession.

IRS Circular 230 Prepared Materials Disclaimer: Barclays does not provide tax advice and nothing contained herein should be construed to be tax advice. Please be advised that any discussion of U.S. tax matters contained herein (including any attachments) (i) is not intended or written to be used, and cannot be used, by you for the purpose of avoiding U.S. tax-related penalties; and (ii) was written to support the promotion or marketing of the transactions or other matters addressed herein. Accordingly, you should seek advice based on your particular circumstances from an independent tax advisor.