BARCLAYS

FICC Research
Quantitative Portfolio Strategy
4 February 2020

Does the Post-Earnings Announcement Drift (PEAD) Extend to Credit Markets?

Arik Ben Dor
+1 212 526 7713
arik.bendor@barclays.com
BCI, US

Jingling Guan
+ 1 212 526 3623
jingling.guan@barclays.com
BCI, US

Xiaming Zeng
+44 20 3134 4461
xiaming.zeng@barclays.com
Barclays, UK

www.barclays.com

- **We examine whether the Post-Earnings Announcement Drift (PEAD) – the tendency of stock prices to only gradually incorporate new information from earnings announcements – is also present in bond price dynamics.**
- **We employ several measures to capture the surprise component of earnings announcements, and find evidence that supports the existence of the PEAD phenomenon in credit markets over the last two decades.**
- **Bonds of issuers with more positive earnings surprises earned higher subsequent abnormal returns over the following several months relative to otherwise similar bonds of issuers with less positive earnings surprises.**
- **This pattern was evident across all time periods, industries and credit ratings and was not driven by illiquidity. It was a distinct phenomenon from other dynamics, such as short-term reversal and momentum.**
- **We illustrate how this market anomaly can be exploited in practice in credit markets. We construct index-tracking portfolios that match the IG and HY index key analytics but overweight issuers with positive earnings surprises. These portfolios outperformed the index in both investment grade and high yield.**
- **Combining the magnitude of earnings surprise with measures of an issuer's bonds' relative pricing leads to further improvement in performance.**

What is the Post-Earnings Announcement Drift?

The Post-Earnings Announcement Drift (PEAD) refers to investors' tendency to under react to new information revealed publicly during earnings announcements. It is one of the earliest discovered and most researched anomalies in equity markets. Empirical studies as early as Ball and Brown (1968) find that stock prices drift in the same direction as the initial earnings surprises over the weeks and months subsequent to the announcements, a pattern that is difficult to reconcile with market efficiency but is consistent with markets' slow incorporation of information (Bernard and Thomas 1990, Chan, Jegadeesh, and Lakonishok 1996). Additional studies find that the PEAD phenomenon extends to international markets (see Liu, Strong and Xu 2003, Gerard 2012, Griffin, Kelly, and Nardari 2010, for examples), and that investors can exploit the phenomenon in practice. For example, Chordia and Shivakumar (2006) show that a long-short portfolio that buys stocks with positive earnings surprises and short sells those with negative surprises delivers a monthly alpha of almost 1%. Recently Ben Dor and Guan (2017) find that although the magnitude of the phenomenon has declined over the last decade, equity investors are still able to achieve economically significant returns.

Ex ante, it is not clear whether we should expect to find the existence of the PEAD phenomenon in credit markets. On the one hand, credit and equity investors do share similar behaviour.[1] In addition, the lower liquidity of credit markets can contribute to the existence of the PEAD phenomenon (ie, partial incorporation of information). On the other hand, the little presence of retail investors in credit markets may limit the effect. The lower liquidity of credit markets also posits a separate, yet perhaps more important question: can credit investors actually benefit from the PEAD phenomenon in practice?

Despite the economic significance of the PEAD phenomenon and that earnings information is equally applicable to credit and equity investors, there has been very little research looking at whether the PEAD exists in credit markets due to two data limitations. First, examining such question requires high-quality and comprehensive corporate bond pricing and analytics data at the daily frequency, which is crucial for studying the impact on corporate bonds from events like earnings announcements. Second, a mapping between bond and equity is needed in order to link bond data to earnings and other firm fundamental data.[2] Such mapping is not commercially available and is in fact very challenging to build.[3]

Using Bloomberg Barclays corporate bond index database and a proprietary bond-to-equity mapping, we examine whether the PEAD phenomenon is also present in credit markets. Our analysis shows that the PEAD is present in corporate bonds. First, issuers that experienced positive (negative) surprises during earnings announcements have earned higher (lower) abnormal performance in the subsequent 60 to 70 trading days. Second, we find that the phenomenon is evident across all years, industries and credit ratings. More importantly, the PEAD phenomenon is present in the most liquid bonds and is thus unlikely to be driven just by illiquidity. In order to evaluate the economic benefits of the phenomenon, we form several replicating portfolios with similar characteristics to the Bloomberg Barclays Credit index but with a tilt towards issuers with positive earnings surprises. These replicating portfolios outperformed the index in both investment grade and high yield regardless of the constraints imposed.

[1] For example, Ben Dor and Guan (2016) find that companies mispriced by credit investors (in terms of bond prices) tend to be also mispriced by equity investors (in terms of stock prices) in the same direction.

[2] Earnings data is usually labelled with equity identifiers because earnings announcements are part of the regulatory requirement for companies with publicly traded stocks.

[3] Mapping bonds to equities issued by the same firm is challenging for a number of reasons. First, there are no common firm-level identifiers across equity and bond markets. Second, corporate actions have different impact on trading activities of bonds and equities. For example, bonds issued by the acquired company often continue to trade after the acquisition whereas equities cease to do so. Last but not least, firms usually have a single class of common shares, but may have multiple bonds outstanding, sometimes issued by more than one entity associated with the same firm.

The remainder of this study is organized as follows. We begin with a discussion of sample construction and the measures we use to quantify earnings surprises. The next section presents an event study approach to analyse whether earnings surprises are predictive of subsequent bond performances. In the subsequent section, we further explore the consistency of the phenomenon across sub-samples and investigate whether it is solely driven by illiquidity. The last section examines the economic implication for investors.

Data and Methodology

The starting universe for our sample consists of all bonds included in the Bloomberg Barclays US Corporate and High Yield indices between January 2001 and December 2017.[4] All bonds issued by companies for which we do not have equity data are removed from the sample since equity data is needed for our analysis.[5]

In addition, we have several filters to make sure that earnings surprise data is accurate and complete. First, if the mapped equities are ADR or traded OTC, we remove bond issuers from the sample. This ensures that earnings data is available on a regular basis and avoids exchange rate dynamics from affecting stock returns, which will be used as one measure of earnings surprises later. Second, we cross-check earnings announcement dates using Compustat and I/B/E/S. We remove the observations where the date difference from the two sources are more than two calendar days. Third, we also filter out companies that are not covered by analysts in the I/B/E/S database or do not have complete stock return data over the three-day window centered on the announcement dates in Compustat. These filters are imposed for the construction of earnings surprises, the details of which will be discussed later.

The final sample includes 1,929 unique firms over the entire sample period. There are, on average, 847 firms per quarter and each firm reports an average of 30 quarterly earnings announcements. Figure 1 displays the proportion of Bloomberg Barclays US Corporate and High Yield indices covered by the final sample. The coverage ratio by market capitalization reaches 84% for the investment grade index and 70% for the high yield index at the end of the sample. The coverage is lower for the high yield index because there is a higher percentage of high yield issuers that are private companies, which are usually not required to report earnings data. The difference between the numbers in the rows of 'Mapped' and 'Included in Final Sample' are due to the three filters we mentioned above.

FIGURE 1

Percentage of Bloomberg Barclays US Indices Included in the Sample by Market Value

Year-end Statistics	Corporate Index					High Yield Index				
	2001	2005	2009	2013	2017	2001	2005	2009	2013	2017
Index Population	1,590	1,609	2,555	3,727	5,192	318	596	747	1,270	1,339
Mapped	90%	95%	98%	97%	98%	80%	87%	82%	80%	85%
Included in Sample	68%	77%	82%	81%	84%	64%	66%	58%	54%	70%

Note: to calculate the index coverage, we look at the issuer constituents in the index statistics universe at the end of December and then report how many of them have earnings data in the final sample in October, November and December. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Despite the partial coverage of the two indices, the final sample is very similar to each respective index in terms of sector representation and key analytics. Figure 2 shows the percentages of market value by sector in the index and the final sample. In addition, Figure 3 shows that the time series of value-weighted averages of bond-level OAS and OASD are very much aligned between the sample and the index. Therefore, any dynamics we observe are unlikely to be driven by the differences between our sample and the indices.

[4] The sample begins in year 2001 due to data availability at the daily frequency, which are necessary to track bond returns immediately following the earnings announcements.

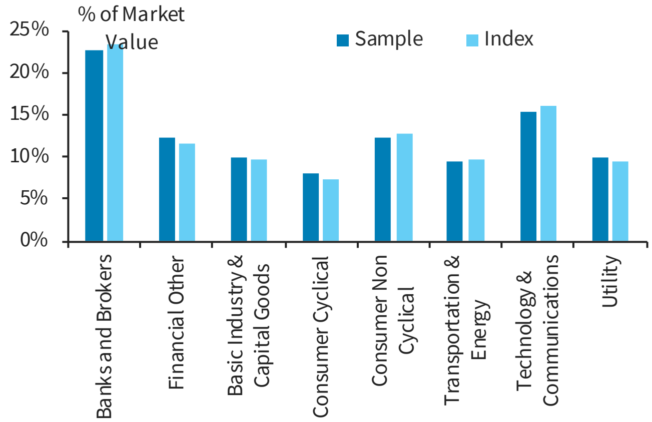
[5] The process of creating the bond-equity mapping is discussed in great details in Ben Dor and Xu (2014).

FIGURE 2

Sector Market Value Distribution in Sample versus in Corresponding Bloomberg Barclays US Indices

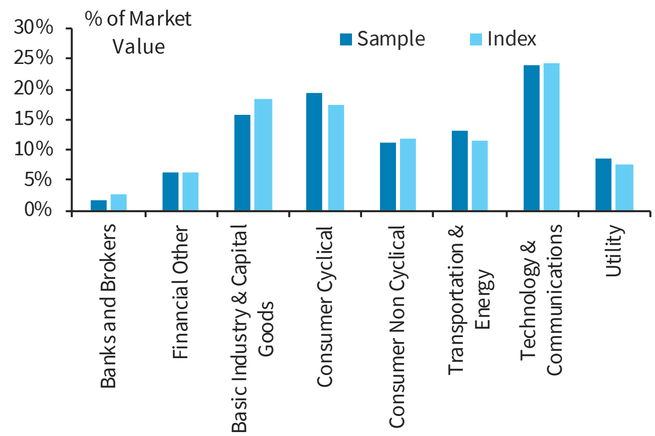
PANEL A

Corporate Index



PANEL B

High Yield Index



Source: Bloomberg, Barclays Research

Figure 4 plots the distribution of earnings announcements by reporting month and day of the week. The charts suggest that there is a cluster of announcements in February and March compared to other months that are quarters (multiples of three months) away (eg, Feb. vs. May, Aug. and Nov.). This is because the announcements of annual reports usually overlap those of the fourth-quarter quarterly reports, so the announcements covering the fourth quarter tend to occur later and cluster in February and March instead of in January.

FIGURE 3

Characteristics of the Sample versus Corresponding Indices

PANEL A

OAS, Corporate Index

PANEL B

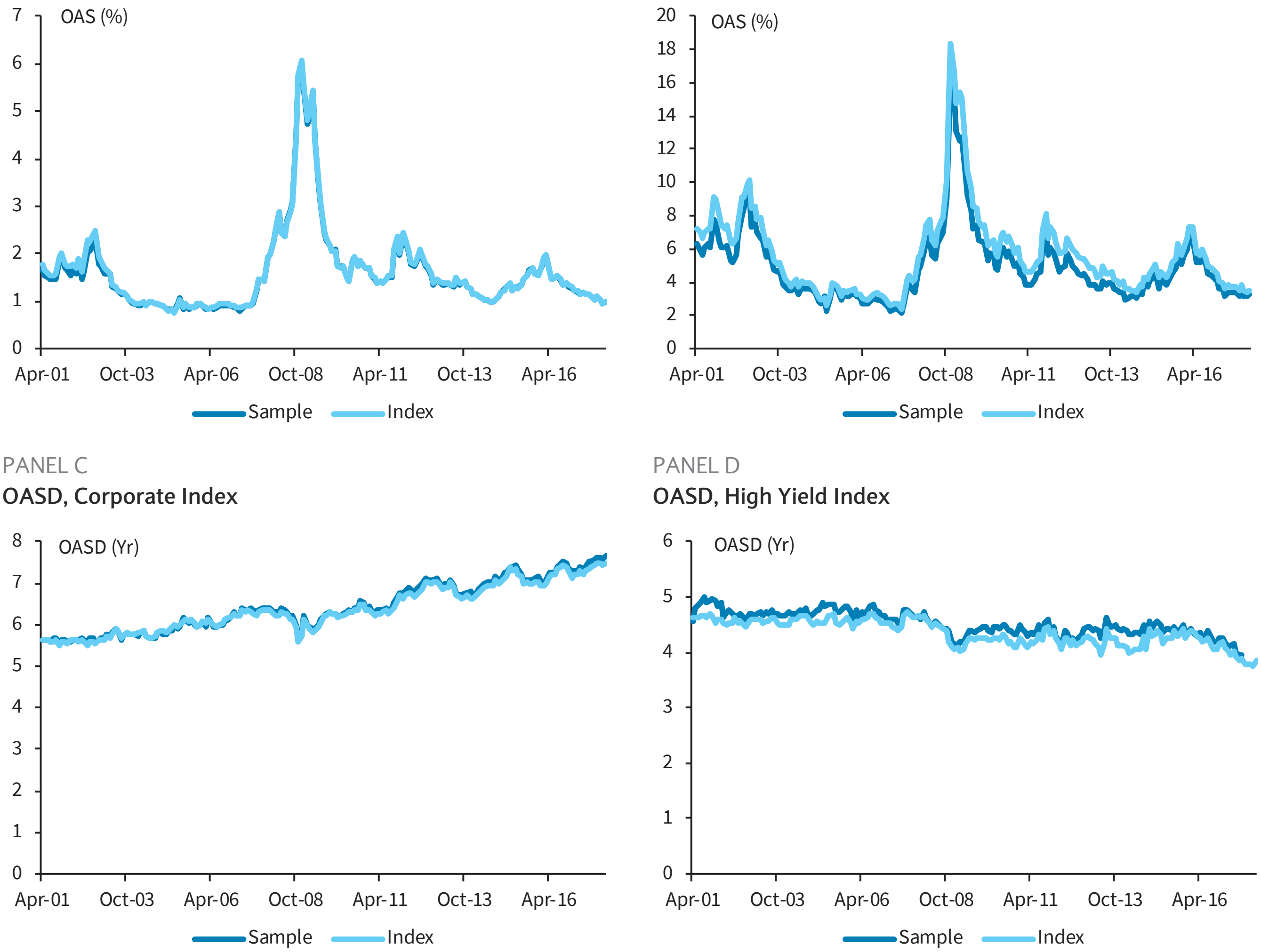
OAS, High Yield Index

PANEL C

OASD, Corporate Index

PANEL D

OASD, High Yield Index

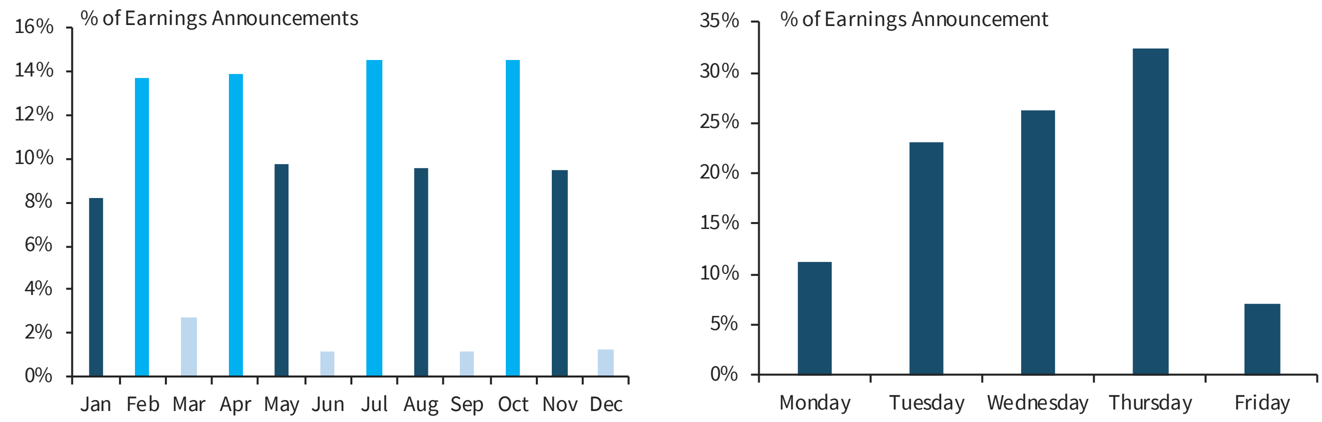


Note: OAS and OASD are aggregated bond-level averages weighted by a bond's market value from the previous month-end. Source: Bloomberg, Barclays Research

FIGURE 4
Distribution of Earnings Announcements in Our Sample by Month and Day of the Week

PANEL A
By Reporting Month

PANEL B
By Reporting Day of the Week



Source: the sample period is from January 2001 to December 2017. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Measures of Earnings Surprises

One key challenge in examining the PEAD phenomenon is how to quantify earnings surprises. The general method of calculating a firm's earnings surprise is to take its realized earnings-per-share number and subtract from it the expected level of earnings before the actual announcement, and then scale this difference by a form of company-specific scaler to standardize the magnitude of earnings surprises in the cross-section for easy comparisons.

One of the earliest measures that came to use is Standardized Unexpected Earnings, also known as SUE (Bernard and Thomas 1989), which uses a time-series model (seasonal random walk) to proxy for the earnings expectations and uses the standard deviation of past earnings surprises as the scaler,

$$SUE_{i,q} = \frac{EPS_{i,q} - E(EPS_{i,q})}{\sigma_{i,q}}, \qquad (1)$$

where $EPS_{i,q}$ is the realized earnings per share for firm i in quarter q with $E(EPS_{i,q})$ denoting its expected value and $\sigma_{i,q}$ representing the standard deviation of earnings surprises over the last eight quarters. A seasonal random walk with a drift is usually used to formulate the expected earnings per share, such as:

$$E\left(EPS_{i,q}\right) = EPS_{i,q-4} + \frac{\sum_{n=1}^{8}(EPS_{i,q-n} - EPS_{i,q-n-4})}{8}. \qquad (2)$$

The SUE measure is appealing for its simplicity. However, the choice of a time-series model for the earnings expectation in this measure is inherently backward-looking as it is solely based on historical time-series averages and ignores other newly available information that is relevant for earnings and may have already been incorporated by the market. New measures were proposed to address this limitation (Livnat and Mendenhall 2006; Doyle, Lundholm, and Soliman 2006). The idea was to use earnings forecasts from analysts to model earnings expectations. This approach is intuitive because analysts can incorporate timelier and more comprehensive information into earnings forecasts and model more complex scenarios rather than simply following the pattern of historical earnings. This measure, denoted as Consensus Forecast Error (CFE), is defined as

$$CFE_{i,q} = \frac{EPS_{i,q} - Analyst\ \ Forecast\ \ Consesus_{i,q}}{p_{i,q}}, \tag{3}$$

where $p_{i,q}$ is the stock close price as of the most recent month-end prior to the earnings announcement.

In addition to capturing surprises more accurately from a conceptual standpoint, using analysts' forecasts was found, in general, to be more effective than SUE in predicting future stock returns following earnings announcements (Livnat and Mendenhall 2006; Doyle, Lundholm, and Soliman 2006; Ben Dor and Guan 2017). Therefore, in the interest of brevity, we use only CFE instead of both.

One limitation of CFE is that it only captures the surprise on a company's bottom-line earnings figure. In reality, during a typical earnings announcement, a firm may release information on many other aspects that are relevant for its valuation, such as changes in revenue/sales, net income, etc. as well as forward-looking updates, such as future guidance, changes in dividend policy and business strategies. As for earnings surprises, investors may only partially incorporate the surprises related to the other aspects of the firm's operations at the time of the announcements and slowly incorporate the rest of the surprises subsequently over a longer window. For example, Jegadeesh and Livnat (2006) find that surprises in revenues also exhibit a persistent post-announcement drift regardless of whether the surprises are measured over a time-series (similar to SUE) or an analyst-forecast benchmark (similar to CFE). As investors initially react to the new information released during the earnings announcements, stock returns around the time of the announcements would serve as a composite measure of surprises reflecting all aspects, including both earnings and non-earnings surprises (Chan, Jegadeesh and Lakonishok 1996, and Brandt, Kishore, Santa-Clara and Venkatachalam 2008). For example, if there is overall positive information released during an earnings announcement, the stock market reaction during the announcement should be positive as well. This all-inclusive measure, termed the Earnings Announcement Returns (EAR), is supposed to capture both earnings and non-earnings as well as backward- and forward-looking information from earnings announcements using stock market reactions. Specifically, EAR for issuer i in quarter q is defined as its cumulative abnormal return over the returns of a benchmark portfolio of firms with similar risk exposures in a three-day window[6] centered on the announcement date q_t:

$$EAR_{i,q} = \prod_{j=q_t-1}^{q_t+1} \left(1 + R_{i,j}\right) - \prod_{j=q_t-1}^{q_t+1} (1 + FF_j), \tag{4}$$

where FF_j is the benchmark return (the size and book-to-market Fama-French portfolio to which stock i belongs) during the same announcement window.[7] The benchmark returns in the EAR calculation are included to make sure that the EAR captures company-specific information and not systematic movements in the market driven by other risk characteristics, such as size and book-to-market.

We further expand the set of surprise measures by including credit market reaction, a measure we term as Bond Announcement Returns (BAR). The idea is similar to EAR: all relevant information released during earnings announcements, earnings and non-earnings, should be at least partially incorporated into corporate bond prices around earnings announcements, and as a result the credit market reaction during the earnings announcement window should be proportional to the information released. Surprises reflected through credit market reactions have been explored as a predictor for equity PEAD

[6] We accumulate returns until one-day after the announcement date because some times earnings announcements are made after market close, so market reaction will be captured in the following day (qt+1).

[7] We use 25 portfolios based on the intersection of five size-based cutoffs and five book-to-market based cutoffs as the benchmark portfolios. The cutoffs and portfolio returns are from Kenneth French's website.

by Even-Tov (2017). This measure could potentially offer a lot of benefits because equity and bond markets could capture different aspects of information as they have varying clientele bases, different pricing models and focus on different maturities of firm cash flows as discussed in details in Ben Dor and Xu (2014).

The construction of BAR is similar to that of EAR as a measure of corporate bond returns over returns of a benchmark portfolio during the earnings announcement window. Specifically, we first calculate bond k's daily abnormal return on day j $(R_{k,j} - R_{peers,j})$, by subtracting its peer bonds' return ($R_{peers,j}$, value-weighted return of all bond *j*'s industry and credit-rating matched peers in the index) from its own return ($R_{k,j}$). To construct peer benchmarks, index bonds are divided into four by eight ratings (A+/A, Baa, Ba, B/B-) and industry buckets (financials, basic industry, capital goods, consumer cyclical, consumer non-cyclical, transportation & energy, technology & communications, and utility). The daily abnormal returns of bonds are then aggregated to the issuer level using bonds' market capitalizations as weights (w_k^{MV}). BAR for issuer *i* in quarter *q* is the sum of issuer *i*'s daily abnormal returns over the three-day window centered on the announcement date q_t,

$$BAR_{i,q} = \sum_{j=q_t-1}^{q_t+1} \left(\sum_{k=1}^{Total\ \#\ of\ Bonds_i} w_{k,j-1}^{MV} \left(R_{k,j} - R_{peers,j}\right) \right). \tag{5}$$

We also use the same abnormal return calculation and issuer-level aggregation method behind BAR to measure issuers' post announcement returns. Specifically, we sum up each issuer's daily abnormal returns over a window of multiple days subsequent to the announcement (holding horizon) and report that as the issuer's post-earnings announcement drift. Excess returns are used for investment grade bonds while total returns are used for high yield bonds.

Figure 5 summarizes the definitions and information sources of the measures used in this report. The stock prices, returns, book-to-market ratios and market values are from Compustat data, whereas the reported EPS values and analyst consensus are based on data from I/B/E/S. To formulate the analyst consensus, we utilise the most recent forecast of each analyst before a company's earnings announcement dates. Forecasts from analysts that have ceased their coverage by the time of a company's announcement dates are excluded.[8] We also remove estimates that are provided on an accounting basis different from the majority in I/B/E/S, which is flagged in the database's IBDSL table. The consensus is then defined as the average of all surviving analysts' forecasts.

Figure 6 reports various summary statistics of the three measures. The average surprises are all close to zero except those based on CFE, which are negative. CFE also have large standard deviations, consistent with Lermann, Livnat, and Mendenhall (2008) and many other studies. Unreported results also indicate that CFE has the largest kurtosis and a negative skewness among the three measures. These results suggest large outliers, especially negative ones. A further inspection shows that these outliers are mainly driven by firms that were close to bankruptcy with low stock prices. Nevertheless, the median of each surprise measure is close to zero indicating that surprises are mostly free from directional biases. Hence, nonparametric methods such as bucketing are unlikely to be affected by the outliers.

[8] To avoid any look-ahead bias, we only use real-time information that was available at each point in time in applying this exclusion rule. For example, if an analyst stopped coverage on a company before one of its earnings announcement, but such termination of coverage wasn't announced until after the earnings announcement, we still keep this particular analyst's estimate in the calculation of analyst consensus.

FIGURE 5

Earnings Surprise Measures

Measure	Surprise Source	Definition
Consensus Forecast Error (CFE)	Accounting Measure	Earnings deviation from analyst consensus forecasts scaled by stock prices
Earnings Announcement Returns (EAR)	Equity Market Reaction	A stock's cumulative abnormal return over a characteristics-matched benchmark portfolio during a three-day window centered on the earnings announcement
Bond Announcement Returns (BAR)	Credit Market Reaction	An issuer's total abnormal return over industry and rating-matched peers during a three-day window centered on the earnings announcement

Source: Barclays Research

The table also indicates that surprises tend to be larger in magnitude in HY names suggested by their wider percentiles and larger standard deviations. Several factors could lead to this observed pattern. First, HY issuers tend to be small in size, and therefore are usually covered by fewer analysts and receive less investor attention, leading to bigger surprises. Second, HY names are more leveraged and are hence inherently riskier and more difficult to value. Both can contribute to HY issuers' bigger surprises. Figure 6 also lists the pairwise correlations of the three measures. Overall, the correlation varies from low to medium, showing that the three measures are capturing different aspects of information from earnings announcement events. In particular, CFE and EAR have a positive correlation, but not very high, confirming the intuition that EAR captures additional information besides CFE. In addition, the pairwise correlations between CFE and BAR, EAR and BAR, are very low, highlighting the differences among the three measures, indicating that even though EAR and BAR are constructed using the same intuition and for the same firm, bonds and stock behaviour around earnings announcements can be very different.

FIGURE 6

Summary Statistics of Earnings Surprise Measures

Index	Surprise (%)	Mean	Standard Deviation	Percentiles					Pairwise Correlation	
				5th	25th	50th	75th	95th	CFE	EAR
Corporate	CFE	-0.39	38.40	-0.38	-0.01	0.05	0.17	0.66		
	EAR	0.06	5.20	-7.44	-2.34	0.07	2.50	7.52	0.28	
	BAR	0.01	1.06	-0.64	-0.13	0.00	0.12	0.71	0.02	0.05
High Yield	CFE	-3.28	219.59	-3.28	-0.19	0.06	0.32	1.85		
	EAR	0.01	9.44	-13.63	-4.13	-0.03	4.16	13.43	0.32	
	BAR	0.02	2.23	-1.72	-0.34	0.01	0.41	1.86	0.11	0.18

Note: the sample period is from January 2001 to December 2017. Pairwise correlations are rank correlations. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

In the next section, we investigate whether these surprise measures are predictive of subsequent bond performance.

Is PEAD Present in Corporate Bonds?

Given that reported earnings and returns are public information, market efficiency would imply that they should not be predictive of a security's future performance, especially at medium- to long-term horizons. To investigate the existence of PEAD in credit, we examine the existence of such predictability in an event-study setting by assigning each issuer announcement in the sample into five buckets based on their earnings surprise measures. The assignment is done within each sector separately and the breakpoints are the previous quarter's quintile cut-offs from each sector. Using cut-offs from the previous quarter allows the bucket assignment to be implementable in practice while grouping issuers by sectors neutralizes the possible impact of sector effects on performance. We then track the subsequent performance of each issuer following their announcements over various holding horizons, starting from the second trading day after the earnings announcement date.[9] If the earnings surprise measures have no predictability (ie, in the absence of the PEAD phenomenon), the subsequent performance of each bucket should be similar on average.

Figure 7 reports the average abnormal returns of each earnings surprise bucket over different holding horizons, ranging from 30 trading days to 120 trading days. Panel A reports the results for investment grade with excess returns, and Panel B for high yield with total returns. The choice of return units for the two indices follows the market convention. To allow comparison across investment grade and high yield, we also report high yield results in excess returns in Panel C. All the results reported in this section start from April 2001 because breakpoints from the previous quarter are needed for bucket assignment.

FIGURE 7

Cumulative Abnormal Returns Following Earnings Announcements by Ranking Measure and Subsequent Holding Horizon

Ranking Measure	CFE				EAR				BAR			
Holding Horizon	30	60	90	120	30	60	90	120	30	60	90	120
Panel A: Investment Grade (Excess Returns, %)												
Q1	-0.06	-0.03	0.06	0.08	-0.17	-0.24	-0.17	-0.18	0.00	0.05	0.13	0.20
Q2	0.05	0.01	0.07	0.06	0.09	0.15	0.15	0.18	0.05	0.03	0.05	0.03
Q3	0.06	0.07	0.15	0.14	0.10	0.11	0.21	0.26	0.11	0.09	0.12	0.10
Q4	0.14	0.12	0.17	0.21	0.15	0.18	0.24	0.27	0.10	0.10	0.17	0.17
Q5	0.16	0.29	0.37	0.40	0.20	0.29	0.42	0.39	0.09	0.18	0.33	0.35
Q5-Q1	0.22***	0.32***	0.31***	0.32***	0.37***	0.53***	0.59***	0.57***	0.09**	0.13**	0.20***	0.15**
Panel B: High Yield (Total Returns, %)												
Q1	-0.29	-0.45	-0.59	-0.69	-0.56	-0.82	-1.00	-1.24	-0.03	-0.20	-0.31	-0.50
Q2	0.06	0.10	0.06	-0.21	-0.06	-0.33	-0.41	-0.33	0.10	0.14	0.13	0.05
Q3	0.02	0.03	0.18	0.14	0.14	0.25	0.37	0.32	0.03	0.07	0.11	0.11
Q4	0.24	0.21	0.25	0.20	0.25	0.32	0.51	0.37	0.12	0.14	0.18	0.18
Q5	0.47	0.45	0.55	0.53	0.74	0.90	0.96	0.86	0.29	0.17	0.31	0.12
Q5-Q1	0.76***	0.90***	1.14***	1.22***	1.30***	1.72***	1.96***	2.10***	0.32***	0.37**	0.62***	0.62**
Panel C: High Yield (Excess Returns, %)												
Q1	-0.28	-0.45	-0.59	-0.68	-0.57	-0.84	-1.02	-1.27	-0.03	-0.21	-0.36	-0.56
Q5	0.47	0.45	0.54	0.55	0.75	0.90	0.96	0.89	0.32	0.19	0.36	0.19
Q5-Q1	0.75***	0.90***	1.13***	1.23***	1.32***	1.74***	1.99***	2.15***	0.35***	0.41**	0.72***	0.75**

Note: the sample period is from April 2001 to December 2017. The holding horizon tracks the performance from trading day *t+2*, in which *t* represents the earnings announcement date. When reporting cumulative abnormal total (excess) returns for high yield names, the ranking measure BAR is computed in the same way, using total (excess) returns. The superscripts ***, **, and * indicate statistical significance of Q5-Q1 return difference at the 1%, 5% and 10% level respectively. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Several observations emerge from the table regarding the performance of the different PEAD quintile buckets. Panel A shows that a larger positive surprise is generally associated with higher subsequent returns both across different earnings surprise measures and across different holding horizons. This effect is particularly evident when issuers are ranked by EAR. The return difference between issuers with the most positive surprises (Q5) and those with

[9] We exclude the first day after the earnings date because announcements can be released either intraday or overnight and Compustat data does not provide the exact timing of the announcement. This also ensures that the subsequent holding horizon we use to measure post announcement drift is not overlapped with the window used for constructing EAR and BAR.

the most negative surprises (Q1) is always positive and significant, and the return difference gradually increases when the holding horizon lengthens. These increases stop at roughly 90 trading days. Looking at the other two earnings measures, while there is also some predictability associated with CFE, the magnitude and strength is smaller than that of EAR. BAR seems to have the weakest predictability as it has the smaller Q5-Q1 differences in subsequent abnormal returns across all horizons.

Results in Panel B for high yield names are broadly similar. Regardless of the surprise measure, more positive earnings surprises are followed by higher average subsequent abnormal returns. EAR remains the most effective measure in predicting future performance, CFE the second while BAR is the weakest predictor.

Third, a cross-panel comparison shows that the Q5-Q1 difference in subsequent abnormal returns in high yield are always larger than the corresponding number in investment grade. This pattern persists regardless of the measure used for ranking the issuers. The smallest return difference between Q5 and Q1 in high yield based on BAR is similar to the biggest Q5 – Q1 return difference in investment grade based on EAR. One possibility of the return difference between investment grade and high yield is the different types of returns reported for the two groups. However, Panel C shows that the return differences between Q5 and Q1 in the high yield universe barely changed when switching to excess returns. Another possible explanation for seeing the bigger Q5-Q1 return difference in high yield is that high-yield-rated issuers are more likely to experience larger surprises in earnings than better-rated issuers. High yield bonds are usually more difficult to value because of their higher risk. The wider percentiles and larger standard deviation of CFE, EAR, and BAR in Figure 6 support this observation empirically. One last explanation is that, controlling for the magnitude of the surprises, prices of high yield bonds are more sensitive to earnings news since they are closer to defaults. For example, a one-standard deviation change in earnings surprises may lead to a much larger overall price impact in HY than in IG bonds. In the next section, we show that in a parametric regression analysis, high yield names indeed tend to earn higher abnormal returns even after controlling for the magnitude of the surprises.

Overall, results in Figure 7 are consistent with the existence of the PEAD in credit markets. However, this observation may be driven by our benchmark construction methodology, in particular, the use of sector and credit rating-matched peer groups in calculating bond abnormal returns. Indeed, when risks between an issuer and its underlying benchmark are not matched sufficiently close, the subsequent return difference could be a result of other unintended risks instead of a delayed reaction to earnings surprises. Although this partition captures two major sources of risk in corporate bonds, it does not address the differences of spread and duration among bonds.[10]

To neutralize possible differences in spread and duration among bonds, we adjust the peer returns by the difference between a bond's and its peer group's Duration Times Spread (DTS), which measures the expected volatility of a bond's excess returns (Ben Dor, Dynkin, Hyman, Houwelling, van Leeuwen, and Penninga 2007). Since bonds with higher DTS carry more risk, they should be compensated for by a higher expected return. Specifically, before subtracting the value-weighted return of a bond's industry and credit rating-matched peers, we first multiply the peer group return by the ratio of the bond's DTS to the market value weighted DTS of its peer group. The DTS adjusted abnormal return of bond k, $R_{k,t}^{\text{DTS-adj. abn}}$, is computed as,

[10] For example, if the bonds in Q5 have higher spreads than those in Q1, it could potentially explain why Q5 bonds have higher subsequent returns.

$$R_{k,t}^{\text{DTS-adj. abn}} = R_{k,t} - \frac{DTS_{k,t}}{DTS_{peers,t}} R_{peers,t}, \tag{6}$$

where $DTS_{k,t}$ is bond k's DTS as of day t and $DTS_{peers,t}$ is the market value weighted average DTS of all peers as of day t. As before, excess returns are used when bonds are investment grade and total returns are used when bonds are high yield. To compute cumulative returns, we first aggregate daily DTS-adjusted bond abnormal returns to the issuer level and then sum over the respective evaluation window.

FIGURE 8

Cumulative Abnormal Returns Following Earnings Announcements with DTS Adjustments to Benchmark Returns

Ranking Measure	CFE				EAR				BAR			
Holding Horizon	**30**	**60**	**90**	**120**	**30**	**60**	**90**	**120**	**30**	**60**	**90**	**120**
Panel A: Investment Grade (DTS Adjusted Excess Returns, %)												
Q1	-0.03	-0.01	0.10	0.14	-0.16	-0.24	-0.17	-0.15	0.02	0.00	0.13	0.19
Q5	0.10	0.22	0.27	0.27	0.19	0.34	0.46	0.43	0.06	0.14	0.25	0.25
Q5-Q1	0.13***	0.23***	0.17***	0.13*	0.35***	0.58***	0.63***	0.58***	0.04	0.13**	0.12*	0.06
Panel B: Investment Grade (Non-DTS adjusted Excess Returns, %)												
Q1	-0.06	-0.03	0.06	0.08	-0.17	-0.24	-0.17	-0.18	0.00	0.05	0.13	0.20
Q5	0.16	0.29	0.37	0.40	0.20	0.29	0.42	0.39	0.09	0.18	0.33	0.35
Q5-Q1	0.22***	0.32***	0.31***	0.32***	0.37***	0.53***	0.59***	0.57***	0.09**	0.13**	0.20***	0.15**
Panel C: High Yield (DTS Adjusted Total Returns, %)												
Q1	-0.50	-0.84	-1.08	-1.38	-0.67	-1.07	-1.32	-1.67	-0.02	-0.32	-0.50	-0.89
Q5	0.42	0.44	0.50	0.46	0.69	0.87	0.96	0.91	0.18	0.03	0.12	-0.04
Q5-Q1	0.92***	1.28***	1.58***	1.83***	1.36***	1.94***	2.28***	2.58***	0.21*	0.34**	0.61***	0.85***
Panel D: High Yield (Non-DTS adjusted Total Returns, %)												
Q1	-0.29	-0.45	-0.59	-0.69	-0.56	-0.82	-1.00	-1.24	-0.03	-0.20	-0.31	-0.50
Q5	0.47	0.45	0.55	0.53	0.74	0.90	0.96	0.86	0.29	0.17	0.31	0.12
Q5-Q1	0.76***	0.90***	1.14***	1.22***	1.30***	1.72***	1.96***	2.10***	0.32***	0.37**	0.62***	0.62**

Note: the sample period is from April 2001 to December 2017. The holding horizon tracks the performance from trading day *t+2*, in which *t* represents the earnings announcement date. The computation of BAR is always consistent with the way that abnormal return is reported. For example, when reporting cumulative DTS-adjusted abnormal excess returns for IG bonds, BAR is also computed with DTS-adjusted abnormal excess returns. The superscripts ***, **, and * indicate statistical significance of Q5-Q1 return difference at the 1%, 5% and 10% level respectively. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Figure 8 reports the results when both subsequent abnormal returns and BAR are adjusted by DTS ratios. First, the return differences between Q5 and Q1 are very similar for both CFE and EAR and some even become larger when spread and duration differences are controlled for, ruling out the hypothesis that the Q5-Q1 return differences were driven by spread and duration differences. This holds up in both investment grade and high yield universe. Second, when we adjust for DTS in both BAR and subsequent returns, the performance was very similar to before, indicating that controlling for the spread and duration differences in the predictor (BAR) would not improve its predictive power.[11]

[11] If we only adjust for DTS in the subsequent returns and not in the BAR measure, the results are very similar to the results with using non-adjusted returns in both measures (Panel B and D). Results not reported for brevity.

Understanding PEAD Dynamics

The key result we have established in the previous section was that *on average* there is a statistically significant predictive relationship between earnings surprises and subsequent bond returns over the following 60 to 70 trading days. In this section, we take a detailed look at the dynamics of the phenomenon and examine PEAD in various sub-samples and sub-periods. As EAR proved to be the most effective measure, we focus our discussion on PEAD portfolios that are ranked by EAR. In addition, all results are based on DTS-adjusted abnormal returns.

Calendar Time Effects

First, we examine the subsequent bond returns on a daily basis and examine its decays over the days after the announcements. Panels A and B of Figure 9 plot the daily average abnormal excess returns of top- and bottom-ranked investment grade issuers. In addition, the charts also display the cumulative daily average abnormal returns (shown in solid lines). Panel A suggests that the top-ranked issuers have a steady upward trend in their cumulative abnormal returns for 60 to 70 trading days. The bars show that the daily average abnormal excess returns for the top-ranked issuers are highly positive in the beginning, and become less consistent as they move further away from the initial announcements. Panel B shows a similar pattern for the bottom-ranked issuers with an opposite trend. These patterns show that the predictability of surprises post announcement span a good number of days instead of only concentrating in a few days. Panels C and D of Figure 9 show similar daily dynamics of PEAD among high yield issuers, although the bottom-ranked EAR quintile does exhibit a stronger downward trend that continues beyond 70 trading days.

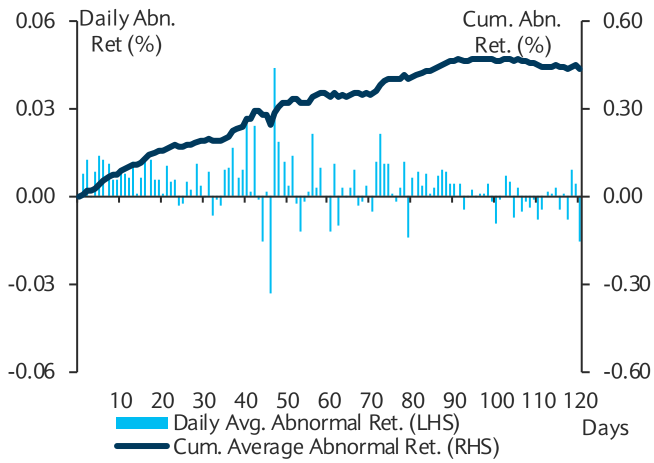
Collectively, the results in Figure 9 confirm that the post-earnings announcement drift in corporate bonds persists steadily after the earnings announcements for about 70 days, after which the effect dissipates with no subsequent mean-reversion. This is similar to the PEAD dynamics in the equity market and is consistent with the market slowly incorporating the earnings surprises information into prices.

FIGURE 9

Daily Average Abnormal Returns of Top and Bottom EAR Quintiles Following Earnings Announcements

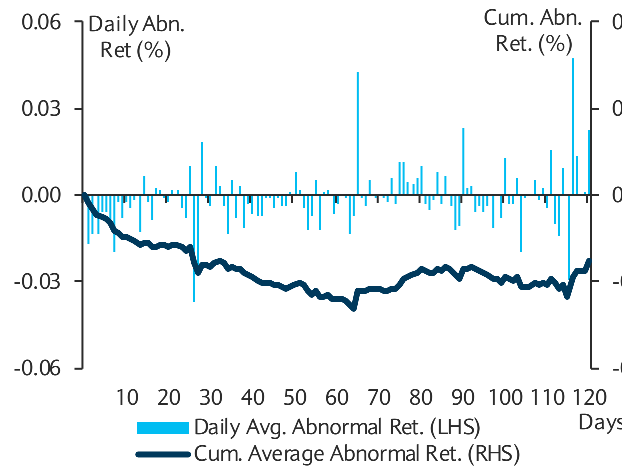
PANEL A

Corporate Index, Top (Q5) Ranked Issuers



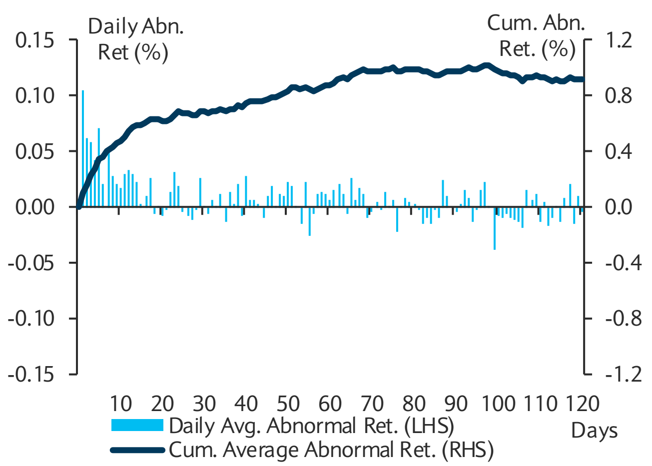
PANEL B

Corporate Index, Bottom (Q1) Ranked Issuers



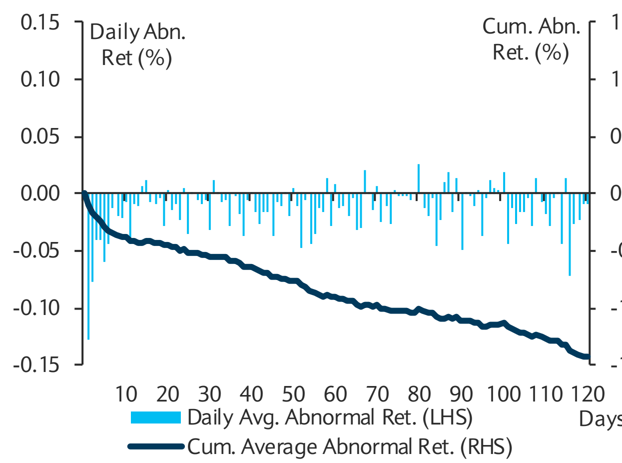
PANEL C

HY Index, Top (Q5) Ranked Issuers



PANEL D

HY Index, Bottom (Q1) Ranked Issuers



Note: the sample period is from April 2001 to December 2017. The horizontal axis is the number of trading days since trading day t+2, in which t represents the earnings announcement date. The daily average abnormal returns (bar) are computed as the average of all issuers' DTS adjusted abnormal excess (total) returns on the "ith" trading day for the IG (HY) universe. The cumulative (line) is the cumulative sum of the daily average abnormal returns. Issuers are assigned into Bottom (Q1) and Top (Q5) buckets using same universe and same sector's EAR quintile cutoffs from the previous quarter. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Next we examine whether the results are consistent over time or driven by a limited number of years. Figure 10 reports the differences in average abnormal returns between top- and bottom-ranked EAR quintiles grouped by year.[12] The charts suggest that the return difference is positive in all years for both investment grade and high yield universes. The difference generally increases from 30 trading days to 60 trading days and for the majority of years the increment continues up to 90 trading days, very similar to the aggregate results we saw in Figure 7 and 8. As before, we observe a larger top-bottom return difference in high yield compared with investment grade in all years.

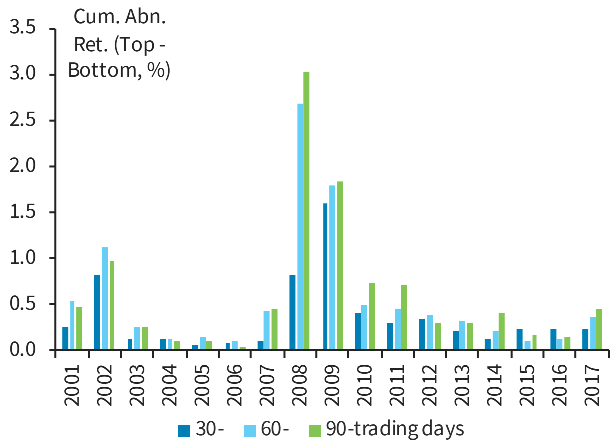
[12] The year refers to the time when the earnings announcements were releases. The subsequent holding horizon could extend to the following year.

FIGURE 10

Cumulative Abnormal Return Differences Between Top and Bottom EAR Quintiles, by Year and Holding Horizon

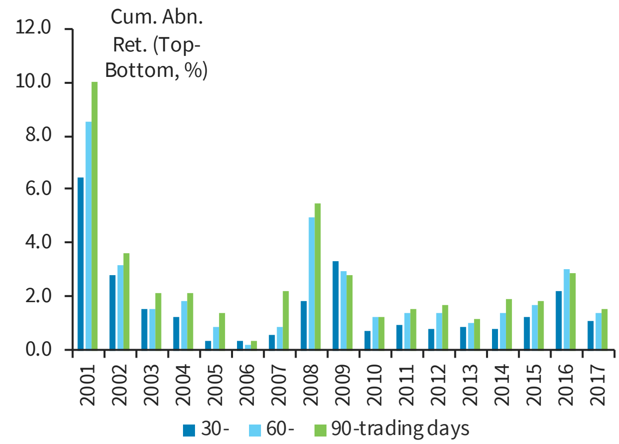
PANEL A

Corporate Index



PANEL B

HY Index



Note: the sample period is from April 2001 to December 2017. Issuers are assigned into bottom (Q1) and top (Q5) buckets using same universe and same sector's EAR quintile cutoffs from the previous quarter. For issuers in the IG universe, reported return differences are based on DTS adjusted abnormal excess returns; while in the HY universe, they are based on DTS adjusted abnormal total returns. Year is based on the earning announcement date. Source: Bloomberg, Compustat. I/B/E/S, Barclays Research

Industry and Rating Effects

Next, we investigate whether the PEAD is specific to certain industries and whether it is affected by ratings. Figure 11 reports the differences in average abnormal returns between top- and bottom-ranked EAR quintiles grouped by different industries. Ranking issuers by EAR leads to positive return differences between top and bottom buckets in all industries, showing that the phenomenon is not industry specific. Most patterns we observed in aggregate, such as the increase in the top-bottom difference in abnormal performance for longer holding horizons and the differences between investment grade and high yield bonds, are still present at the industry level.

FIGURE 11

Cumulative Abnormal Return Differences Between Top and Bottom EAR Quintiles, by Industry and Holding Horizon

Sector	Corporate Index			HY Index		
	30	60	90-Trading Day	30	60	90-Trading Day
Financials	0.56	1.08	1.18	1.69	2.12	2.28
Basic Industry	0.47	0.49	0.43	0.82	1.49	1.64
Capital Goods	0.18	0.15	0.40	0.92	1.43	1.68
Consumer Cyclical	0.32	0.51	0.71	0.85	1.64	1.95
Consumer Non Cyclical	0.12	0.22	0.22	1.53	2.15	2.79
Transportation & Energy	0.40	0.49	0.60	2.24	2.90	3.33
Technology & Communications	0.20	0.40	0.46	1.92	2.34	2.73
Utility	0.26	0.36	0.27	0.51	0.87	1.19

Note: the sample period is from April 2001 to December 2017. Issuers are assigned into top (Q1) and bottom (Q5) buckets using same universe and same sector's EAR quintile cutoffs from the previous quarter. For issuers in IG universe, reported return differences are based on DTS adjusted abnormal excess returns; while in HY universe, they are based on DTS adjusted abnormal total returns. Source: Bloomberg, Compustat. I/B/E/S, Barclays Research

Figure 12 shows that the difference in abnormal returns between top- and bottom-ranked EAR quintiles are positive for all rating buckets with an inverse relation between the rating and the difference: the lower the credit rating, the larger the difference in subsequent abnormal returns. This is consistent with the performance difference between investment grade and high yield indices. As discussed earlier, one possible contributing factor to the phenomenon is that lower-rated issuers usually experience larger surprises. Figure 12 is consistent with this hypothesis as the median EAR between top- and bottom-ranked issuers increases as the rating deteriorates.

FIGURE 12

Cumulative Abnormal Return Differences Between Top and Bottom EAR Quintiles, by Credit Rating and Holding Horizon

Rating Bucket	Cumulative Abnormal Return Differences Post Announcements (Top-Bottom, %)			Median EAR Value (around Announcements) of Bottom and Top Ranked Issuers (%)	
	30	60	90	Q1	Q5
A or higher	0.28	0.64	0.74	-4.22	4.61
BBB	0.41	0.53	0.55	-4.89	5.02
BB	0.80	1.10	1.18	-7.56	7.60
B or lower	1.66	2.40	2.88	-9.31	9.27

Note: Issuers are assigned into bottom (Q1) and top (Q5) buckets using same universe and same sector's EAR quintile cutoffs from the previous quarter. For issuers rated with Baa and above, reported return differences are based on DTS adjusted abnormal excess returns; while issuers rated with Ba or lower are based on DTS adjusted abnormal total returns. The holding horizon tracks the performance starting from trading day t+2, in which t represents the earnings announcement date, for the next 30, 60 and 90 trading days. Source: Bloomberg, Compustat. I/B/E/S, Barclays Research

Taken together, Figures 9 through 12 show that the PEAD effect as represented by the outperformance of Q5 over Q1 is not limited to a specific day after the announcement, a specific year, an industry or a rating bucket.

Are Our Results simply a Reflection of Illiquidity?

Credit markets are known to be relatively illiquid. The PEAD phenomenon reflects the gradual incorporation of information by investors. Hence, is it possible that our results are, to a large extent, driven by the lower liquidity in the credit market that prevents investors from trading quickly and reflect all the information revealed in the earnings announcements? To address this question, Figure 13 examines the differences in cumulative abnormal returns in top-over-bottom EAR quintile as a function of liquidity. We use two measures as proxies of bond liquidity. The first is Trade Efficiency Scores (TES), that combines information on liquidity cost scores[13] (bid-offer spreads) and trading volumes at the security-level (see Konstantinovsky, Ng, and Phelps 2016 for more details). We group bonds into three TES buckets: liquid, actively traded bonds with TES between 1 and 3, moderately liquid bonds with TES between 4 and 7, and illiquid less-frequently-traded bonds with TES between 8 and 10. The second liquidity measure is based on autocorrelation of bonds' daily excess returns. Autocorrelation is seen as a proxy for illiquidity because investors tend to break trades in less liquid securities into multiple transactions in order to limit market impact, leading to positive autocorrelation. In addition, the prices of illiquid bonds may be less frequently updated and would therefore be subject to "stale" pricing, contributing to return autocorrelation.

The results in Figure 13 suggest that the PEAD effect is evident for all liquidity buckets for both measures. More importantly, if the PEAD effect was entirely driven by illiquidity, the phenomenon should have been stronger among bonds with lower liquidity. Looking at Figure 13 indicates that the difference in cumulative abnormal returns increases as liquidity (TES)

[13] LCS measures the cost of an immediate, institutional-size, round-trip transaction, and is expressed as a percent of the corporate bond's price. LCS relies on simultaneous, bond-level, bid-ask quotes issued by Barclays traders.

deteriorates in the first 30 trading days. The monotonicity breaks up when the holding horizon extends to 60 and 90 trading days for both investment grade and high yield universes. When issuers are grouped by autocorrelation, the return difference is actually larger among liquid issuers than illiquid issuers. Overall, the results in Figure 13 do not support the notion that the PEAD phenomenon observed in the credit market is just an artefact of illiquidity.

FIGURE 13

Differences in Cumulative Abnormal Returns between Top and Bottom EAR Quintiles, by Liquidity and Holding Horizon

Liquidity Proxy	Proxy Buckets	Liquidity	Corporate Index (%)			HY Index (%)		
			30	60	90	30	60	90
TES (Starting from 2007)	1-3	Liquid	0.33	0.68	0.75	0.77	1.53	2.00
	4-6	Medium	0.41	0.55	0.64	1.29	2.12	2.51
	7-10	Illiquid	0.52	0.89	1.09	1.53	1.97	1.90
Auto-correlation in Daily Excess Returns	Low	Liquid	0.43	0.68	0.78	1.86	2.35	2.97
	Medium	Medium	0.34	0.49	0.56	1.38	1.98	2.32
	High	Illiquid	0.28	0.52	0.51	0.83	1.44	1.24

Source: the sample period is from April 2001 to December 2017. Issuers are assigned into bottom (Q1) and top (Q5) buckets using same universe and same sector's EAR quintile cutoffs from the previous quarter. For issuers in the IG universe, reported return differences are based on DTS adjusted abnormal excess returns; while in the HY universe, they are based on DTS adjusted abnormal total returns. Issuer-level TES ranks are market value weighted bond-level TES ranks (rounded to the nearest integer) from the most recent month end before earnings announcement. Because TES is only available since 2007, results in TES rows are based on a sub-period starting from 2007. We compute auto-correlation using issuer's daily excess returns over [*t-121*, *t-2*] trading day window, in which *t* represents the earnings announcement day, and requires at least 60 daily observations. In each quarter, issuers in each bond universe are ranked into terciles using auto-correlation values. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Understanding the Drivers of Cross-Sectional Variation in PEAD

In this section, we analyse the PEAD effects in a regression setting with two objectives: first to quantify the relative predictive power of the three earnings surprise measures we looked at, and second to examine whether their effects are subsumed by other possible predictors of bond returns. To understand the decay in predictability over time, we use three dependent variables, each representing subsequent cumulative abnormal bond returns over a different non-overlapping 20-trading-day holding horizon: [2d,21d], [22d, 41d], and [42d, 61d].[14]

We begin with univariate regressions where we regress the subsequent cumulative abnormal returns on each of the three earnings surprise measures in isolation. Figure 14 reports the regression results, with Panel A for the investment grade universe and Panel B for the high yield universe. The table shows that EAR is the only measure that is statistically significant in predicting bond abnormal returns over all three holding horizons, and the coefficients on EAR have the largest magnitude among the three measures. CFE demonstrates significant predictive power over the first two holding horizons, but not for the 42-61d horizon. BAR demonstrates no predictive power as it has the smallest coefficients which are either insignificant or have the wrong sign.

Panel B of Figure 14 reports the results for the same univariate regressions for the high yield universe. The table shows that all three surprise measures in isolation exhibit significant predictive power over the three holding horizons, consistent with the results in Figure 7. Similar to the results in the investment grade universe, the coefficients on EAR have the largest magnitude, CFE the second, and BAR the smallest. As found previously, the effect in high yield is larger than that in the investment grade universe. This can be partially explained by the larger surprises experienced by high yield issuers as shown in Figure 12. Figure 14

[14] The numbers represent the number of trading days following the earnings announcement date, defined as day zero.

provides further evidence that even after controlling for the magnitude of surprises, high yield bonds are still more likely to display larger effects as the coefficients on the surprises in high yield are larger than those in investment grade.[15]

FIGURE 14

Results of Cross-sectional Univariate Regression of Cumulative Abnormal Return over Subsequent $[t_1, t_2]$-Day Horizon on Univariate Predictors

Univariate Predictor		Panel A. Corporate Index			Panel B. High Yield Index		
		Dependent Variable: Cumulative Abnormal Bond Returns over Subsequent [t1,t2]-day Holding Horizon					
		[2,21]	[22,41]	[42,61]	[2,21]	[22,41]	[42,61]
EAR	Coef	**0.06**	**0.05**	**0.02**	**0.15**	**0.06**	**0.05**
	T-stat	**(9.26)**	**(6.73)**	**(2.51)**	**(5.93)**	**(7.62)**	**(5.38)**
	Adj. R Sq.	0.5%	0.2%	0.1%	2.2%	0.4%	0.3%
CFE	Coef	**0.02**	0.02	0.01	**0.07**	**0.04**	**0.03**
	T-stat	**(2.63)**	(1.98)	(1.19)	**(4.06)**	**(2.95)**	**(2.22)**
	Adj. R Sq.	0.2%	0.0%	0.1%	0.5%	0.2%	0.2%
BAR	Coef	**-0.04**	0.01	0.01	**0.03**	**0.03**	**0.02**
	T-stat	**(-3.22)**	(0.60)	(1.11)	**(1.91)**	**(2.38)**	**(1.81)**
	Adj. R Sq.	0.3%	0.0%	0.1%	0.2%	0.1%	0.2%

Note: the sample period is from April 2001 and December 2017. The notation for holding horizon $[t_1, t_2]$ is always relative to the earnings announcement date, which is represented by t=0. Stock return [-250, -21] and stock return [-20, -2] are both adjusted by the contemporaneous return of the Fama-French size and book-to-value matched portfolio, similar to the construction of EAR. The numbers in parenthesis are t-statistics and are computed with errors clustered at year-quarter level. Explanatory variables that are continuous and dependent variables are all standardized to have mean 0 and standard deviation of one.
Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

For the second objective to examine whether the effects of the earnings surprise measures are subsumed by other predictors of bond returns, we move to multivariate regressions and include four additional predictor variables. The first two predictors are past returns of stocks issued by the same company. We use **past stock returns over the intermediate term** (250 trading days preceding the announcement skipping the most recent 20 trading days , *t-250* to *t-21*[16], momentum) and **the short term** (20 trading days preceding the announcement skipping the most recent trading day , *t-20* to *t-2*, short-term reversal). We include past stock returns because prior research finds a positive empirical relationship between past equity returns and subsequent returns of corporate bonds (Equity Momentum in Credit, EMC, see Polbennikov and Desclée 2017 for details). We want to test whether the PEAD in credit is a distinct phenomenon or is subsumed by the equity momentum phenomenon in credit. In equities, there is mixed evidence[17]. We separate past stock returns over the intermediate and short terms because finance literature has documented opposite patterns for future stock returns relative to past stock returns over these two look-back windows: at the intermediate term, we observe a continuation of momentum (past winners continue to be winners, Jegadeesh and Titman 1993), and at the short term, we observe a price reversal (past winners become losers, Lo and MacKinlay 1990). The third predictor is **bond past returns** (DTS-adjusted abnormal bond return over the same window as stock short term return) to capture

[15] In alternative regressions (not reported for brevity), we include both IG and HY issuers in a pooled regression allowing different slopes for IG and HY issuers while the variables were standardized over the same mean and standard deviation. HY issuers still have larger slopes on EAR, indicating that controlling for the actual size of surprises, HY issuers still have a larger drift.

[16] *t* represents the day of the earnings announcement. All in unit of trading days.

[17] For example, Chan, Jegadeesh, and Lakonishok (1996) find that both earnings surprises and past intermediate equity returns contributed significantly to the predictability of future equity returns even after controlling for each other, whereas Chordia and Shivakumar (2005) and Novy-Marx (2015) find that equity momentum is subsumed by the equity PEAD effects.

the general trend in bond prices that may be unrelated to the announcements themselves but potentially have predictive power of future returns. The last predictor is the **lagged EAR** (EAR from the previous quarter) to control for any spill over effect from the previous quarter. We include the lagged term only on EAR because it is the most significant surprise measure. We also include sector dummies and rating dummies in the regressions as control variables. Continuous explanatory variables and dependent variables are all trimmed at 0.5% and 99.5% percentiles and then standardized to have mean zero and standard deviation of one within each year-quarter for easy interpretation. We cluster errors at the year-quarter level.

FIGURE 15

Cross-sectional Multivariate Regression of Cumulative Abnormal Return $[t_1, t_2]$ on Different Predictors

	Panel A. Corporate Index			Panel B. High Yield Index		
Multivariate Predictors	Dependent Variable: Cumulative Abnormal Bond Returns over Subsequent [t1,t2]-day Holding Horizon					
	[2,21]	[22,41]	[42,61]	[2,21]	[22,41]	[42,61]
EAR	**0.06**	**0.05**	**0.01**	**0.14**	**0.05**	**0.04**
	(8.84)	**(6.32)**	**(2.07)**	**(3.73)**	**(6.23)**	**(4.98)**
CFE	0.01	0.00	0.00	**0.04**	0.02	0.02
	(0.69)	(0.42)	(0.36)	**(2.25)**	(1.49)	(1.14)
BAR	**-0.05**	0.00	0.01	-0.02	0.01	0.01
	(-3.74)	(0.19)	(1.01)	(-1.10)	(0.59)	(0.79)
Stock Ret [-250,21]	0.01	**0.01**	**0.01**	**0.02**	**0.03**	**0.04**
	(1.53)	**(2.06)**	**(1.76)**	**(2.21)**	**(3.12)**	**(4.02)**
Stock Ret [-20,-2]	**0.04**	**0.03**	**0.02**	**0.07**	**0.04**	**0.03**
	(5.94)	**(2.87)**	**(2.34)**	**(7.02)**	**(3.77)**	**(3.43)**
Bond Ret [-20,-2]	**-0.06**	-0.02	0.00	**-0.05**	**0.04**	**0.05**
	(-3.33)	(-1.36)	(-0.14)	**(-2.49)**	**(1.73)**	**(3.48)**
lag(EAR)	**0.01**	0.00	-0.01	0.00	0.00	0.00
	(2.38)	(-0.04)	(-0.75)	(-0.18)	(0.39)	(0.26)
Adj. R Sq.	1.2%	0.3%	0.1%	2.9%	0.9%	1.1%

Note: the sample is from April 2001 to December 2017. The notation for holding horizon $[t_1, t_2]$ is always relative to the earnings announcement date, which is represented by t=0. Stock return [-250, -21] and stock return [-20, -2] are both adjusted by the contemporaneous return of the Fama-French size and book-to-value matched portfolio, similar to the construction of EAR. The bond return [-20,-2] is adjusted by the DTS inflated contemporaneous return of industry and credit-rating matched issuers, similar to the construction of BAR. The lag(EAR) represents the EAR from the previous quarter. The column header $[t_1, t_2]$ represents the DTS-adjusted abnormal excess return. The numbers in parenthesis are t-statistics and are computed with errors clustered at year-quarter level. Continuous explanatory variables and dependent variables are all standardized to have mean 0 and standard deviation of one. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Figure 15 reports the results for the multivariate regressions, with Panel A for the investment grade universe and Panel B for the high yield universe. Although the predictability of CFE is no longer significant in the multivariate regressions, EAR continues to be a statistically significant predictor with the presence of past intermediate stock return, past short-term stock return, past short-term bond return and lagged EAR. This demonstrates that the PEAD is a distinct phenomenon and not subsumed by other bond price predictors. In fact, the coefficients on EAR have larger magnitude than the other predictors considered. Since the independent variables have been standardized to have mean 0 and a standard deviation of 1, this observation means that a one-standard-deviation change in EAR has a bigger impact on future bond returns compared to a one-standard-deviation change in other predictors. Unlike EAR and CFE, BAR appears to have little predictability after the first 20 trading days, and its slope is significantly negative in the first 20 trading days. One more observation worth noting is that the predictability (coefficients) of EAR decays when the holding horizon is further away from the announcement date in both the univariate and multivariate regressions, consistent with investors slowly incorporating new information at a decreasing rate.

Results for the high yield universe in Panel B of Figure 15 are broadly similar to the investment grade universe. As found in the univariate regressions, the coefficients on EAR in high yield are larger than those in investment grade. As discussed earlier, it suggests that the overall PEAD effects are larger in high yield not only because the surprises are larger as suggested in Figure 12, but also because the reactions to the surprises are larger as shown in the comparison of EAR coefficients between Panel A and Panel B of Figure 15.

Regression results in Figures 14 and 15 are based on the full sample. Although we have looked at the PEAD across different years, we are interested to see if regression results would remain similar across different sub-periods. We focus on two sub-periods, one prior to the financial crisis and one after the crisis. Excluding the financial crisis from the analysis also helps to prevent drawing conclusions driven by extreme yet rare economic environments. We run the same sets of multivariate regressions for both sub-periods in both IG and HY. Overall, results are very similar across sub-periods (not reported for brevity). For example, the magnitude of the EAR coefficients varies little between the two sample periods, and the coefficients on EAR in high yield continue to be larger than those of investment grade.

Can Investors Benefit from PEAD Dynamic in Practice?

As discussed in the introduction, the existence of PEAD does not necessarily mean that investors can profit from the phenomenon. This is especially true in credit markets given the higher transaction costs and low liquidity of corporate bonds. Our previous analysis helps understand the dynamics of the phenomenon but does not address its practical relevance. First, performance numbers in Figures 7 and 8 are obtained by transacting thousands of bonds, which is unrealistic for a credit portfolio manager. Second, earning the performance difference between Q5 and Q1 requires shorting thousands of corporate bonds, which is almost impossible in a credit portfolio. Third, issuers do not release earnings all on the same day each quarter. Instead, the announcements are made sporadically and in an unsynchronized way. Therefore, continuously establishing positions immediately after the announcement is very difficult from a practical stand point of portfolio rebalancing.

To address all these practical concerns, we consider a more realistic portfolio formulation. In particular, we build a tracking portfolio for the Bloomberg Barclays US indices while tilting towards bonds with positive earnings surprises. We then examine PEAD's economic value by inspecting the tracking portfolio's performance. Next, we provide details on how to build the tracking portfolio.

The portfolio is constructed on a monthly basis with two steps. In the first step, we form a universe of liquid bonds as candidates for index tracking. The tracking universe starts with bonds that satisfy the following set of eligibility criteria,

- Senior bonds
- Time-to-maturity is more than three years
- Notional is greater than the 25th-percentile of the notional amounts of all bonds in the corresponding Bloomberg Barclays US index

After that, if an issuer has multiple eligible bonds, we select one bond to represent the issuer and remove the others based on the following rule: if an issuer has any eligible bonds with ages less than two years, we remove the bonds with age more than two years. If there are still multiple eligible bonds for the issuer, we select the one with duration closest to the industry average. As a result, the final tracking universe consists at most of one bond per issuer in the index representing only liquid names.

In the second step, we build well-diversified bond portfolios to track Bloomberg Barclays US Indices, using bonds from the tracking universe. We constrain the tracking portfolio to match the risk profiles of the index while tilting the portfolio towards issuers with more positive surprises by maximizing portfolio's weighted average of EAR. An issuer's EAR is from its most recent announcement in the past three months. In detail, we implemented the following constraints on the tracking portfolios. First, we cap the weight on each bond in the portfolio at 1% to ensure that the tracking portfolios are highly diversified and idiosyncratic risks are minimized. Second, to match the risk profile of the index and eliminate unintended risk exposures, we require the tracking portfolio to have the exact same characteristics as the index across the following dimensions of risks: sector weights, index-OAS and index-DTS exposures. Such matching is implemented on a monthly basis.

Figure 16 shows the characteristics of the tracking portfolio, tracking universe and the index. As reported in the figure, the number of bonds in the tracking portfolio is about 100. Second, the performance of the tracking universe is similar to that of the index, assuring that any performance difference between the tracking portfolio and the index is unlikely to be driven by the universe difference. Third, one may wonder why the average bond market value in the tracking universe is smaller than that of the index given that a minimum notional amount constraint is imposed when forming the tracking universe. Similarly, one may also be puzzled by why the liquidity cost score (LCS) in the tracking universe is higher than that of the index since the goal of having a tracking universe is to improve the liquidity profile. Both observations are in fact due to the requirement of keeping just one bond per issuer, which essentially increases the presence of smaller issuers, because big issuers usually have many more bonds and more notional outstanding than small issuers. Last, but not least, Figure 16 confirms that OAS and DTS of the tracking portfolio is the same as the index, indicating success in matching the risk profiles.

Figure 17 reports the performance of the tracking portfolios. Apart from the portfolio construction specifications we discussed earlier, we also consider several other portfolio construction specifications. One is to drop the restriction on matching index OAS. The other is to relax the cap on the weight of each bond from 1% to 2%. First, as shown in Figure 17, tracking portfolios with EAR-tilt are able to outperform the index regardless of the specification. Second, when a portfolio's OAS is matched to the index besides the other risk characteristics, the tracking error is reduced as the tracking portfolio becomes more similar to the index. The performance is also reduced in investment grade, whereas it does not change much in high yield. Third, having a more concentrated portfolio (2% cap) increases the tracking error but returns also go up. As a result, the direction of change in the information ratio of the tracking portfolio over the index is less clear. It increases for high yield and remains almost unchanged for investment grade. Fourth, in addition to constructing a tracking portfolio using issuers with positive earnings surprises, we construct another portfolio in the exact same way except minimizing instead of maximizing a portfolio's weighted average of EAR. To distinguish between the two portfolios, we denote the former as Max-EAR and the latter as Min-EAR. The Min-EAR portfolio tilts toward issuers with negative earnings surprises while matching the major risk characteristics of the index. The performance of a long-short portfolio between Max-EAR and Min-EAR demonstrates the benefits of PEAD when shorting or avoiding negative surprise names is possible. Figure 17 reports performances of the long-short portfolio in the 'Max-EAR over Min-EAR' column. Returns and information ratios of the long-short portfolio increase by 2-4x compared to those of Max-EAR over index, indicating considerable benefits of screening out issuers with negative earnings surprises.

FIGURE 16

Characteristics of Bonds in the Index, Tracking Universe and Tracking Portfolio

			Characteristics (Monthly Average)						Excess Returns				
		Avg # of Bonds/m	Quality	OAS (bps)	OASD (yr)	DTS	LCS	Avg Bond MV ($MM)	Avg. Ret (%/Yr)	Vol. (%/Yr)	Inf. Ratio (ann.)	Worst Ret. (%/m)	Corr. with Index
IG	Index	3890	3.21	162	6.38	10.85	0.88	691	1.11	4.86	0.23	-8.38	
	Tracking Universe	824	3.37	169	6.60	11.16	0.91	616	1.24	4.69	0.26	-8.28	0.98
	Tracking Portfolio	105	3.33	162	6.74	10.85	0.98	666					
HY	Index	1755	5.78	566	4.36	23.12	1.68	452	3.98	10.86	0.37	-16.50	
	Tracking Universe	885	5.89	575	4.33	23.98	1.79	411	3.81	10.72	0.35	-18.37	0.99
	Tracking Portfolio	104	5.73	566	4.37	23.12	1.86	466					

Note: the sample period is from April 2001 to December 2017. The tracking portfolio has a tilt on EAR while matching index DTS, OAS and industry weights and subject to bond weights no more than 1%. The numeric values of quality ratings are converted by following scale AAA=1, AA=2, A=3, BAA=4, BA=5, B=6, CAA=7, C/CA=8 and D=9. The reported LCS numbers only use the sample starting from 2007 because that's when LCS becomes available. Quality, OAS, Spread Duration, DTS, and LCS are all first aggregated by the market value weight across issuers on a monthly basis. The reported value is the average of the monthly time series.
Source: Bloomberg, Barclays Research

Figure 18 plots the cumulative outperformance of the tracking portfolios (Max-EAR) over the index and over Min-EAR. Both Max-EAR and Min-EAR portfolios are formed by matching index DTS, OAS, and sector weights on a monthly basis, subject to a 1% cap on each bond. In the IG universe, the outperformance of Max-EAR over index is restricted to the beginning of the sample as well as months between late 2008 and early 2011. However, Max-EAR consistently outperforms Min-EAR with outperformance built gradually over the entire sample. These results indicate that there is a consistent benefit in avoiding the issuers with low EAR rankings. The outperformance of Max-over-Min EAR has not waned in recent years. Instead, it becomes stronger, having a steeper slope post 2010 compared to that prior to 2008. In the HY index, unlike investment grade, the cumulative performance of Max-EAR over the index has been trending upwards more uniformly over the entire sample. Max-EAR also beats Min-EAR consistently throughout the sample, which suggests that in HY there is both consistent benefit from holding the high EAR issuers as well as avoiding low EAR issuers. Similar to the IG index, we also do not see any deterioration of performance, if not stronger, in recent years.

It is worth highlighting that the tracking portfolios are rebalanced on a monthly basis and maximize EAR values from the past three-month window. This means that some surprises are fresher and some are from more distant past. The current portfolio construction treats them equally, which we acknowledge might not be the most efficient way to use the EAR information. In fact, one challenge in exploiting PEAD in credit where constantly positioning after announcement is almost infeasible is how to make a trade-off between issuers with weaker but more recent surprises versus those with stronger but less recent surprises.

FIGURE 17

Performance Summary Statistics of the Index-Tracking Portfolios with EAR Tilt

Constraints		Matched Index DTS + Sector Weight			Matched Index DTS + OAS + Sector Weight		
Issuer Cap		Tracking Portfolio (Max-EAR)	Max-EAR over Index	Max-EAR over Min-EAR	Tracking Portfolio (Max-EAR)	Max-EAR over Index	Max-EAR over Min-EAR
Panel A: Corporate Index							
1%	Avg Ex. Ret (%/Yr)	2.05	0.94	1.83	1.52	0.41	1.56
	Vol. (%/Yr)	4.18	1.29	1.23	4.18	1.21	1.14
	Inf. Ratio (ann.)	0.49	0.73	1.49	0.36	0.34	1.37
	Worst Ret (%/m)	-6.41	-1.68	-0.69	-6.66	-1.63	-0.55
	Corr with Index	0.97	-0.63	-0.20	0.98	-0.65	-0.19
2%	Avg Ex. Ret (%/Yr)	2.19	1.08	2.37	1.55	0.45	1.87
	Vol. (%/Yr)	4.07	1.62	1.78	4.11	1.47	1.64
	Inf. Ratio (ann.)	0.54	0.67	1.33	0.38	0.30	1.14
	Worst Ret (%/m)	-5.30	-2.59	-1.43	-5.78	-2.67	-1.49
	Corr with Index	0.95	-0.62	-0.15	0.96	-0.63	-0.10
Panel B: High Yield Index							
1%	Avg Ret (%/Yr)	9.86	1.83	3.53	9.91	1.88	3.16
	Vol. (%/Yr)	8.61	3.16	2.94	9.00	2.86	2.33
	Sharpe (inf.) Ratio (ann.)	0.94	0.58	1.20	0.91	0.66	1.35
	Worst Ret (%/m)	-16.94	-5.47	-5.21	-17.19	-5.84	-2.51
	Corr with Index	0.94	-0.42	-0.23	0.95	-0.30	-0.12
2%	Avg Ret (%/Yr)	10.89	2.86	5.63	10.79	2.76	5.88
	Vol. (%/Yr)	8.78	3.30	3.79	8.93	3.23	3.70
	Sharpe (inf.) Ratio (ann.)	1.04	0.87	1.48	1.02	0.85	1.59
	Worst Ret (%/m)	-15.68	-3.66	-3.61	-16.23	-4.51	-3.63
	Corr with Index	0.94	-0.37	-0.21	0.94	-0.32	-0.16

Note: the sample period is from April 2001 to December 2017. Tracking portfolio (Max-EAR) is formulated by tracking the index while tilting toward bonds with positive earnings surprise (EAR). The Min-EAR portfolio is constructed in the same way as the Max-EAR portfolio with only one exception of tilting toward issuers with negative earnings surprises. Sharpe Ratios are computed using 1-month Libor rate. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

FIGURE 18

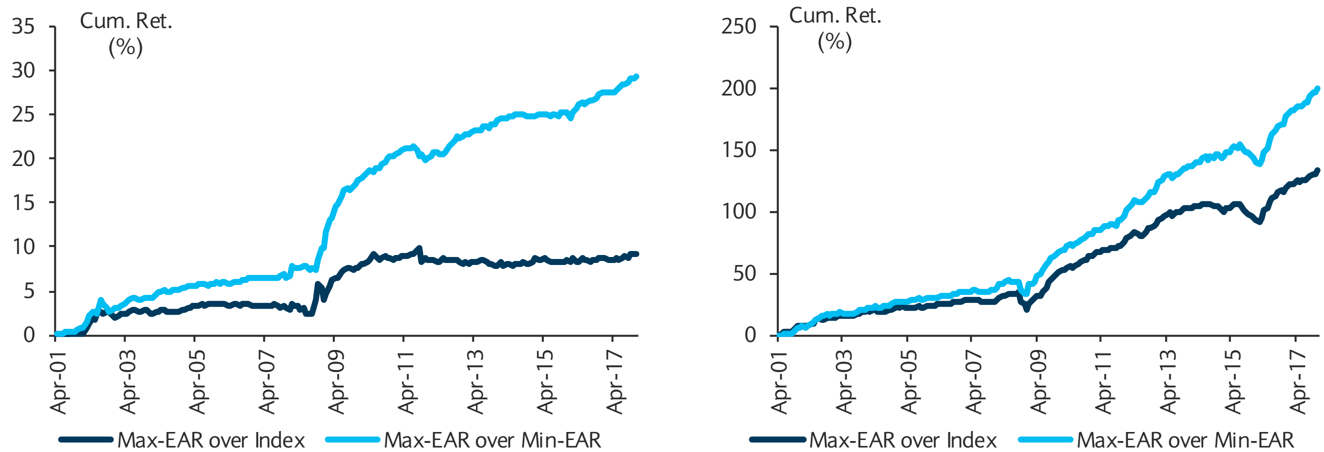
Cumulative Performance of Tracking Portfolio (Max-EAR) over the Corresponding Bloomberg Barclays US Index and Min-EAR

PANEL A

Corporate Index

PANEL B

High Yield Index



Note: the sample period is from April 2001 to December 2017. Tracking portfolio (Max-EAR) is formed by tracking the index while tilting toward bonds with positive earnings surprise (EAR). The tracking portfolio matches index sector weights, OAS and DTS on a monthly basis and has a cap of 1% on bond weight in the portfolio. The Min-EAR portfolio is constructed in the same way as the Max-EAR portfolio with only one exception of tilting toward issuers with negative earnings surprises.
Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

To differentiate bonds with different levels of informativeness in the earnings surprise measures, we use a relative value score to filter out bonds that are already "expensive", surprises of which may have already been picked up by the market. The idea is simple. What matters most is how much of the initial surprise is left to be exploited rather than how far back the announcement is. We use Excess Spread over Peers (ESP) to measure the cheapness of the bond. ESP is bond-level score (1-10) that measures a bond's relative value as its spread over peers unexplained by issuer characteristics and fundamentals (see Desclée, Maitra, and Polbennikov 2016 and Polbennikov, Desclée, and Katenko 2017 for details). A high ESP score indicates that a bond is cheap relative to its peers.

Figure 19 reports performances of the tracking portfolios using bonds from the tracking universe with ESP scores greater than or equal to 5 (bonds that are still cheap relative to peers). The tracking portfolios are formed by matching index DTS, OAS, and sector weights on a monthly basis, subject to a 2%-cap on each bond. The index tracked by high yield bonds is a subset of the standard index with ratings B/Ba because ESP is only available for bonds rated B and above. A 2%-cap is imposed instead of 1% because there are fewer high yield names in the intersected universe back in the early years and using the 1%-cap would be too restrictive.

As shown in Figure 19, PEAD performance strengthens among issuers with high ESP scores. The tracking portfolios with an ESP >= 5 filter deliver higher returns, lower volatilities and higher information ratios than those without the filter. The outperformance is present regardless of the index that is being tracked. Some may argue that the performance we see in the tracking portfolios with an ESP filter is completely driven by ESP. To test whether that's the case, we form a tracking portfolio using high ESP bonds but instead minimizing EAR. If ESP can fully explain the performance, we should see no difference between such portfolio and the Max-EAR portfolio with the ESP filter. However, this hypothesis is not supported by the evidence. We find that a similar tracking portfolio that minimizes the portfolio EAR with an ESP filter (last column in Figure 19) produces much lower returns and information (Sharpe) ratios than the Max-EAR portfolio with the ESP filter (column 4) in both IG ad HY. In sum, our results show that a relative value measure is complementary to the earnings surprise measure in exploiting the PEAD phenomenon in credit. This is especially valuable given that credit investors might be unable to exploit PEAD immediately after the announcements and have to decide when it's too late to enter the game.

FIGURE 19

Performance Summary Statistics of Tracking Portfolios with an ESP Filter

	Tracking Portfolio (Max-EAR)	Max-EAR over Index	Min-EAR	Tracking Portfolio (Max-EAR)	Max-EAR over Index	Min-EAR
	Without ESP Filter			Filter: ESP >= 5		
Panel A: Tracking the Corporate Index						
Avg Ex. Ret (%/Yr)	1.55	0.45	-0.32	2.31	1.21	0.24
Vol. (%/Yr)	4.11	1.47	4.38	3.92	1.75	4.50
Inf. Ratio (ann.)	0.38	0.30	-0.07	0.59	0.69	0.05
Worst Ret (%/m)	-5.78	-2.67	-5.81	-5.10	-1.99	-7.50
Corr with Index	0.96	-0.63	0.94	0.94	-0.67	0.94
Panel B: Tracking the HY B/Ba Index						
Avg Ret (%/Yr)	9.99	2.57	5.46	10.69	3.27	7.84
Vol. (%/Yr)	7.97	2.69	8.53	8.02	2.75	8.02
Sharpe (inf.) Ratio (ann.)	1.04	0.96	0.44	1.12	1.19	0.77
Worst Ret (%/m)	-16.21	-2.32	-17.80	-14.97	-2.33	-15.59
Corr with Index	0.95	-0.28	0.96	0.94	-0.26	0.94

Note: the sample period is from April 2001 to December 2017. Tracking portfolio (Max-EAR) is formulated by tracking the index while tilting toward bonds with positive earnings surprises (EAR). The Min-EAR portfolio is constructed in the same way as the Max-EAR portfolio with only one exception of tilting toward issuers with negative earnings surprises. Sharpe Ratios are computed using 1-month Libor rate. Source: Bloomberg, Compustat, I/B/E/S, Barclays Research

Conclusion

We find that the phenomenon of post-earnings announcement drift is present in corporate bonds. Issuers that are associated with more positive earnings surprises had higher subsequent abnormal bond returns than issuers with more negative earnings surprises. Furthermore, our study shows that PEAD is not driven by liquidity and is a distinct phenomenon from other bond price behaviours such as equity momentum in corporate bonds.

We have also investigated the economic value embedded in PEAD by examining the performance of an index tracking portfolio with a tilt towards issuers with positive earnings surprises. Such tilted portfolios have outperformed the indices.

As a final note, this report also showcases how an anomaly in equity markets can be potentially exploited in credit markets. Given our unique mapping algorithm and our team's experiences in both quantitative equity and credit research, we plan to explore more cross-asset research like this in the future.

References

Ball, R., and P. Brown. 1968. An Empirical Evaluation of Accounting Numbers. *Journal of Accounting Research* 6:159-178.

Ben Dor, A., L. Dynkin, J. Hyman, P. Houweling, E. van Leeuwen, and O. Penninga, 2007. DTSSM (Duration Times Spread). *Journal of Portfolio Management*, 33(2), pp.77-100.

Ben Dor, A., and J. Guan. 2016. Using Credit Signals to Enhance Equity “Value” Strategies. *Barclays Research*, 11 May 2016.

Ben Dor, A., and J. Guan. 2017. The Post-Earnings-Announcement Drift (PEAD): Has the Market Finally Caught Up. *Barclays Research*, 10 May 2017.

Ben Dor, A., and J. Xu. 2014. Value of Bond Market Information in Equity Momentum Strategies. *Barclays Research*, 5 June 2014.

Bernard, V. L., and J. K. Thomas. 1989. Post-Earnings-Announcement Drift: Delayed Price Response or Risk Premium. *Journal of Accounting Research* 27: 1-35.

Bernard, V.L. and J. K. Thomas, 1990. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings. *Journal of Accounting and Economics*, 13(4), pp.305-340.

Brandt, M. W., R. Kishore, P. Santa-Clara, and M. Venkatachalam. 2008. Earnings Announcements Are Full of Surprises, Working paper.

Chan, L. K. C., N. Jegadeesh, and J. Lakonishok. 1996. Momentum Strategies. *Journal of Finance* 51: 1681-1713.

Chordia, T., and L. Shivakumar. 2006. Earnings and Price Momentum. *Journal of Financial Economics* 80: 627-656.

Desclée, A., A. Maitra, and S. Polbennikov. 2016. Relative Value Investing in Credit. *Barclays Research*, 9 May 2016.

Doyle, J.T., R. J. Lundholm, and M. T. Soliman, 2006. The extreme future stock returns following I/B/E/S earnings surprises. *Journal of Accounting Research*, 44(5), pp.849-887.

Even-Tov, O. 2017. When does the Bond Price Reaction to Earnings Announcements Predict Future Stock Returns. *Journal of Accounting and Economics* 64: 167-182.

Gerard, X. 2012. Information Uncertainty and the Post-Earnings Announcement Drift in Europe. *Financial Analyst Journal* 68: 51-69

Griffin, J. M., P. J. Kelly, and F. Nardari. 2010. Do Market Efficiency Measure Yield Correct Inferences? A Comparison of Developed and Emerging Markets. *Review of Financial Studies* 23: 3225-3277.

Jegadeesh, N., S. Titman, 1993. Returns to buying winners and selling losers: implications for stock market efficiency. *Journal of Finance*, 48 (1), 65-91.

Konstantinovsky, V., K. Y. Ng, and B. Phelps. 2015. Measuring Bond-Level Liquidity: Liquidity Cost Scores (LCS), *Barclays Research*, 24 July 2015.

Konstantinovsky, V., Phelps, B., Ng, K.Y., 2016. Measuring bond-level liquidity. *Journal of Portfolio Management*, 42 (4), 116-128.

Lerman A., J. Livnat, and R. R. Mendenhall. 2008. The High-volume Return Premium and Post-Earnings Announcement Drift. Working Paper, 18 April 2008.

Liu, W., N. Strong, and X. Xu. 2003. Post-earnings-announcement Drift in the UK. *European Financial Management* 9: 89-116.

Livnat, J., and R. Mendenhall. 2006. Comparing the Post-Earnings Announcement Drift for Surprises Calculated from Analyst and Time Series Forecasts. *Journal of Accounting Research* 44: 177-205.

Lo, A.W., A. C. MacKinlay, 1990. When are contrarian profits due to stock market overreaction? *Review of Financial Studies*, 3 (2), 175-205.

Novy-Marx, R., 2015. Fundamentally, momentum is fundamental momentum (No. w20984). *National Bureau of Economic Research*.

Polbennikov, S., and A. Desclée. 2017. Equity Momentum in Credit (EMC). *Barclays Research*, 18 August 2017.

Polbennikov, S., A. Desclée, and E. Katenko. 2017. An Update on ESP Scorecard – A Framework to Identify Relative Value in Credit. *Barclays Research*, 15 June 2017

Analyst Certification

We, Arik Ben Dor, Jingling Guan and Xiaming Zeng, 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:

To the extent that the information about the companies mentioned in this publication is sufficient to constitute a 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.

Barclays Capital Inc. and/or one of its affiliates does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that Barclays may have a conflict of interest that could affect the objectivity of this report. Barclays Capital Inc. and/or one of its affiliates regularly trades, generally deals as principal and generally provides liquidity (as market maker or otherwise) in the debt securities that are the subject of this research report (and related derivatives thereof). Barclays trading desks may have either a long and / or short position in such securities, other financial instruments and / or derivatives, which may pose a conflict with the interests of investing customers. Where permitted and subject to appropriate information barrier restrictions, Barclays fixed income research analysts regularly interact with its trading desk personnel regarding current market conditions and prices. Barclays fixed income research analysts receive compensation based on various factors including, but not limited to, the quality of their work, the overall performance of the firm (including the profitability of the Investment Banking Department), 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. To the extent that any historical pricing information was obtained from Barclays trading desks, the firm makes no representation that it is accurate or complete. All levels, prices and spreads are historical and do not necessarily represent current market levels, prices or spreads, some or all of which may have changed since the publication of this document. Barclays Research Department produces various types of research including, but not limited to, fundamental analysis, equity-linked analysis, quantitative analysis, and trade ideas. Recommendations and trade ideas 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*.

Types of investment recommendations produced by Barclays FICC 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 in FICC Research. Any such investment recommendations produced by non-Credit Research teams shall remain open until they are subsequently amended, rebalanced or closed in a future research report. Any such investment recommendations produced by the Credit Research teams are valid at current market conditions and may not be otherwise relied upon.

Disclosure of other investment recommendations produced by Barclays FICC Research:

Barclays FICC 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 FICC 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)
Barclays Bank PLC, DIFC Branch (Barclays Bank, DIFC)

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 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. Clients that are subscribed to receive equity research reports, will not receive certain cross asset research reports co-authored by equity and FICC research analysts that are distributed as "institutional debt research reports" unless they have agreed to accept such reports. Eligible clients may get access to such cross asset reports by contacting 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. This material is distributed in the Cayman Islands and in the Bahamas by Barclays Capital Inc., which it is not licensed or registered to conduct and does not conduct business in, from or within those jurisdictions and has not filed this material with any regulatory body in those jurisdictions.

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. This material is distributed in New Zealand by Barclays Bank PLC, but it has not been registered, filed or approved by any New Zealand regulatory authority or under or in accordance with the Financial Markets Conduct Act of 2013, and this material is not a disclosure document under New Zealand law.

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). This material does not constitute or form part of any offer to issue or sell, or any solicitation of any offer to subscribe for or purchase, any securities or investment products in the UAE (including the Dubai International Financial Centre) and accordingly should not be construed as such. Furthermore, this information is being made available on the basis that the recipient acknowledges and understands that the entities and securities to which it may relate have not been approved, licensed by or registered with the UAE Central Bank, the Dubai Financial Services Authority or any other relevant licensing authority or governmental agency in the UAE. The content of this report has not been approved by or filed with the UAE Central Bank or Dubai Financial Services Authority. 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.

BRCF2242