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# Introducing the Fallen Angel Reversal (FAR) Scorecard

- Fallen angels are typically subject to widespread selling concentrated over a short period when they transition to high yield status. The resulting imbalance between demand and supply leads to a disconnect between the market price and fundamental value of these bonds, which self-corrects over time.
- Over the past decade, we have examined extensively the unique price dynamics of fallen angels, and in 2010 proposed a simple rule-based strategy, termed '3m-Reversal,' to exploit the reversal dynamics. The strategy delivered consistent outperformance versus otherwise similar originally issued high-yield bonds in the US and Europe. Furthermore, in a follow-up study, we documented that a variant of the '3m-Reversal' strategy that exploited dislocations in the bond-CDS basis of fallen angels delivered outstanding performance as well.
- In this paper, we introduce a scorecard that ranks fallen angel bonds on their attractiveness based on the magnitude of the price reversal they are expected to experience. The score is based on individual bond characteristics, such as price trajectory and trading volume behaviour, rather than average dynamics of the entire fallen angel population.
- Over the past decade, fallen angels with better FAR scores outperformed those with lower rankings consistently. FAR scores were better able to distinguish future performance among bonds than alternative measures.
- FAR scores offer flexibility in portfolio construction as both a screening filter and a weighting metric. A high yield portfolio with a fallen angel tilt constructed using FAR scores outperformed the HY index, as well as a similar fallen angel-tilted portfolio without using FAR scores.

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## Introduction

Fallen angels (FAs) are corporate bonds that were rated investment grade and have been downgraded to below investment grade status. The price dynamics of fallen angels after their downgrade possess some unique features since they are driven by market structural dislocations, such as supply and demand imbalance, rather than by firm fundamentals.

After their downgrade to high yield status, fallen angels are excluded from the IG indices, such as the Bloomberg Barclays U.S. Corporate Investment Grade Index, at the next month's rebalancing. Many investors face explicit mandate constraints or implicit tracking error restrictions so that they are forced to sell fallen angels in a short amount of time as the bonds leave the investment grade index, creating an inflow of supply. On the demand side, the high yield market is much smaller than the investment grade market, and a typical high yield bond issue size is much smaller than a typical investment grade bond, so the high yield market has a limited capacity to absorb all downgraded investment grade bonds in a short amount of time. As documented in *Ben Dor and Xu (2010)*, this supply and demand imbalance has led to underperformance of fallen angels over their otherwise similar HY peers around downgrades. The underperformance represents a disconnect between the fundamental and market-level of prices for the fallen angels. Later, as the selling intensity dissipates, fallen angels experience strong price reversals during the two-year period following downgrades as their prices adjust back to their long-term fundamental levels. Moreover, we found that the price reversals associated with fallen angels were limited only to the bond market and did not extend to equities of the same issuers, because these equities were not subject to the same selling pressure.

Based on these dynamics, in the 2010 study we introduced a simple systematic rule-based strategy, '3m-Reversal', to exploit the fallen angels' reversal dynamics. Fallen angels in this strategy generated consistent outperformance over their high yield peers through time in both the US and European markets. Our 2012 paper (*Ben Dor, Berkovitz, and Xu 2012*) showed that the fallen angel strategy remained profitable after taking into consideration implementation issues such as portfolio size, capacity, and transactions costs. Furthermore, we explored a strategy that trades the bond-CDS basis of fallen angels to hedge both the systematic and idiosyncratic credit risk and found it to generate sizeable returns.

The 3m-Reversal strategy treats all fallen angels equally based on the average reversal dynamics. However, individual fallen angels differ in their reversal dynamics in terms of timing and magnitude. In this paper, we introduce a monthly Fallen Angel Reversal (FAR) scorecard that provides bond-level FAR scores on each fallen angel's attractiveness based on their individual reversal dynamics. The FAR scores take into consideration several aspects of a fallen angel's reversal cycle, such as its price trajectory and trading dynamics. As the FAR scores provide a ranking for each individual fallen angel instead of indiscriminately including them equally as in the 3m-Reversal strategy, the scores allow flexibility in portfolio construction and can better exploit the variation in profitability across fallen angels.

We find the FAR scores to be very informative of subsequent performance. Fallen angel bonds with higher FAR scores outperformed their peers more than fallen angel bonds with lower FAR scores, both in terms of returns and inf. ratio. The outperformance was persistent over sub-periods. Moreover, the FAR scores worked more effectively than alternative scores based on relative OAS alone. In a more practical setting, we construct a high yield portfolio with a fallen angel tilt by using FAR scores in selecting fallen angels and in determining their overweight. We find that the FA-tilted portfolio using FAR scores outperformed the HY index, and another FA-tilted portfolio in which all fallen angels are equally weighted.

The rest of the paper is organized as follows. The first section provides an overview of the extensive research that Barclays has done on the special dynamics of fallen angels. The second section describes the rationale and the construction of FAR scores in detail. The subsequent section examines the effectiveness of FAR scores in predicting subsequent performance over peers. The last section concludes.

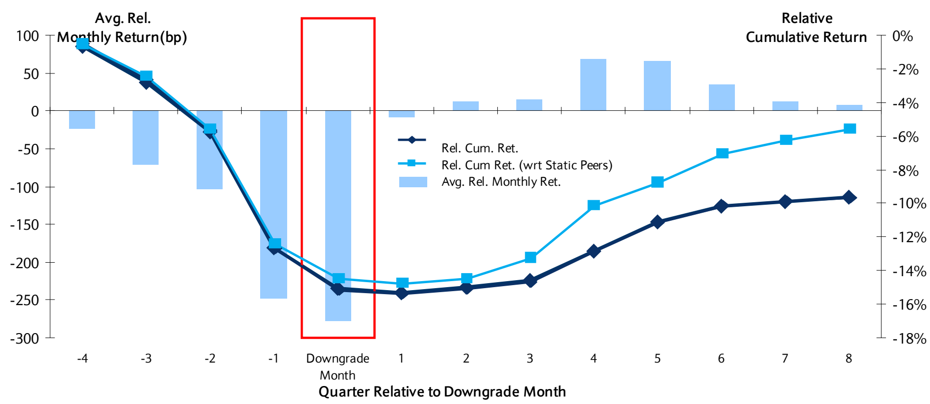
## Overview of Previous Fallen Angel Studies

In 2010 we conducted a detailed analysis of the characteristics and price dynamics of fallen angels using a comprehensive sample spanning more than 20 years and 1,400 bonds that migrated from investment grade to non-investment grade status (*Ben Dor and Xu 2010*). Figure 1 Panel A depicts the reversal patterns that Ben Dor and Xu (2010) documented: fallen angels experienced considerable underperformance versus peers even prior to the actual rating changes as IG investors liquidated the soon-to-become fallen angels. The underperformance lasted on average until three months after the downgrades. At that point, price declines reversed, and fallen angels outperformed high yield peers with similar characteristics for up to two years after the downgrade. Furthermore, in the cross-section, the price recovery by an individual issuer was inversely related to the magnitude of its initial underperformance.

Moreover, we find that the price reversals associated with fallen angel bonds did not extend to equities of the same issuers. Figure 1 Panel B shows the cumulative returns around downgrades of equities and bonds of the issuers that got downgraded from IG to HY and have both securities. There was evidently no price reversal in the equity markets following downgrades, whereas the corresponding bonds exhibited clear mean reversion. This discrepancy in price reversals is due to forced selling of fallen angel bonds by IG investors, whereas equities of the same issuers are not subject to such selling pressure.

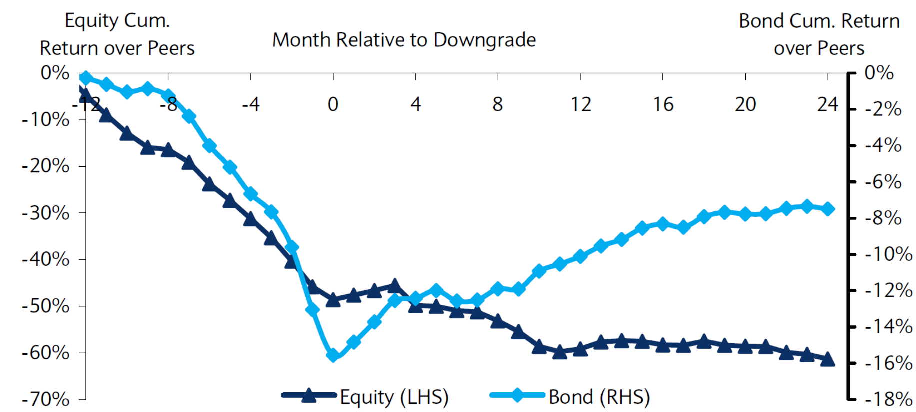
FIGURE 1

**Panel A: Fallen Angel Performance around Downgrade Month (Jan. 1990 – Jun. 2010)**




Note: Returns were value-weighted. Source: *Ben Dor and Xu (2010)* Bloomberg, Barclays Research

**Panel B: Cumulative Returns of Fallen Angels' Bonds and Equities around the Downgrade**




Note: The figure presents the cumulative performance of bonds and equities of fallen angels over peers around the downgrade month. The sample is comprised of all issuers that were downgraded from investment-grade to high yield status as in Ben Dor and Xu (2010) and have both public debt and equity. Equity and bond peer groups are based on 1-digit SIC's and a combination of industry, rating class and maturity, respectively
Source: *Ben Dor, Berkovitz, and Xu (2012)*, Bloomberg, Compustat, Barclays Research

Based on these dynamics, in the 2010 study we introduced a simple systematic rule-based strategy, 3m-Reversal, to take advantage of fallen angels' price reversals. As outlined in Figure 2 Panel A, the 3m-Reversal strategy purchases fallen angels at the end of the third month following their downgrades and employs relative-spread-based[1] inclusion and exclusion criteria to select fallen angels that maximize profit. The idea is that if a fallen angel has a high enough relative spread (relative spread>=40bps), it is cheap enough compared to peers and represent a good investment opportunity. Therefore, it should be included in the portfolio. Similarly, if a fallen angel is no longer cheap relative to peers (relative spread<=0bps), it should be excluded from the portfolio as the selling pressure has dissipated and the price most likely has reversed back to its long-term equilibrium level. This strategy, as documented in Ben Dor and Xu (2010), generated an average outperformance of 9.4% per year with information ratios in excess of one versus high yield peers[2] from Jan. 1991 – Jun. 2010. Our 2012 paper (*Ben Dor, Berkovitz, and Xu 2012*) took into consideration implementation issues such as portfolio size, capacity, and transactions costs and found that the 3m-Reversal strategy still outperformed peers. Furthermore, we explored a strategy that trades the bond-CDS basis of fallen angels to hedge both systematic and idiosyncratic credit risk, as CDS of fallen angles are not subject to the same investment constraints and selling pressure, but are exposed to the same credit risk as the fallen angel cash bonds. A strategy formulation which buys cash bonds of a fallen angel and sells short in the corresponding CDS, with timing comparable to the 3m-Reversal, delivered a gross Sharpe ratio in excess of 3 from 2004 – 2010.

Almost a decade after its initial publication, the 3m-Reversal strategy has delivered persistent and stable outperformance over peers. Our 2015 update (*Ben Dor and Xu 2015*) shows that in an environment with changing supply and demand dynamics, the 3m-Reversal strategy still delivered similar inf. ratio over peers as in the original 2010 study. Figure 2 Panel B shows the performance of the 3m-Reversal strategy since 1991 in three sub-periods: Ben Dor and Xu 2010 study (Jan. 1991 – Jun. 2010), 2015 update (Jul. 2010 – Dec. 2014), and recent period (Jan. 2015 – Dec. 2019). The magnitude of the inf. ratio stayed stable over the three periods with only small variations from one period to another (1.03, 1.23, and 0.91, respectively for the three sub-periods).

[1] Relative spread of a fallen angel is the spread over its peers. Peers are non-fallen angel bonds in the same industry and rating category. All peer bonds spreads are aggregated using their market values as weights.
[2] A fallen angel's peer bond group contains all index bonds in the same level-3 industry and with the same rating as the fallen angel. Peer returns for a fallen angel is calculated by the market-value-weighted average return of all bonds in its peer group. The return for the peer portfolio is the equally weighted average of all respective peer group returns for the FA portfolio.

We also evaluated the 3m-Reversal strategy in European markets following the same buying and selling triggers and the same peer group definition as the U.S. strategy, and find that the same 3m-Reversal strategy without any recalibration generated persistent returns in European markets as well (*Ben Dor and Guan 2018*). Figure 2 Panel C shows the performance of the 3m-Reversal portfolio in European markets (using Bloomberg Barclays Euro Corporate and HY indices to define fallen angels) covering two decades (Jan. 1999 to Dec. 2019) over three sub-periods corresponding to the same sub-periods of our U.S. studies in Panel B for easy comparison. The average monthly returns of the European 3m-Reversal portfolio over peers were consistent over the three sub-periods: 0.38%, 0.50%, and 0.17% respectively. The inf. ratio of the 3m-Reversal over peers was also above 0.60 in all three sub-periods (0.69, 0.60, and 1.14 respectively).

FIGURE 2

**Panel A. Fallen Angel 3m-Reversal Strategy Bond Inclusion/Exclusion Criteria**

| Fallen Angel 3m-Reversal Strategy Bond Inclusion/Exclusion Criteria | | |
|---|---|---|
| Buy Conditions (if all are satisfied) | Timing | Month 3 |
| | Spread relative to Peers | >= 40 bps |
| | Bond Price | >=40 |
| Sell Triggers (if any one is satisfied) | Timing | Month 24 |
| | Spread relative to Peers | Negative |
| | Technical | Bonds matured, defaulted or were called |
| Weighting | | Equally weighted with 10% issuer cap (one bond per issuer). Any excess capital will be allocated to peer index. Fully seeded with cash at inception. |
| Rebalancing | | Monthly |

**Panel B. Performance of the 3m-Reversal Strategy in the US**

| | FA 3m-Reversal Portfolio | Peer Group | FA Ret. over Peer Group | High-Yield Index | FA Ret over HY Index |
|---|---|---|---|---|---|
| Jan. 1991 - Jun. 2010 (Ben Dor and Xu 2010 study) | | | | | |
| Average (%/m) | 1.62% | 0.84% | 0.78% | 0.81% | 0.82% |
| Volatility (%/m) | 3.99% | 2.31% | 2.63% | 2.68% | 2.56% |
| Sharpe/Inf. Ratio (Ann.) | 1.12 | 0.76 | 1.03 | 0.61 | 1.11 |
| % of Positive Ret. Months | 75% | 76% | 63% | 76% | 64% |
| % Invested in Fallen Angels | 69% | | | | |
| Jul. 2010 - Dec. 2014 (Ben Dor and Xu 2015 update) | | | | | |
| Average (%/m) | 1.11% | 0.80% | 0.31% | 0.74% | 0.38% |
| Volatility (%/m) | 1.85% | 1.62% | 0.88% | 1.78% | 0.92% |
| Sharpe/Inf. Ratio (Ann.) | 2.06 | 1.67 | 1.23 | 1.40 | 1.42 |
| % of Positive Ret. Months | 74% | 74% | 65% | 74% | 70% |
| % Invested in Fallen Angels | 55% | | | | |
| Jan. 2015 -Dec. 2019 | | | | | |
| Average (%/m) | 0.88% | 0.49% | 0.39% | 0.51% | 0.38% |
| Volatility (%/m) | 2.54% | 1.48% | 1.49% | 1.53% | 1.44% |
| Sharpe/Inf. Ratio (Ann.) | 1.06 | 0.92 | 0.91 | 0.93 | 0.90 |
| % of Positive Ret. Months | 67% | 72% | 55% | 68% | 60% |
| % Invested in Fallen Angels | 83% | | | | |

**Panel C. Performance of the 3m-Reversal Strategy in European Markets**

| | FA 3m-Reversal Portfolio | Peer Group | FA Ret. over Peer Group | High-Yield Index | FA Ret over HY Index |
|---|---|---|---|---|---|
| | Jan. 1999 -Jun. 2010 | | | | |
| Average (%/m) | 0.72% | 0.34% | 0.38% | 0.48% | 0.24% |
| Volatility (%/m) | 4.70% | 3.89% | 1.90% | 4.01% | 1.96% |
| Sharpe/Inf. Ratio (Ann.) | 0.32 | 0.06 | 0.69 | 0.18 | 0.42 |
| % of Positive Ret. Months | 63% | 66% | 44% | 67% | 47% |
| % Invested in Fallen Angels | 21% | | | | |
| | Jul. 2010 - Dec. 2014 | | | | |
| Average (%/m) | 1.33% | 0.83% | 0.50% | 0.85% | 0.48% |
| Volatility (%/m) | 5.13% | 3.28% | 2.84% | 2.44% | 3.28% |
| Sharpe/Inf. Ratio (Ann.) | 0.89 | 0.86 | 0.60 | 1.18 | 0.51 |
| % of Positive Ret. Months | 78% | 78% | 72% | 76% | 69% |
| % Invested in Fallen Angels | 80% | | | | |
| | Jan. 2015 - Dec. 20019 | | | | |
| Average (%/m) | 0.43% | 0.26% | 0.17% | 0.35% | 0.08% |
| Volatility (%/m) | 1.39% | 1.11% | 0.51% | 1.23% | 0.46% |
| Sharpe/Inf. Ratio (Ann.) | 0.82 | 0.48 | 1.14 | 0.70 | 0.59 |
| % of Positive Ret. Months | 63% | 59% | 42% | 59% | 33% |
| % Invested in Fallen Angels | 28% | | | | |

Note: The returns for the portfolios' peer group were computed as the equal–weighted performances of the individual bonds' peer group returns (same rating and same industry). For more details, see *Ben Dor and Xu (2010)*. Sharpe Ratio was calculated using the 1-month Libor rate. Information ratio is the ratio of average to standard deviation of returns over peers. If a fallen angel issuer has multiple bonds, the one with the largest bond market value was chosen. Excess capital was allocated in peer group bonds of the existing fallen angels. If there are no fallen angels in the portfolio, excess capital was allocated in the HY index. Source: Bloomberg, Barclays Research

One concern might be that fallen angels outperformed their peers because they possess certain characteristics that made them riskier, and the outperformance is purely a compensation for risk. To test whether that is the case, we compare characteristics of fallen angels to their peers (same credit rating and industry) and also with the broad Bloomberg Barclays High Yield Index. Figure 3 shows the characteristics comparison for the time series median of historical portfolios for both the U.S. (left panel) and Europe (right panel). Historically, the most noticeable difference between FA 3m-Reversal portfolio constituents and peers are their OAS, as the 3m-Reversal strategy picks up fallen angels with high relative spreads by design. Other than spread, the 3m-Reversal constituents were very similar to their peers in terms of size[3], time-to-maturity, rating, and Liquidity Cost Score (LCS) indicating that 3m-Reversal strategy's outperformance was not driven by difference in characteristics. Note that the LCS of the fallen angels are slightly higher than that of peers, with a difference of 19bps (U.S.) and 23bps (Europe) in time series median of FA and peers LCS. First, the difference is consistent with our finding in Ben Dor and Xu (2010) that the relative LCS of FAs increased sharply around downgrade months with forced selling and came down to around 0 slowly over the subsequent 12-15 months. Second, the difference in LCS is very small compared to the return difference we have seen in FA over peers.

[3] At a closer look, in Europe the 3m-Reversal issuers were larger than their peers, which is to be expected as IG issuers were typically much larger than HY issuers. Nevertheless, the size difference does not account for fallen angel outperformance as there is no prevailing evidence that larger issuers outperform smaller issuers to a magnitude of fallen angel outperformance in European markets.

FIGURE 3

**Characteristics of 3m-Reversal Portfolios vs. Peers**

| | Historical Portfolios (Times Series Median) | | | | | |
|---|---|---|---|---|---|---|
| | FA 3m-Reversal Portfolio | Peers | HY Index | FA 3m-Reversal Portfolio | Peers | HY Index |
| | U. S. | | | Euro | | |
| | Jan. 1991 - Dec. 2019 | | | Jan. 1999 - Dec. 2019 | | |
| Issuer Size (MV, in Million) | $1,506 | $1,441 | $612 | € 1,255 | € 764 | € 566 |
| OAS (%) | 6.18 | 3.88 | 4.41 | 7.90 | 6.07 | 4.62 |
| Time to Maturity (Yr) | 9.80 | 9.06 | 7.79 | 4.65 | 4.67 | 5.05 |
| Rating (3:Ba, 4:B, 5:Caa/Ca/C) | 3.43 | 3.41 | 3.77 | 3.48 | 3.48 | 3.51 |
| LCS* (%) | 1.76 | 1.57 | 1.23 | 1.33 | 1.10 | 0.90 |
| # of Bonds | 20 | | 1614 | 6 | | 231 |
| # of Issuers | 9 | | 930 | 4 | | 175 |

* LCS data was available since Jan. 2007 in the U.S. and since May 2010 for the Euro Index.
Note: Characteristics of all qualifying bonds of an issuer were first value-weighted, and then issuer-level statistics were equally-weighted to come up with portfolio statistics for FA portfolios.
Source: Bloomberg, Barclays Research

## Constructing Fallen Angel Reversal (FAR) Scores

Given the successful track records of the 3m-Reversal strategy, what are the additive benefits from the FAR scores? The additive benefits come from two aspects: how FAR scores are constructed and how FAR scores can be used by investors. Construction wise, the 3m-Reversal strategy treats all fallen angels equally based on the average reversal dynamics of all fallen angels, whereas the FAR scores are based on the reversal dynamics of each individual fallen angel, such as its price trajectory and trading dynamics. By looking at individual fallen angel's reversal dynamics, FAR scores are able to capture some return opportunities that would have been missed by the 3m-Reversal strategy. Regarding how the two can be used by investors, the 3m-Reversal strategy is fairly inflexible: each fallen angel bond is either in or out of the portfolio, determined at a fixed point (3m after downgrade) with a fixed spread cut-off. As a comparison, FAR scores rank all fallen angels on their attractiveness on a monthly basis starting right after downgrades and therefore offer a lot more flexibility in portfolio construction. The flexibility comes in two dimensions: time of inclusion (investors can choose when to include each FA in their portfolio) and attractiveness (investors can be more or less selective or vary the weights on fallen angels based on their FAR scores).

Regarding the timing of inclusion, the 3m-Reversal strategy purchases all fallen angels at the end of the 3-month after initial downgrades because our research indicates that by the end of the 3-month period most fallen angels have started mean-reversion. In reality, each fallen angel may start mean-reversion sooner or later than the 3m mark. When constructing FAR scores, we assess the likelihood of each individual fallen angel entering into the reversal cycle by employing several sources of information, such as the past spread change trajectory and a bond's trading dynamics relative to its peers. The fixed timing rule of the 3m-Reversal may lead the portfolio to include some bonds that are not very good choices and at the same time miss some bonds that might have been good buys, whereas the FAR scores are more comprehensive in capturing the good investment opportunities. For example, if price and trading patterns indicate that a fallen angel may start reversal before the average 3-month mark, the bond could be included into the portfolio immediately after the downgrade, not at the fixed 3m point like the 3m-Reversal strategy. This way we would catch the golden opportunity in the initial months when price reverses course at a very fast pace. As another example, if a fallen angel was not cheap enough compared to peers at the 3m point, it will never be included in the 3m-Reversal strategy. If the bond later becomes cheap enough relative to peers (thus a good buy), its FAR score would recognize the investment opportunity and give the bond a favourable ranking to suggest inclusion in the portfolio.

The second dimension of flexibility is that the FAR scores rank each individual fallen angel on its attractiveness (i.e. expected mean reversion in relative spread in the subsequent month). In the 3m-Reversal strategy, all bonds passing the fixed relative-spread cut-off (40bps) at the 3m point are included and receive equal weights in the portfolio. Investors may also want to be more or less selective of the fallen angels than suggested by the 3m-Reversal strategy due to their different capacity. With FAR scores, an investor can either be very selective and focus only on bonds with top rankings, or be more inclusive and invest in all fallen angels. An investor may also want to vary the weights based on the attractiveness of the investment opportunity presented by each bond, and the individual rankings through FAR scores make it possible.

The FAR scores and the 3m-Reversal strategy are conceptually consistent. For example, the 3m-Reversal strategy uses relative spreads as its buy and sell triggers. The FAR scores also use relative spreads as one of the inputs to gauge the expected reversal magnitude. Fallen angels with higher relative spreads are more likely to be ranked higher among all fallen angels and thus more likely to be included in the portfolio, similarly as in the 3m-Reversal. Given the overall consistency, the FAR scores provide more granular information on distinguishing investment opportunities among fallen angels by incorporating details in individual fallen angel's reversal dynamics. In this section, we provide details on the universe of fallen angels that the FAR scores cover and also how they are constructed.

## Universe

We provide FAR scores for the universe of fallen angels with positive relative spreads immediately following the downgrades and keep track of the bonds for as long as their relative spreads remain positive within in the 24-month window following downgrades. We only focus on the fallen angels with positive relative spreads because these are the fallen angels identified in our earlier study as being cheaper than peers and having profit potentials. We exclude any fallen angels after 24 months following downgrades because our earlier studies indicate that the prices of fallen angels generally will have reverted to their fundamental levels at the end of the 24-month period.

## Construction

There are three steps in constructing the FAR scores. The first step is to identify which stage a fallen angel is at within its mean reversal cycle post downgrade: is the spread still widening, or has it started mean reversal yet? To identify the stage, we examine the spread change trajectory up to each point in time and the bond-level trading dynamics. The second step is to predict the mean reversal magnitude conditional on each stage. We rely on two predictors, the relative spread to peers and the remaining number of months until the end of the reversal cycle. The former measures how far away a fallen angel is from its long-term fundamental price level, and the latter measures how many remaining months the bond has to adjust to that fundamental price level. Putting the two predictors together gives us the average adjustment speed per month as a baseline. However, the next month's expected spread change is also dependent on the stage. Therefore, we use a regression approach to estimate stage-dependent sensitivities of subsequent month's spread change to current month's relative spread separately for each stage of the mean reversal cycle. The last step is to put together both the stage information and sensitivities together to come up with one unified score.

### Step I: Identify Expected State of Fallen Angels within Their Reversal Cycles

We first discuss ex post, with the knowledge of the whole mean reversal cycle, how we can classify the cycle into different stages. The purpose of this part is to have a good understanding of a typical mean reversal cycle covering the two-year span following the downgrades so that we know when is the best time to enter and exit. The next part discusses the real time prediction approach: in real time with a price trajectory only up to a particular month, how we can identify which stage a fallen angel is in without the whole price trajectory in view. Note that the goal of the prediction is to identify the stage during the post-downgrades reversal cycle to take advantage of the fallen angel reversal dynamics. It does not attempt to predict the downgrades, which is a separate topic and out of the scope of this paper.

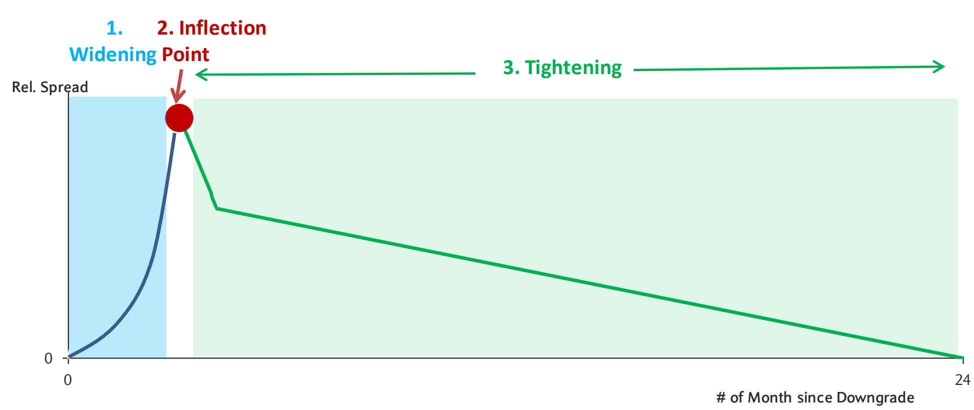
#### *Ex Post Classification of Stages*

Ex post, a fallen angel's typical mean reversal cycle can be broken down into three stages: widening, inflection point, and tightening, as illustrated in Figure 4 Panel A. After downgrades, the relative spread[4] of a fallen angel may keep widening as there is consistent selling pressure from institutional investors who are forced to liquidate their fallen angel holdings within a short amount of time. After a while, the selling pressure slows down and the widening reaches its peak, the inflection point, where a fallen angel bond transitions from widening to tightening. Based on the whole price trajectory, the inflection point is defined as the month when a fallen angel's relative spread is the highest within the 24-month window following its downgrade. We classify the periods before and after the inflection month as the 'widening' stage and the 'tightening' stage, respectively (both excluding the inflection month and within the 24-m window following the downgrade). Note that the widening period is not defined as months with constant spread widening. Although the widening period is generally characterized by spread widening, relative spreads could also temporarily decline from the general ascend.

Figure 4 Panel B presents the actual historical pattern of spread changes surrounding inflection months by showing the median monthly change in relative OAS by the number of months from the inflection point. In the months leading up to the inflection point, there is consistent spread widening. The one month right after the inflection point has the biggest spread reversal, with a median of 122bps. Following that, the fallen angel mean reversal cycle enters into a stage with more uniform-sized reversals lasting until the end of the cycle.

FIGURE 4

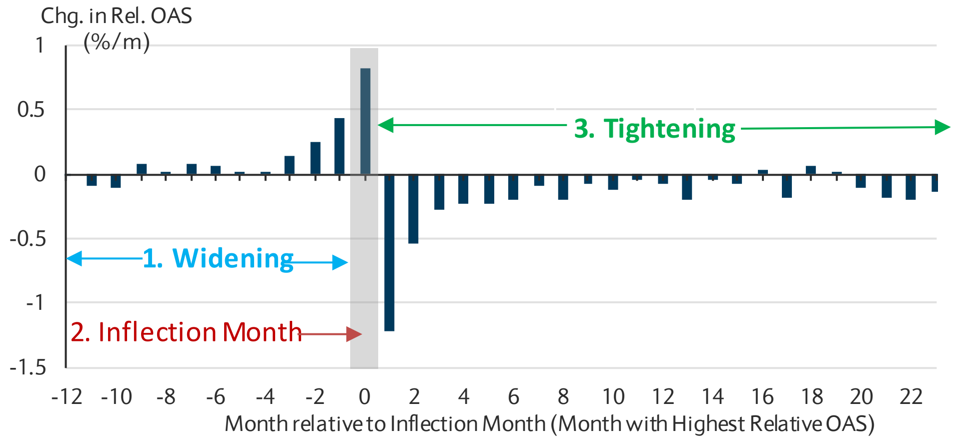
**Panel A. Illustration of a Typical Fallen Angel Spread Mean Reversal Cycle**




Source: Barclays Research

[4] The relative spread of a fallen angel is calculated as its spread over the average spread of its peer group. A fallen angel's peer group contains all index bonds with the same credit rating and industry as the fallen angel bond. The spread of all bonds in a peer group are value weighted.

**Panel B. Median Monthly Change in Rel. OAS by the Number of Month relative to Inflection Month**




Note: All statistics are based on data from Jan. 1991 – Dec. 2019. Inflection month is defined as the month in when the relative OAS of a fallen angel is the highest in the [0m,24m] window following downgrades.
Source: Bloomberg, Barclays Research

### *Real Time Prediction of Stages*

In real time, it is relatively easier to tell whether a month is in the 'widening'/'inflection' stages versus the 'tightening' stage, but hard to distinguish between the 'widening' and 'inflection' months. The reason is that in real time, the price trajectory leading up a 'widening' month and an 'inflection' month look very similar: consistent spread widening as shown in Figure 4 Panel B. It is only with ex post knowledge of the whole trajectory in view that we can classify a month as 'inflection' with confidence. Then the question is whether it is worth the trouble trying to tell the 'widening' and 'inflection' months apart. The answer is yes. The median change in relative spread in the subsequent months following a 'widening' month is a further widening of 13bps, so it is a good idea to avoid holding fallen angels in the 'widening' months. However, if we don't distinguish the 'widening' versus 'inflection' months and avoid holding fallen angels in those months all together, we would be missing out on some golden investment opportunities: the median tightening speed following an inflection month is very high at 122 bps, seven times of the median reversal following a typical 'tightening' month (17bps). The big subsequent spread reversals make the inflection months the most profitable point to enter and hold fallen angels. Another possibility is to hold a fallen angel as soon as its downgrade to ensure that the big reversal following the 'inflection' month is captured. This is not optimal either because one could be stuck with several months of spread widening that would dilute the overall profits.

The real-time prediction takes two steps: the first step is to distinguish whether a fallen angel is in a 'widening'/'inflection' month versus in a 'tightening' month. If a bond lands in the 'widening' or 'inflection' bucket, the second step is to estimate the probability of a month being an 'inflection' month. For the first step, we propose to rely on a fallen angel's price trajectory from downgrades up to the month in evaluation. For the second step, we use a bond's trading dynamics: its trading volume relative to peers.

1. Real time indicator *Pre-Reversal* based on Price Trajectory

To predict whether a month is in the 'widening'/'inflection' bucket or the 'tightening' bucket, we define a 0/1 indicator variable, denoted as *Pre-Reversal*, which equals 1 in month $t$ if rel. OAS in month $t$ is the highest in the window from downgrade to month $t$ and 0 otherwise.[5]

[5] An alternative is to monitor past months' spread change and declare a month to be in the '*Pre-Reversal*' bucket if the fallen angel's spread has been increasing. There are a couple of caveats to this type of definition. First, if we require a sequence of spread widening to classify a month as 'widening', we would misclassify months when the previous

The *Pre-Reversal*=1 periods are supposed to pick up the 'widening' and 'inflection' months, and the *Pre-Reversal*=0 periods are supposed to pick the 'tightening' months.

How effective is this predictor indicator in real time? In the tightening stage, the variable *Pre-Reversal* would always have a value of 0 (correct classification), because by definition of the 'tightening' stage, the fallen angels have already passed their maximum spread point. In the inflection months, the *Pre-Reversal* would always have a value of 1 (also correct), because the relative spread achieves maximum in these months. In the widening months, we have mixed results. In some 'widening' months *Pre-Reversal* would be 1 (correct), but in some other 'widening' months it could also be 0 (wrong classification) when the spread declines temporarily on the path to the inflection point.[6] Figure 5 illustrates the effectiveness of the indicator variable *Pre-Reversal* by showing the translation between the predicted value of *Pre-Reversal* and its mapped ex post stages. The fraction of the monthly fallen angel observations falling in each stage over the whole sample is included in the parenthesis, and the median subsequent month rel. OAS change is included in the line below.

FIGURE 5

**Real Time Predictor Variable *Pre-Reversal* vs. Ex Post Stages**

| Real Time Predictor | Ex Post Stage Classification | | Effectiveness of Real Time Predictor |
|---|---|---|---|
| **Pre-Reversal=1 (27%)**<br>Median(Sub. Rel. OAS chg) = -14bps | **Inflection (8%)**<br>Median(Sub. Rel. OAS chg) = -122 bps | | Right |
| | **Widening (41%)**<br>Median(Sub. Rel. OAS chg) = 13 bps | Increasing Spread (20%)<br>Median(Sub. Rel. OAS chg) = 9bps | Right |
| **Pre-Reversal=0 (73%)**<br>Median(Sub. Rel. OAS chg) = -6bps | | Temporarily spread declining (22%)<br>Median(Sub. Rel. OAS chg) = 16bps | Wrong |
| | **Tightening (51%)**<br>Median(Sub. Rel. OAS chg) = -17bps | | Right |

Note: the frequency of monthly observations in each state is in parenthesis. All statistics are based on data from Jan. 1991 – Dec. 2019. The indicator variable *Pre-Reversal* = 1 if rel. OAS of month t is the maximum of all rel. OAS from month 0 (downgrade month) to month t. Inflection month is defined as the month in when the relative OAS of a fallen angel is the highest in the [0m,24m] window following downgrades.
Source: Bloomberg, Barclays Research

Empirically, the indicator variable *Pre-Reversal* does a decent job identifying the tightening period. Of all months with *Pre-Reversal* = 0, 70% (51% / (22%+51%)) of them are indeed in the tightening period. The rest 30% (22% / (22%+51%)) of months with *Pre-Reversal* = 0 are the months still in the widening period but where spread temporarily tightened on the course to the inflection point.

However, the *Pre-Reversal* indicator by itself does not do a good job at predicting subsequent relative spread changes, as suggested by the median spread change in subsequent months in Figure 5. The median change in subsequent month rel. OAS is a tightening of 14bps when *Pre-Reversal* = 1 and a tightening of 6 bps when *Pre-Reversal* = 0. The majority of the *Pre-Reversal* = 1 months are characterized by widening, so it is counterintuitive that following a *Pre-Reversal* = 1 month the median spread change is a tightening. This is because the *Pre-Reversal* indicator cannot distinguish the inflection months from other widening months. When the inflection point happens, the magnitude of

months had temporarily deviated from the general spread widening trajectory but had come back to course as 'tightening.' If we just use the previous month's spread change to do the classification, a second caveat is that during the 'tightening' stage, a fallen angel's relative spread could temporarily deviate from the general reversal pattern, but later go back to the original trajectory. These months would be misclassified as 'widening' if we just monitor the past month's spread change. Monitoring the maximum level of relative spreads avoids these caveats.

[6] These periods include two types of months in this temporary tightening during the 'widening' stages: months in which the spreads have 1) temporarily tightened and 2) subsequently widened (right after the temporary tightening) but not yet reaching the pre-tightening spread level.

the spread tightening is so large such that those changes dominate the spread widening in the non-inflection months. In the next part, we will use a fallen angel's trading dynamics to predict the probability of inflection to disentangle the inflection months from other widening months.

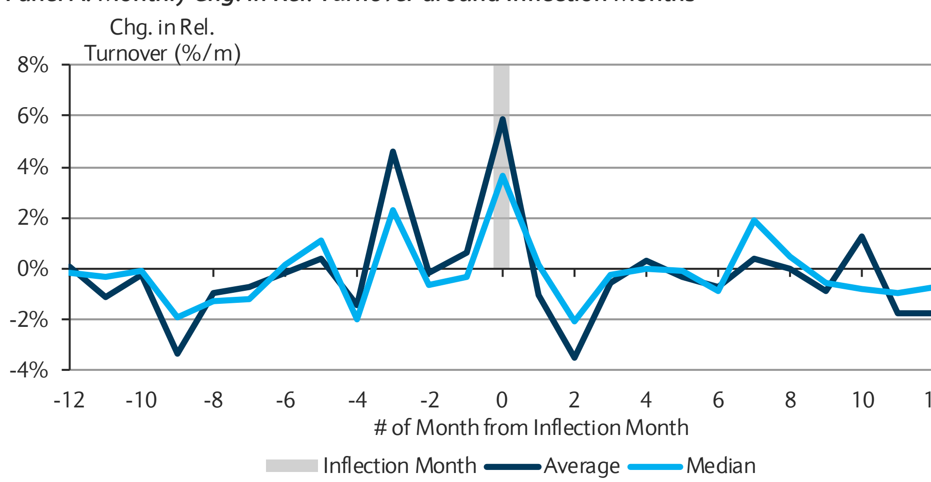
2. Using change in relative turnover to estimate probability of inflection

We rely on trading dynamics because the initial price drops and subsequent reversals are driven by supply and demand imbalance instead of firm fundamentals. Therefore, looking at prices alone is insufficient to pinpoint the inflection point in the price pattern since it's not a pure price phenomenon. To predict when the selling pressure has dissipated and when the price trajectory will change course, we have to look at the other key piece in the supply and demand dynamics: quantity. Ben Dor and Xu (2010) find that the turnover of fallen angels relative to their peers[7] captures their price pressure from forced selling around downgrade. They find that fallen angels' median relative turnover spiked at downgrade months, which are usually peaks of forced selling. Following downgrades, the median relative turnover decreased slowly as the selling pressure dissipated.

Can turnover also be used to identify the inflection months? Figure 6 Panel A plots the median and average of changes in monthly relative turnover from the previous month (denoted as *chg. in rel. turnover*) before and after inflection months for the period Jan. 2007 – Dec. 2019. During inflection months, the relative turnover had the largest increase over the previous months, with an average of 6%. This relation is also confirmed by Figure 6 Panel B, which shows the results of regressing individual bond's monthly *chg. in rel. turnover* on the inflection dummy, which equals 1 if the fallen angel is in inflection month in the current month and 0 otherwise. In both the whole sample and the sub-sample with *Pre-Reversal* = 1, the *chg. in rel. turnover* is significantly higher during inflection months than during non-inflection months. Note that the difference in *chg. in rel. turnover* between inflection and non-inflection months is much smaller for the *Pre-Reversal* = 1 sub-sample. This is because this sub-sample contains 'widening' and 'inflection' months, which are both in general characterized by forced selling and increases in relative turnover, and thus are very difficult to tell apart. On the other hand, the 'tightening' periods associated with *Pre-Reversal* = 0 have *chg. in rel. turnover* much closer to 0. Therefore, in the whole sample with all three stages, we observe a bigger difference between inflection and non-inflection months, as the average change in turnover of the non-inflection month is lower due to the inclusion of '*Pre-Reversal*=0' months with small values in *chg. in rel. turnover*.

FIGURE 6

**Panel A. Monthly *Chg. in Rel. Turnover* around Inflection Months**




[7] A bond's turnover is calculated as the ratio of its monthly trading volume scaled by its amount outstanding to normalize its size. Next, to control for any market-wide systematic trading dynamics, a bond's peer group's turnover is subtracted from its own to get its relative turnover over peers. Peer group turnover is calculated as market-value weighted average of all peer bond's turnover in each month.

Panel B. *Chg. in Rel. Turnover* in Inflection Months vs. Non-Inflection Months

| Dependent Variable: *Chg. in Rel. Turnover* | | |
|---|---|---|
| **Coefficient** | **Whole Sample** | **Sub-Sample with *Pre-Reversal*=1** |
| Intercept | -0.33% | 3.44%*** |
| Inflection Month Dummy (=1 if month *t* is an inflection month, 0 otherwise) | **6.2%*****  | **2.43%**** |

Note: Inflection month is defined as the month in when the relative OAS of a fallen angel is the highest in the [0m,24m] window following downgrades. The indicator variable *Pre-Reversal* = 1 if rel. OAS of month t is the maximum of all rel. OAS from month 0 (downgrade month) to month t. The sample periods are from Jan. 2007 to Dec. 2019 because our TRACE data start in 2007. Source: TRACE, Bloomberg, Barclays Research

Based on the turnover dynamics, we use a parsimonious non-parametric method to estimate the inflection probability in the sample with *Pre-Reversal*=1. We focus on the sub-sample with *Pre-Reversal*=1 because by construction of the variable, a month with *Pre-Reversal*=0 cannot be an inflection month since its relative spread is not even the highest since downgrades while the inflection month is defined as the month with the maximum in relative spread in the 24m window post downgrade.

To examine the effectiveness of this method, we first divide fallen angel monthly observations into two groups based on their *chg. in rel. turnover,* with a cut-off of 5%. The 5% cut-off was chosen based on the median (4%) and mean (6%) of the *chg. in rel. turnover* values during the inflection months. Results are robust to using alternative cut-off values in the 4-6% range, or using median/mean values estimated from trailing windows. Over the whole sample period, the two groups indeed had very different probabilities of inflection. As shown in Figure 7 Panel A, the probability of inflection of the small turnover change group are much lower than that of the large turnover change group among all fallen angels in our sample (5% vs. 12% respectively) and also among fallen angels in months with *Pre-Reversal*=1 (24% vs. 32% respectively).

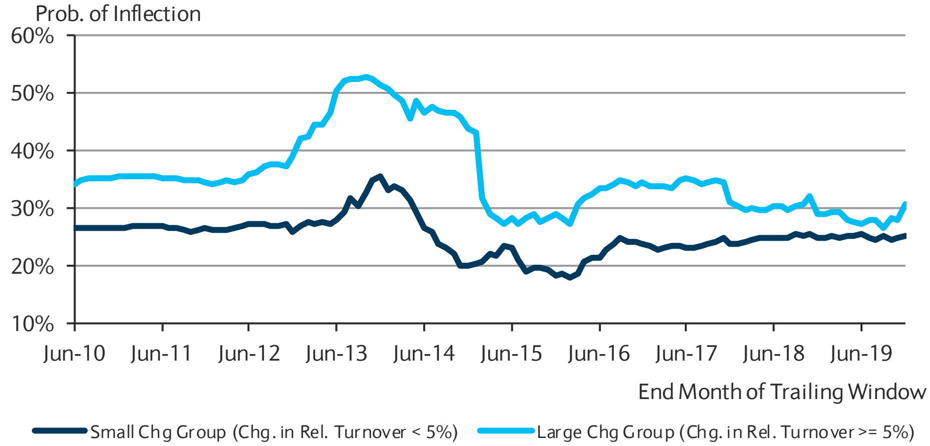
In real time, we use the empirical distribution of inflection months in the trailing 5-year window (sub-sample with *Pre-Reversal* =1) to estimate the probabilities of inflection at any point in time. Each month we calculate the fraction of inflection months in each group based on the available data in the trailing 5-year window and use the empirical fraction of inflection months in each group as an estimate of the inflection probability for that group in the coming month. Figure 7 Panel B shows the historical monthly estimates of inflection probability using trailing 5-year data. There is some time-series variation in the probability of inflection, but the inflection probabilities in the large change group (*chg. in rel. turnover*>=5%) are always higher than that in small change group (*chg. in rel. turnover* <5%) at any point in time.

FIGURE 7

Panel A. Probability of Inflection by Groups of *Chg. in Rel. Turnover*

| | **Whole Sample** | | **Sub-Sample with *Pre-Reversal* = 1** | |
|---|---|---|---|---|
| | **# of Monthly obs** | **Prob. of Inflection** | **# of Monthly obs** | **Prob. of Inflection** |
| Small Chg Group (*Chg. in Rel. Turnover* <5%) | 3,457 | 5% | 744 | 24% |
| Large Chg Group (*Chg. in Rel. Turnover* >= 5%) | 1,349 | 12% | 523 | 32% |

**Panel B. Rolling Estimation of Probability of Inflection by *Chg. in Rel. Turnover* Groups (trailing 5-year window)**




Note: the universe for the rolling estimation of probability of inflection is the sub-sample with *Pre-Reversal*=1. The indicator variable *Pre-Reversal* = 1 if rel. OAS of month t is the maximum of all rel. OAS from month 0 (downgrade month) to month t. Inflection month is defined as the month in when the relative OAS of a fallen angel is the highest in the [0m,24m] window following downgrades. Relative turnover is calculated as a bond's turnover (total monthly trading volume over its total amount outstanding) over the value-weighted turnover of its peer group (matched by rating and industry). *Chg in Rel. Turnover* is calculated as the difference from a bond's current month's relative turnover over its last month's relative turnover. The sample periods are from Jan. 2007 to Dec. 2019.
Source: Trace, Bloomberg, Barclays Research

## Step II: Sensitivity of subsequent relative spread change in each state

The variable we are interested in predicting is the magnitude of a fallen angel's relative spread change in the subsequent month. This variable is calculated in two parts. The first part is to estimate a baseline for monthly spread reversal, incorporating both the current relative spread, and how many months the fallen angel still has to adjust its spread back to its long-term level. The second part is to estimate how sensitive the next month's spread changes are to this baseline separately for each stage through regressions.

### *Baseline monthly spread change: normalize relative spreads by the number of remaining months till the end of the reversal cycle*

To establish a baseline for next month's spread change, we normalize the current month's relative spread level by the number of remaining months until the end of the reversal cycle (24m period following downgrade based on findings in Ben Dor and Xu 2010). The idea is that the current relative spread of a bond captures the deviation of its spread from its long-term fundamental level (proxied by peer spread). Ben Dor and Xu (2010) find that a fallen angel's spread in general fully adjusts back to its long-term level (i.e. 0 spread relative to peers) at the end of the 24m period. If we assume such reversal happens at a uniform speed during the remaining months, the expected adjustment speed per month can be calculated as the current relative spread divided by the number of remaining months. We denote this quantity as *rel. OAS/m* and it is calculated as:

$$Rel.OAS/m = \frac{Spread\ \ Relative\ \ to\ \ Peers}{24 - \#\ \ of\ \ Months\ \ since\ \ Downgrades + 1}$$

### *Estimate Conditional Sensitivities*

We classify three stages in the regression using the stage variable *Pre-Reversal* and inflection dummy:

- 1) the tightening stage proxied by *Pre-Reversal* = 0;
- 2) inflection month captured by an inflection dummy which equals 1 when the month is an inflection month;

- 3) the non-inflection 'widening' month during the sub-sample with *Pre-Reversal*=1 (captured by *Pre-Reversal**(1-Inflection Dummy)).

We try to characterize stages with the variable *Pre-Reversal* instead of the ex post characterization of tightening and widening stages because the *Pre-Reversal* variable is observable in real-time. In the regressions, we had to use the inflection dummy which cannot be calculated in real time for the current month, but is known ex post for other months for the purpose of calibration. In calculating the FAR scores, we use the estimated probability of inflection and not the inflection dummy so that the scores can be calculated in real time.

To estimate the sensitivity in each stage, we regress subsequent month's relative OAS change on the interaction terms of the three state dummies and *rel. OAS/m* (baseline model). The whole sample results are reported in Figure 8. The sign and relative magnitude of the coefficients are as expected. The sensitivity is -0.82 in the tightening periods, which means that in tightening months, fallen angels on average have a spread tightening with the size of 82% of the baseline adjustment (current month's *rel. OAS/m*). The sensitivity in inflection month is -4.26, which means that in inflection months, the average price reversal is much larger at 4.26 times of the baseline adjustment, which is to be expected as we discussed earlier that the inflection months are followed by the largest reversals. The sensitivity in non-inflection widening month is 1.86, which means that in these months, relative spreads would continue widening in the subsequent month with the change being 1.86 times of the baseline adjustment.

In model 2, we include an additional variable *Pre-Reversal* to test whether there is a difference in the level of subsequent spread changes when *Pre-Reversal* = 1 vs. when *Pre-Reversal* = 0 besides the differences in their sensitivities. The coefficient on *Pre-Reversal* is insignificant, and there is minimal difference in the adj. $R^2$ between the baseline model (23.42%) and model 2 (23.45%). The sensitivity coefficients are also similar. The results confirm that the subsequent month's spread changes do not differ in level between *Pre-Reversal* = 1 vs. *Pre-Reversal* = 0 months, and the three sensitivities are enough to capture the differences. The coefficients reported in Figure 8 are based on the full sample in order to give a comprehensive depiction of the general fallen angel dynamics. In calculation of the FAR scores, the sensitivity coefficients are computed from a trailing 5-year window using only data available up to the evaluation months to avoid any look-ahead bias.

FIGURE 8

**Sensitivities of Subsequent Rel. Spread Chg to *Rel. OAS/m***

| Dependent Variable: subsequent month Rel. OAS change | | | |
|---|---|---|---|
| **Coefficient** | **Denoted as** | **Baseline Model** | **Model 2** |
| Intercept | | -0.05 | -0.01 |
| Rel. OAS/m *(1 – Pre_Reversal) | *Sensitivity_Tightening* | -0.82** | -0.85** |
| Rel. OAS/m * Pre_Reversal * Inflection_Dummy | *Sensitivity_Inflection* | -4.26*** | -4.23*** |
| Rel. OAS/m * Pre_Reversal * (1-Inflection_Dummy) | *Sensitivity_Widening* | 1.86*** | 1.91*** |
| Pre_Reversal | | | -0.17 |
| Adj. R_squared | | 23.42% | 23.45% |

Note: The indicator variable *Pre-Reversal* = 1 if rel. OAS of month t is the maximum of all rel. OAS from month 0 (downgrade month) to month t. The Inflection_Dummy =1 for month t if it's an inflection month and 0 otherwise. The above regressions are based on fallen angel observations from Jul. 2005 – Aug. 2019. The starting month corresponds with the starting month of the trailing window used for sensitivity estimation (Jun. 2010).
Source: Bloomberg, Barclays Research

### Step III: Putting the Stages and Sensitivities Together

The last step is to integrate the results from the first two steps, reversal stages and sensitivities, together into a single score that captures the expected spread reversal magnitude in the subsequent month for each individual fallen angel at each month. The raw scores are constructed as follows (outlined in Figure 9): the scores are conditional on the state variable *Pre-Reversal*. If *Pre-Reversal* = 0, the score equals to (– Sensitivity_Tightening x *rel. OAS/m*). If *Pre-Reversal*=1, the score equals to the expected relative spread change across the two states (inflection month and non-inflection months), which is calculated as the sum across states of the product of probability of each state and the predicted subsequent spread change in each respective state (which is –sensitivity coefficient * *rel. OAS/m*). The sensitivity coefficients are betas of the subsequent rel. spread change to current month's *rel. OAS/m* in each state estimated from regressions discussed in the previous section. When we construct the raw scores, we multiply *rel. OAS/m* by the negative of the sensitivity coefficients because the sensitivity predicts future spread changes, and fallen angels with more negative spread changes (tightening) observe more positive returns and thus should receive a higher score as they are more attractive. For easy interpretation, the final FAR scores are normalized to be between 0-100 as the percentile ranking on a bond's raw score among all fallen angel bonds within the FAR universe in a particular month. A higher FAR score indicates a more positive expected return reversal in the coming month.

FIGURE 9

**Construction of FAR Score**

| Fallen Angel Reversal (FAR) Score | |
|---|---|
| **Meaning** | |
| A higher score indicates a larger reversal magnitude in spread (higher return) relative to peers in the subsequent month | |
| **Scenario** | **Raw Score** |
| If *Pre-Reversal* =0 (Rel. OAS < max since DG) | -Sensitivity_Tightening * Rel.OAS/m |
| If *Pre-Reversal* =1 (Rel. OAS = max since DG) | P_inflection*(-Sensitivity_Inflection)*Rel. OAS/m + (1- P_inflection)*(-Sensitivity_Widening*Rel. OAS/m) |
| **Normalization** | |
| The final scores are normalized to be between 0-100 as the percentile ranking of all fallen angel bonds in the FAR universe within a month on the raw score | |
| **Universe** | |
| The universe includes all fallen angels with positive relative spreads immediately following the downgrades and keeps track of the fallen angel bonds for as long as their relative spreads remain positive within in the 24-month window following downgrades | |

Note: *Rel. OAS/m* is calculated as rel. OAS divided by (24 - # of months since downgrade + 1). Sensitivity_Tightening, Sensitivity_Inflection, and Sensitivity_Widening are estimated from trailing 5-year regression of subsequent month's Rel. OAS on the interaction terms of *Rel. OAS/m* and three state dummies. P_inflection is determined by the empirical fraction of inflection months in the two groups of *chg. in rel. turnover* (<5% and >=5%) in the trailing 5-year window with sub-sample having *Pre_Reversal*=1. Source: Barclays Research

To avoid any look-ahead bias, we only use the data available up to each point in time to calculate FAR score each month. We estimate both the probabilities of inflection and subsequent spread sensitivities using a trailing window of 5-year.[8] We choose to use a fix-

[8] One issue to be handled with care in constructing the trailing windows is that to identify the inflection month we need the full 24m history of each fallen angel since downgrade. Such history is not available for all fallen angels at the time of estimation. One option is to delete all fallen angels that don't have the full 24-month history at the month of estimation, but we would lose a big chunk of the sample. Instead we revise the definition of inflection month in constructing the real-time sample to balance using only data available to investors at each point in time and not losing

length window and not an expanding window because fallen angel reversal dynamics could change over time. As an example, in 2015 we show that the supply-demand dynamics of fallen angels have changed over time, and such change had a material impact on average fallen angel performance (Ben Dor and Xu 2015). In our 2018 study, we also show that in recent years, the reversal of fallen angels happened at a faster pace (Ben Dor and Guan 2018). If there are any changes to fallen angel reversal dynamics, a fixed-length trailing windows would capture the changes in a timelier manner than an expanding window, in which the recent changes may be diluted by the early months before such changes.

We start the estimation of FAR scores in June 2010. We choose this date for two reasons. First, our TRACE data for calculating turnover starts in Jan. 2007 and we need a long enough period for the initial real-time estimation. Second, we want the sample period to best correspond to our FA strategy sub-period analysis in earlier publications for comparison. June 2010 is the choice after balancing the two criteria. For the period from June 2010 to Nov. 2011, we have less than 5-year of data each month in estimating empirical probabilities of inflection. We do have full 5-year data for estimating spread change sensitivity coefficients since spread data starts well before 2007.

## Efficacy of FAR Score

We perform two types of analysis to assess the efficacy of FAR scores. In the first analysis, we sort all eligible fallen angels into two groups each month based on their FAR scores and compare their performance. In a more practical setting, we construct a high yield portfolio with a fallen angel tilt by using FAR scores in selecting fallen angels and in determining their overweight.

### Top and bottom portfolios sorted on FAR scores

To evaluate the efficacy of FAR scores, we form a monthly-rebalanced long-short portfolio that buys the top half of fallen angels with highest FAR scores and shorts the bottom half of fallen angels with lowest FAR scores. All bonds are equally weighted subject to a 10% cap to reduce the impact of any single bond. If there are less than 10 bonds in either portfolio, the excess capital will be allocated to 1m Libor.

We evaluate the performance of the top, bottom, and top over bottom portfolios with the performance measured by total returns relative to peers.[9] If the score has predictive power of subsequent spread reversals, we would expect the top portfolio to outperform the bottom portfolios more and the top over bottom portfolio to have a positive inf. ratio. Besides the FAR scores, we also consider two other predictors, rel. OAS and *rel. OAS/m*, as benchmarks to show the additive performance from using FAR scores.

The performance statistics of each portfolio's returns over peers are reported in Figure 10 Panel A. The first three columns show the relative returns of the top and bottom portfolios sorted on a naive ratio: each fallen angel's rel. OAS alone. From Jul. 2010 to Dec. 2019, the top-over-bottom rel. OAS portfolio has average relative return of 3.88% per year with an I.R. of 0.40. This means that the top portfolio outperformed peers more than the bottom portfolio by 3.88% per year. When we adjust for the remaining time in the reversal cycle and use *rel. OAS/m* to sort fallen angels into top and bottom half portfolios (column 4-6), the inf. ratio of the top-bottom portfolio increased to 0.51 with an average return of 4.69% per year. Finally, as we further augmented *rel. OAS/m* with the trajectory of spread changes, trading dynamics as well as different sensitivities in the three stages of reversal cycle to construct the FAR scores, the top over bottom portfolio sorted on FAR scores has the highest I.R. of 0.65

too much data. At each month, we dropped the fallen angels who have less than 6 months of post-downgrade data at that month and re-define the inflection point as the months with the highest rel. spread from downgrade to the earlier of either 24 months following downgrade or the end of the estimation window.

[9] Any excess capital allocated to Libor would receive 0 return relative to peers.

and also the highest average return of 5.67% per year. In the two sub-periods Jul. 2010 – Dec. 2014 and Jan. 2015 – Dec. 2019, the top – bottom portfolio sorted on FAR scores also generated higher I.R. than those sorted on rel. OAS or *rel. OAS/m*. Besides having higher I.R. ratio in all sub-periods, the FAR score top – bottom portfolio also had better risk properties (lower vol. and better tail risk measures) than the other two in both sub-periods. The max. drawdown of FAR score top – bottom portfolio is less than half of that of the other two (-9.42% vs. -26.12% and -23.90%). The persistent performance of FAR top – bottom portfolio as well as its better risk properties indicate that the FAR scores are more effective at predicting subsequent price reversals than either rel. OAS or *rel. OAS/m*.

Furthermore, if we look at the top and bottom portfolios separately, the top FAR score portfolio had higher inf. ratio and better max. drawdown than the bottom FAR score portfolio in all sub-periods, indicating that FAR scores are not simply loading on spread risk and are indeed effective in identifying fallen angels with higher subsequent price reversals. In contrast to the FAR score portfolio, the top *rel. OAS/m* portfolio had lower I.R. (0.75) than the bottom portfolio (0.88) in the Jan. 2015 – Dec. 2019 period and worse tail risk statistics than the bottom portfolio in all sub-periods. The same is true for the rel. OAS portfolios as well. The fact that the top portfolios sorted on rel. OAS and *rel. OAS/m* have higher returns, higher vol., but similar I.R. and worse tail risk properties is consistent with these two measures picking up risky bonds, not necessarily bonds with likely subsequent reversals.

Another observation is that the bottom portfolio based on FAR scores has positive returns relative to peers in all sub-periods. This is consistent with our general finding that fallen angels represent good investment opportunities (Ben Dor and Xu 2010). Even not so attractive fallen angels ranked low by the FAR scores still delivered outperformance over peers, just not as much as the highly ranked ones.

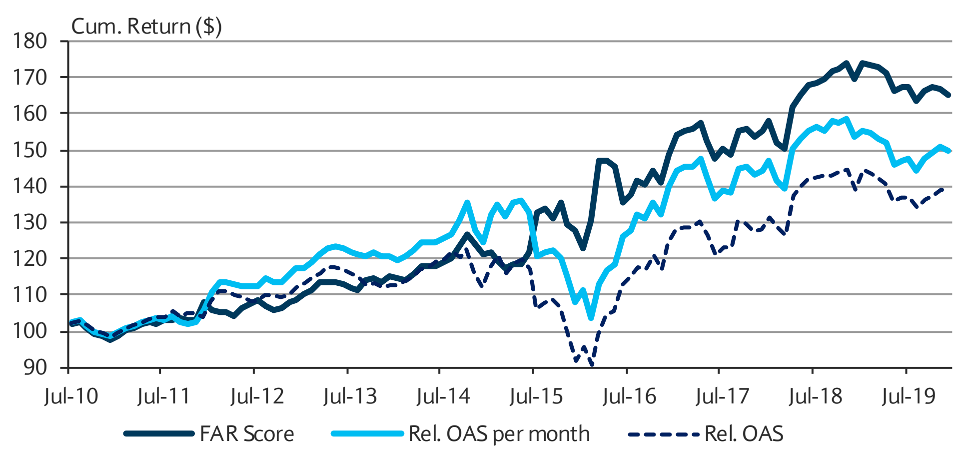
Figure 10 Panel B plots the time-series of cumulative returns over peers of the top-bottom portfolio based on FAR scores and alternative scores. The top FAR score portfolio persistently outperformed the bottom FAR score portfolio throughout time. As a comparison, the performance of the top – bottom portfolio based on rel. OAS and *rel. OAS/m* were not as persistent over time and suffered substantial drawdowns around the second half of 2015.

FIGURE 10

Panel A. Return over Peers of Top - Bottom Sorted on Relative Scores

| | | Scores | Rel. OAS | | | Rel. OAS/m | | | FAR Score | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (Adjusted for remaining time in the reversal cycle) | | | (Augmented with trend of spread changes, trading dynamics, and different spread change sensitivities throughout the reversal cycle) | | |
| | | | Top Half - Bottom Half | Top Half | Bottom Half | Top Half - Bottom Half | Top Half | Bottom Half | Top Half - Bottom Half | Top Half | Bottom Half |
| Full Sample | Jul.2010 - Dec. 2019 | Average (%/yr) | 3.88 | 8.05 | 4.17 | 4.69 | 8.46 | 3.77 | 5.67 | 8.95 | 3.28 |
| | | Volatility (%/yr) | 9.68 | 11.77 | 5.57 | 9.25 | 11.31 | 6.16 | 8.75 | 10.56 | 7.08 |
| | | **Inf. Ratio (Ann.)** | **0.40** | **0.68** | **0.75** | **0.51** | **0.75** | **0.61** | **0.65** | **0.85** | **0.46** |
| | | Worst Monthly Ret.(%) | -9.29 | -8.75 | -4.92 | -9.03 | -8.62 | -4.47 | -6.54 | -5.42 | -8.52 |
| | | Max. DD (%) | -26.12 | -23.41 | -4.92 | -23.90 | -20.17 | -8.02 | -9.42 | -12.72 | -15.03 |
| Sub-Periods | Jul. 2010 - Dec. 2014 (Ben Dor and Xu 2015 update) | Average (%/yr) | 2.67 | 4.46 | 1.79 | 5.07 | 5.67 | 0.59 | 4.38 | 5.33 | 0.95 |
| | | Volatility (%/yr) | 5.42 | 6.16 | 3.01 | 5.73 | 5.72 | 4.01 | 4.55 | 4.96 | 4.25 |
| | | **Inf. Ratio (Ann.)** | **0.49** | **0.72** | **0.59** | **0.89** | **0.99** | **0.15** | **0.96** | **1.08** | **0.22** |
| | | Worst Monthly Ret.(%) | -5.36 | -5.40 | -2.02 | -5.73 | -5.58 | -3.87 | -2.38 | -3.91 | -3.78 |
| | | Max. DD (%) | -8.69 | -11.16 | -3.62 | -7.84 | -9.21 | -6.69 | -4.45 | -7.39 | -7.81 |
| | Jan. 2015 - Dec. 2019 | Average (%/yr) | 4.97 | 11.27 | 6.30 | 4.34 | 10.97 | 6.63 | 6.83 | 12.20 | 5.37 |
| | | Volatility (%/yr) | 12.37 | 15.15 | 7.11 | 11.59 | 14.64 | 7.53 | 11.30 | 13.77 | 8.88 |
| | | **Inf. Ratio (Ann.)** | **0.40** | **0.74** | **0.89** | **0.37** | **0.75** | **0.88** | **0.60** | **0.89** | **0.61** |
| | | Worst Monthly Ret.(%) | -9.29 | -8.75 | -4.92 | -9.03 | -8.62 | -4.47 | -6.54 | -5.42 | -8.52 |
| | | Max. DD (%) | -24.96 | -20.91 | -4.92 | -23.90 | -20.05 | -4.47 | -9.42 | -11.70 | -13.72 |

Panel B. Time Series of Cumulative Returns (ret. over peers) of Top – Bottom Portfolios




Note: All performance reported are fallen angel total returns over peer group returns. A fallen angel's peer bond group contains all index bonds in the same level-3 industry and with the same rating as the fallen angel. The peer return for a fallen angel is calculated as the market value-weighted average return of all bonds in its peer group.

Source: TRACE, Bloomberg, Barclays Research

## Using FAR scores in a Fallen Angel-Tilted High Yield portfolio

The evidence in Figure 10 suggests that FAR scores are effective at selecting fallen angels that outperform other fallen angels. As discussed in the beginning, FAR scores offer a lot more flexibility in portfolio construction compared to the 3m-Reversal strategy, both in terms of weighting and security selection. In this part, we will illustrate through an example of how FAR scores can be used to enhance the performance of a High Yield portfolio by overweighting fallen angel bonds with high FAR scores. In this example, to best utilize the information in FAR, the FAR scores will both be used as a selection metric to choose the bond with the highest expected reversal magnitude for each fallen angel issuer and also used to determine the overweight allocated to each fallen angel issuer, proportional to their signal strength.

In particular, the HY portfolio with a Fallen-Angel tilt (denoted as the FA-tilted portfolio) is constructed as follows on a monthly basis:

- For each fallen angel issuer, we select the bond with the highest FAR score
- Among all fallen angel issuers, the issuer with the highest FAR score receive a 3% overweight. The rest of the fallen angel issuers receive less overweight proportional to their FAR scores (3% * FAR_Score/Max_FAR_Score)
- The rest of the weights will be allocated to the Bloomberg Barclays US High Yield Index

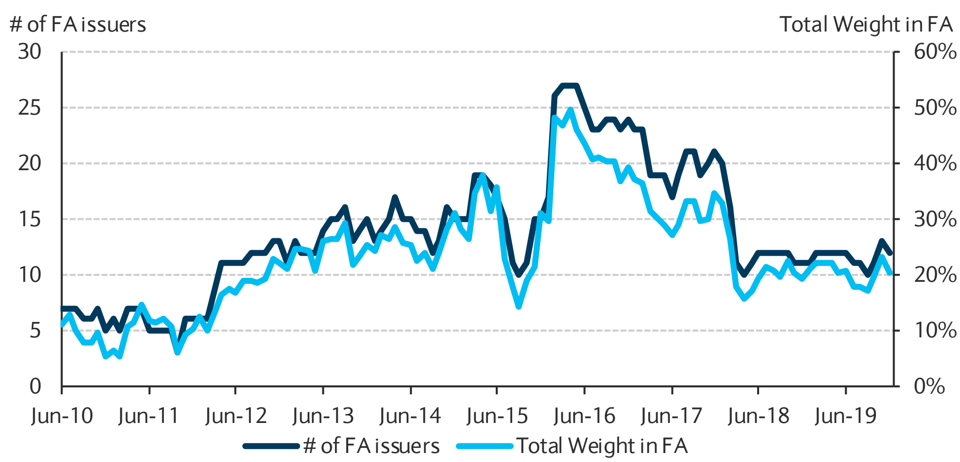
The weights assigned to fallen angels in the second step can be viewed as overweight to these fallen angel bonds because these bonds are already part of the HY index. The total overweights assigned to fallen angels are listed in Figure 11. The fallen angel overweight varies from month to month depending on the total number of fallen angel issuers in our universe. Panel A lists the distribution of the fallen angel overweight. On average the portfolio overweights fallen angels by 23%, with the maximum reaching 50%. Panel B presents the total overweight and the number of fallen angel issuers in the FAR universe by month. One thing worth noting is that the fallen angel overweight in this portfolio is

FIGURE 11

**Panel A. Distribution of monthly allocation to fallen angel overweight**

| Average | Minimum | Q1 | Median | Q3 | Maximum |
|---|---|---|---|---|---|
| 23% | 5% | 18% | 22% | 29% | 50% |

**Panel B. Number of Fallen Angel issuers in FAR universe and overweight assigned to fallen angels**




Source: TRACE, Bloomberg, Barclays Research substantial. In reality, an investor can tune up or down the magnitude of the fallen angel tilt by changing the weight allocated to the fallen angel issuer with the highest FAR score (currently 3%). The performance of FA-tilted portfolio will change, but the sign and the magnitude of the inf. ratio of the outperformance over the HY index will stay the same.

Figure 12 Panel A shows the performance of the FA-tilted portfolio compared to the HY index, reported separately for the two sub-periods, Jul. 2010 – Dec. 2014 and Jan. 2015 – Dec. 2019. In both periods, the FA-tilted portfolio delivered higher average total returns and higher Sharpe ratios than the HY index. The FA-tilted portfolio outperformed the HY index by 1.07% per year and 5.32% per year in the two sub-periods with information ratios around 1 (1.31 and 0.98).

One possible explanation for the outperformance of the FA-tilted portfolio is that it has higher risk than the index, and the higher returns are a compensation for the risk. To control for the risk difference, we constructed a similar portfolio as the FA-tilted portfolio, but instead of overweighting the selected fallen angels, we assign the same overweight in the industry-and-rating-matched peer bonds for each selected fallen angel. This portfolio is denoted as the peer-tilted portfolio. The peer-tilted portfolio had lower returns and Sharpe ratios than the FA-tilted portfolios and did not generate as much outperformance. Moreover, the FA-tilted portfolio has higher Sharpe ratios than the index in both sub-periods, indicating that their outperformance is not entirely driven by higher risk. Panel B of Figure 12 plots the time-series cumulative returns of the FA-tilted and peer-tilted portfolios vs. the index. The FA-tilted portfolios demonstrates steady outperformance over the HY index while the peer-tilted portfolio has similar performance as the index.

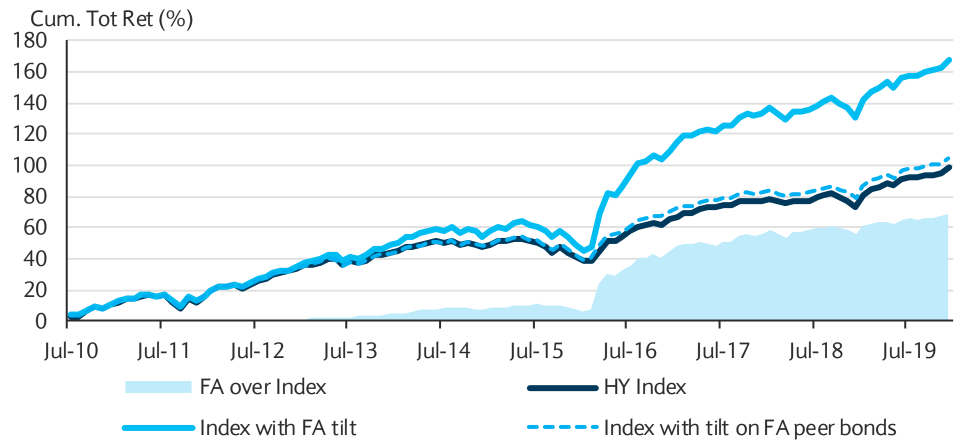
To evaluate the efficacy of FAR scores in selecting fallen angels that outperform other fallen angels, we construct the FA-tilted portfolio in an alternative approach without using the FAR scores. In this approach, we invest in all fallen angel bonds of each issuer in the same universe (value-weight among bonds of an issuer) and then equally-weight all fallen angel issuers. The total overweight allocated to all fallen angel bonds is set to be the same as in the original approach on a monthly basis. We denote this portfolio as the FA-EW-tilted portfolio and show its performance in the second last column of Figure 12 Panel A. the FA-EW-tilted portfolio has lower average returns and Sharpe ratios than the original FAR-score-weighted FA-tilted portfolio in both sub-periods. The differences are small, partially because FAs only accounts for a small fraction of the overall portfolio. A better way to assess the efficacy of using FAR scores as weighting is to look at the difference in monthly returns of the two portfolios and evaluate its persistence. The last column of Panel A reports the performance statistics on the monthly return difference of the FAR-score-weighted FA-tilted portfolio over the equally weighted FA-EW-tilted portfolio. The FAR-score weighted portfolio have inf. ratio of 0.67 and 0.94 over the EW portfolio in the two sub-periods. The sizeable inf. ratio suggests that using FAR scores as a selection and weighting metric indeed improves performance over indiscriminately investing in all fallen angels equally.

FIGURE 12

**Panel A. Performance of Fallen-Angel tilted High Yield portfolios**

| | | Weight by FAR score | | | | | EW | FAR-Weighted over EW |
|---|---|---|---|---|---|---|---|---|
| | | FA-tilted portfolio (1) | Peer-tilted portfolio (2) | HY Index (3) | FA-tilted-portfolio over Index (1) - (3) | Peer-titled-portfolio over Index (2) - (3) | FA-EW-tilted portfolio (4) | FA-tilted over FA-EW-tilted portfolio (1)-(4) |
| Sub-Period 1 (Jul. 2010 - Dec. 2014) | Avg. Ret (%/Yr) | 9.91 | 8.96 | 8.84 | 1.07 | 0.12 | 9.64 | 0.27 |
| | Vol. (%/Yr.) | 6.38 | 6.09 | 6.15 | 0.82 | 0.29 | 6.36 | 0.41 |
| | **Sharpe (inf.) Ratio (ann.)** | **1.52** | **1.44** | **1.40** | **1.31** | **0.41** | **1.48** | **0.67** |
| Sub-Period 2 (Jan. 2015 - Dec. 2019) | Avg. Ret (%/Yr) | 11.43 | 6.60 | 6.11 | 5.32 | 0.50 | 9.61 | 1.81 |
| | Vol. (%/Yr.) | 9.47 | 5.54 | 5.29 | 5.45 | 0.72 | 8.38 | 1.92 |
| | **Sharpe (inf.) Ratio (ann.)** | **1.08** | **0.98** | **0.93** | **0.98** | **0.68** | **1.00** | **0.94** |

**Panel B. Cumulative total returns of FA-tilted portfolio and the HY index**




Source: TRACE, Bloomberg, Barclays Research

## Conclusion

We introduce FAR scores that rank fallen angels on their attractiveness (the magnitude of their expected spread reversal relative to their peers in the subsequent month). The FAR scores incorporate multiple dimensions of a fallen angel's reversal dynamics, such as past trajectories of spread changes and trading dynamics. Fallen angels with higher FAR scores had higher subsequent average return relative to peers, higher information ratios over peers, and better tail risk properties than fallen angels with lower FAR scores, with similar patterns persistent in sub-periods. We also illustrate in an example of how to use FAR scores as selection and weighting metric in constructing a HY portfolio with a fallen angel tilt. Such a FA-tilted portfolio delivered outperformance over the HY index as well a tilted portfolio that equally weighting all fallen angels. Overall, FAR scores provide an effective and versatile metric for investment in fallen angels.

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