

**MODELING
METHODOLOGY**
FROM MOODY'S KMV

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Using EDF Momentum to Provide Insights into Credit Migration and Default Risk

Abstract

This paper presents a study of *momentum* impact within the Moody's Analytics EDF™ (Expected Default Frequency) credit measure on patterns of default risk and rating changes. We define momentum as the significant rise or fall of an issuer's one-year EDF level during a one-year horizon.

The main question motivating our study is whether or not such momentum can provide useful information about future credit events, thus improving the utility of the EDF credit metric for risk managers and investors.

We find that deteriorating momentum in EDF credit measures signals a much higher likelihood of default, whereas entities with improving momentum show lower levels of default risk. In addition, we find that Moody's rating changes are highly correlated with momentum signals: Deteriorating momentum results in higher downgrade rates, whereas improving momentum results in higher upgrades.

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1 Introduction

In this paper, we study the impact of momentum within the Moody's Analytics EDF credit measure on patterns of default risk and rating changes. The main question motivating the study is whether or not EDF momentum can provide useful information about future credit events, when the data is conditioned on the level of the EDF measures.

We define momentum as the significant rise or fall of an issuer's one-year EDF level during a one-year horizon. If the percentage change of an issuer's EDF level is larger than 75% of the percentage EDF level change of the entire population, then the issuer has experienced deteriorating momentum. If the percentage change of an issuer's EDF level is less than 75% of the percentage EDF level change of the entire population, then the issuer has experienced improving momentum.

We find that analyzing the momentum of the EDF measure improves credit risk signals in the following ways.

- Deteriorating momentum signals a much higher likelihood of default, whereas entities with improving momentum show lower levels of default risk.
- Moody's rating changes are highly correlated with momentum signals: Deteriorating momentum results in higher downgrade rates, whereas improving momentum results in higher upgrade rates.

2 Overview

An extensive body of empirical literature exists on momentum within the equity markets. Several studies document a significant momentum effect in equity returns. These studies show that previous three-to-twelve-month winners in equity markets outperform previous three-to-twelve month losers during the next twelve months. Given that stock return momentum is well documented empirically and widely used by practitioners, a natural question arises: Whether or not the EDF credit measure, which is derived using equity information, also illustrates the momentum effect. This paper examines the impact of EDF momentum on credit event patterns such as rating changes and firm defaults.

To get a better picture of the motivation, assume there are three firms—Firm A, Firm B, and Firm C—each of which currently has the same level of risk in terms of Expected Default Frequency. Firm A experienced improving momentum due to the significant fall in its EDF level relative to the entire population during the past 12 months. However, Firm C showed deteriorating momentum due to the significant increase in its EDF level during the same period, and Firm B's EDF level remained relatively stable over the past year and did not show any momentum. Given that Firms A, B, and C each have the same EDF measure today, are they equally likely to experience a credit event during the upcoming 12 months?

Studying momentum facilitates identifying and differentiating separate, entity-specific moves from market-related changes and developments. Momentum may also enhance the credit information that can be derived from the EDF level itself. Risk managers can utilize this momentum study to help identify potential credit risk situations and to differentiate between the prospects of firms with similar EDF measures.

3 Data and Methodology

The sample of firms used in this study includes North American public corporate firms for the period January 1990 through October 2009. The rated universe consists of all North American public corporate firms rated by Moody's during this period.

As described previously, we first identify the companies that exhibited EDF measure momentum by looking at the percentage change of their EDF measure during the past 12 months. We classify these firms in the following way.

- Deteriorating momentum: The percentage change in EDF measures falls within the fourth quartile of the population.
- Improving momentum: The percentage change in EDF measures falls within the first quartile of the population.
- No momentum: We use this classification for the remaining firms.

Next, we aggregate the sample and group firms by their EDF levels. After controlling the sample for EDF level, we record ratings changes or defaults of the momentum companies during the next 12 months. The historical analysis consists of a series of 12-month overlapping cohorts from January 1991 through October 2009. The analysis is based on over 15,354 entity-level observations.

4 Results

4.1 Default Rates

It is well documented that the EDF credit measure is a strong indicator of default risk. The one-year EDF credit measure at time t is designed to describe the expected default frequency for the 12 months following time t . Validation studies illustrate that the EDF model's predicted default rates track realized default rates, and that the EDF measure is very powerful ranking companies with regard to their default risk levels.¹ Companies with higher EDF measures are more likely to default than companies with lower EDF measures. We now consider whether a firm's EDF momentum offers additional insights into default rates by looking at EDF level alone.

As a first step, we condition default data by entities' EDF levels and momentum. To neutralize the effect of credit risk measured with EDF level, the panel data is first grouped into ten EDF level groups with equal sample sizes (10% of the sample each). Then, within each EDF level group, firms are sorted by momentum. Finally, the realized default rates are recorded during a 12-month horizon for each EDF level group-momentum pair.

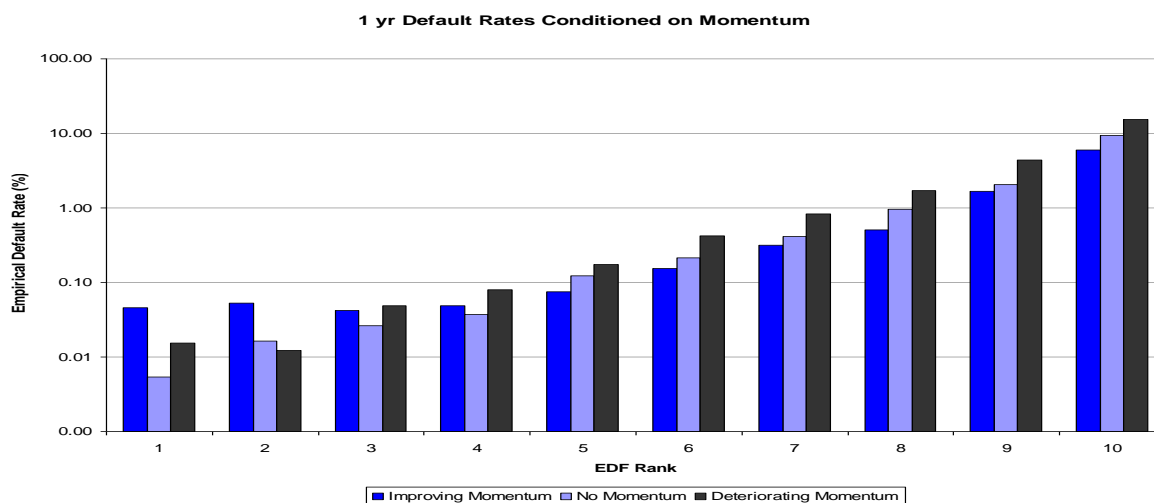


Figure 1 One-year Default Rates Conditioned on Momentum

Figure 1 illustrates the one-year default rate conditioned on EDF measure and momentum.² The upward-sloping bars for EDF level Groups 5 and above show that, for medium to high EDF level groups, firms with deteriorating momentum are more likely to default than firms that do not exhibit any momentum. Firms with no momentum are more likely to default than firms with improving momentum.

The impact of momentum on the default rate for high risk companies is quite significant. For the highest-EDF level group (Group 10) the one-year default rate for deteriorating momentum entities is 15%, whereas for the improving momentum entities it is only 6%; less than half that of the deteriorating group.³ This shows that, in addition to EDF

¹ Korablev and Qu (2009), Gokbayrak and Chua (2009), Dwyer and Korablev (2007)

² Note, EDF levels are plotted in a log scale.

³ Y axis log scale

level, differentiating between improving and deteriorating momentum leads to a better understanding of risk for high-EDF level entities. However, for the low-EDF level group, the effect of momentum on default rates is not uniform. As a result, we can conclude that EDF momentum provides additional insights as an early sign of possible default only for the more risky companies. Avramov, Chordia, Jostova, and Philipov (2007), support this finding by establishing a link between equity momentum and credit rating. They also find that momentum profitability is large and significant among low-grade firms, but is nonexistent among high-grade firms.

4.2 Rating Transitions

Ratings play a key role as a long-term indicator of credit risk, and rating transitions are important in credit risk management. The EDF credit measure is not designed to predict rating migrations; however, EDF momentum can be used to anticipate rating transitions and provides an early signal for better risk management.

Similar to the previous section, we first condition rating transition data by entities' EDF levels and momentum. To neutralize the effect of credit risk measured with EDF level, the panel data of rated public North American corporates is first sorted into ten EDF groups with equal sample sizes (10% of the sample in each group). Then, within each EDF group, firms are sorted by their momentum. Finally, the realized upgrade and downgrade rates are recorded over a 12-month horizon for each EDF group-momentum pair.

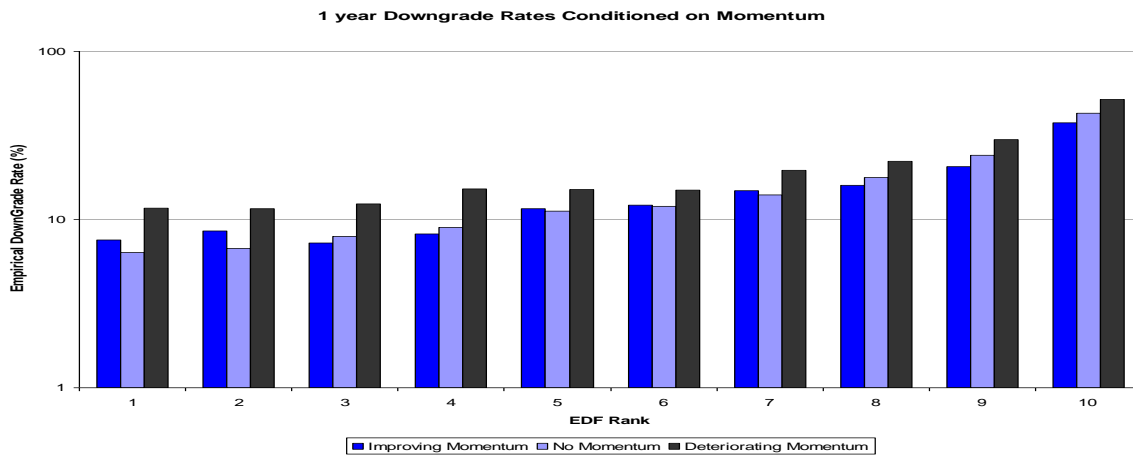


Figure 2 One-year Downgrade Rate Conditioned on Momentum

Figure 2 illustrates the impact of EDF momentum on rating downgrades after conditioning on EDF level. The bar chart shows that downgrade rates are higher for entities with deteriorating momentum compared to entities with improving momentum, regardless of the EDF level. In other words, if an entity has experienced a significant, relative EDF level increase during the past 12 months, this entity is more likely to be downgraded during the next 12 months when compared to another entity that has experienced a significant, relative EDF level drop, even though their current EDF levels are similar.

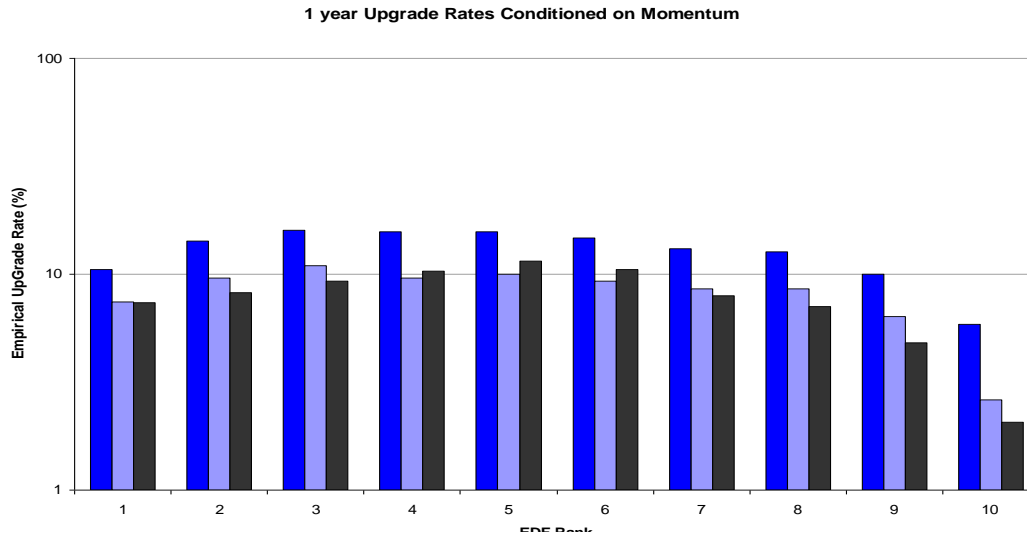


Figure 3 One-year Upgrade Rates Conditioned on Momentum

Similarly, Figure 3 illustrates the impact of EDF momentum on rating upgrades after conditioning on EDF level. The bar chart shows that upgrade rates are higher for entities with improving momentum compared to entities with deteriorating momentum, regardless of the EDF level. This result is significant, since it is relatively difficult to anticipate rating upgrades.

Moody's policies are stricter for upgrades, and firms are required to have sustainable improvement in their credit profile to be eligible for an upgrade. The upgrade rate difference between different momentum subgroups is more significant for high EDF level groups. The high-risk companies, mostly speculative grade companies, are upgraded more frequently with improving momentum. This difference may also be caused by the asymmetrical potential change, since there is more room for an upgrade compared to downgrade for low rated companies.

5 Predicting Power

In this section, we study the effect of momentum on the EDF model ranking power in order to differentiate firms close to experiencing a credit event from the rest the population. The three credit events of interest in this paper are default, rating downgrade, and rating upgrade. To test the model's predictive power, we use a well-known approach: the Cumulative Accuracy Profile (CAP). This approach is summarized by a measure known as the Accuracy Ratio (AR). Typically, the higher the AR, the better the model. In extreme cases, for a totally random model that bears no information on impending defaults $AR=0$. For a perfect model $AR=100\%$.

In this study, to assess the impact of momentum on the predictive power of the EDF credit measure, we compute the Accuracy Ratio of the EDF measure and compare it with the Accuracy Ratio that is calculated using both the EDF measure and the momentum information.

Figure 4 illustrates the AR of the EDF model to predict defaults, downgrades, and upgrades and compares each AR calculated with the additional momentum information. Our findings show that combining the EDF measure with momentum does not add significant power in predicting defaults (79.2% versus 80.4%) and downgrades (41.2% versus 41.8). However, momentum information improves upgrade prediction significantly (11.8% versus 18.8%).

Several factors dictate the relatively small difference in default predicting powers using momentum information in addition to EDF measure. First, momentum does not have a uniform impact on default risk through different EDF groups. As seen in Figure 1, default risk doesn't monotonically increase via momentum for the first four EDF groups, and this trait may have a negative impact on the AR ratio.

In addition, even though momentum is helpful in differentiating risk for high EDF firms within the EDF group, the EDF measure still provides considerably better risk differentiation than the momentum information. For most cases, the default rate of the deteriorating momentum subgroup in a low EDF group is still lower than that of an improving momentum subgroup in a high EDF group. The impact of momentum on the AR would be higher if momentum could change the monotonically increasing trend over EDF groups. Finally, the EDF credit measure is already a very powerful predictor of default, and it is difficult to significantly improve upon the predictive power of this measure.

For similar reasons, momentum does not add much power in predicting rating downgrades. However, the story is different for power in predicting upgrades, where combining momentum with the EDF credit measure increases the AR by 7%. In contrast to the previous two figures, momentum is informative for all EDF groups, and the upgrade rate of any improving momentum subgroup is higher than that of the deteriorating subgroup in the next EDF group. Within an EDF group as well as across all groups, momentum provides information that the EDF measure does not.

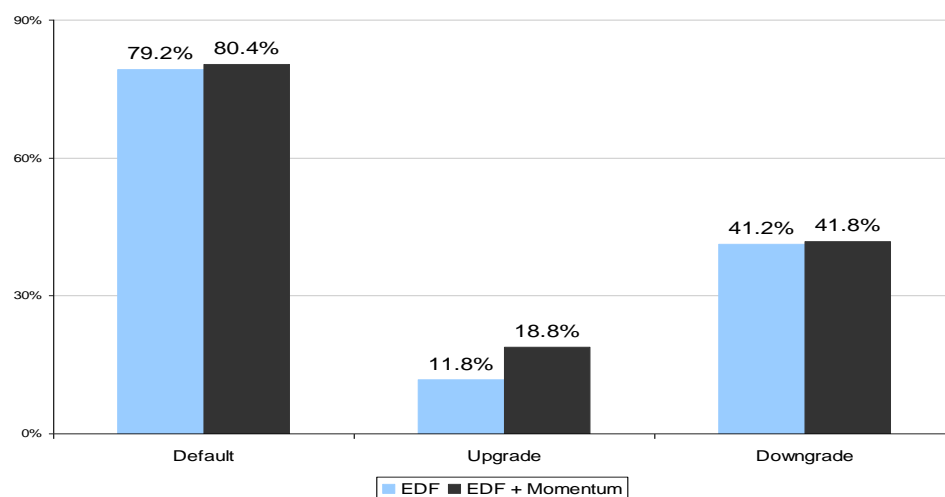


Figure 4 Accuracy Ratios of the EDF Model vs. EDF Model + Momentum

6 Possible EDF Momentum Drivers

In this section, we analyze the possible forces driving EDF momentum. The main drivers of the EDF measure are asset volatility, which reflects the business risk of a firm, and market leverage, which is defined as the ratio of the default point to the market value of the assets, and reflects the financial risk of a firm.⁴

To analyze the momentum in the asset volatility measure, similar to the analyses above, we first identify the companies that exhibited momentum in asset volatility by looking at the percentage change of their asset volatility level during the past 12 months. We divide these firms into the following EDF groups.

- Deteriorating momentum: The percentage change in volatility levels falls within the fourth quartile of the population.
- Improving momentum: The percentage change in volatility levels falls within the first quartile of the population.
- No momentum: We use this classification for the remaining firms.

Next, we aggregate the sample and group firms by their EDF measures. Then, within each EDF group, we sort firms by their asset volatility momentum. Finally, we record the realized default rates over a 12-month horizon for each EDF measure-momentum pair.

⁴ For more information about the public EDF model, see Crosby and Bohn (2003).

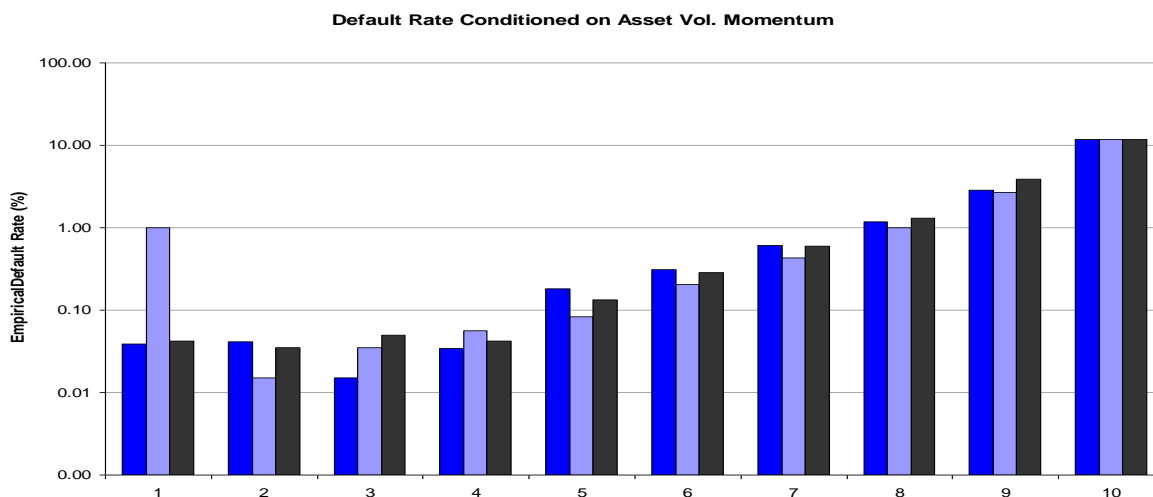


Figure 5 Default Rate Conditioned on Asset Volatility Momentum

Figure 5 illustrates the one-year default rate conditioned on EDF measure and asset volatility momentum. The figure shows that there is no significant difference in a firm's default likelihood, regardless of the EDF group in which the firm resides (improving momentum, deteriorating momentum, or no momentum). In other words, momentum in asset volatility does not differentiate risk considerably in any given EDF group; therefore, asset volatility is not a driver of EDF momentum.

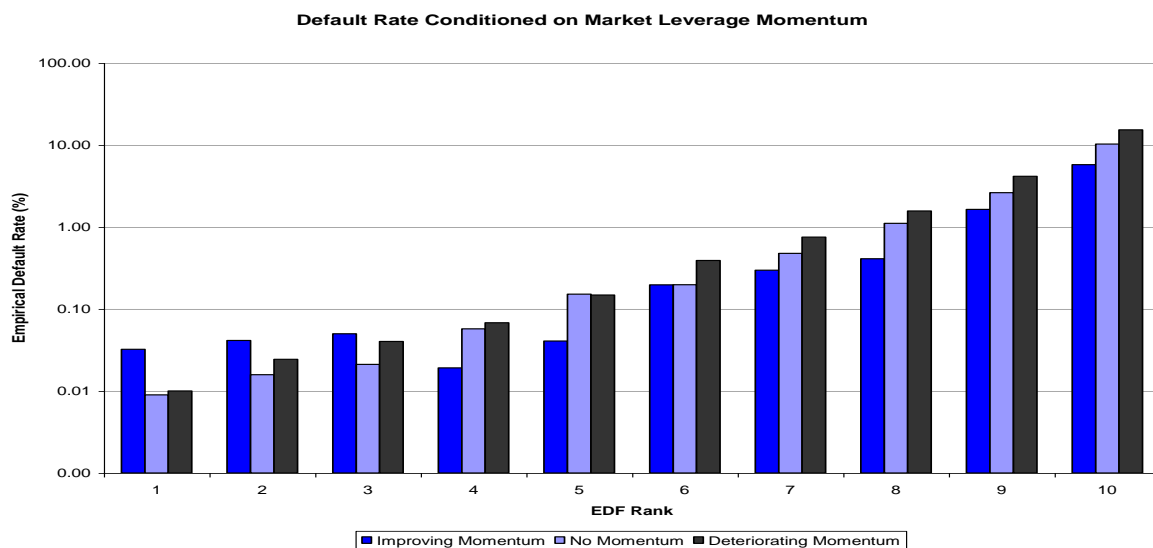


Figure 6 Default Rate Conditioned on Market Leverage Momentum

When we analyze market leverage as a possible source of momentum, we see a very different story. Figure 6 illustrates that for medium to high risk groups, when the definition of momentum is based on the change in market leverage within an EDF group, firms with significant increases in market leverage are more likely to default when compared with firms with significant reductions in their market leverage. The default rate of the deteriorating leverage momentum group is 15.8%, whereas the default rate of the improving momentum group is only 4.6%. The difference is very significant. Given that market leverage is the driving force behind EDF momentum, we drill further down into the

market leverage drivers. Since market leverage depends on both the default point of a firm and its market capitalization, we conduct similar analyses for these variables. We classify these firms in the following way.

- Deteriorating default point momentum: On the liability side, firms that exhibit significant increases in their default points are classified as deteriorating default point momentum, and vice versa.
- Deteriorating market cap momentum: On the equity side, firms that experience significant reductions in their market capital are defined as deteriorating market cap momentum, and vice versa.
- No momentum: Firms with moderate changes in their respective variables.

As shown in Figure 7, for riskier firms with higher EDF measures, the change in book liabilities within the past one year correlates positively with the observed default rate during the upcoming 12 months. For example, on average, firms with significant liability increases posted more frequent defaults during the upcoming year, while firms with significant reductions in their liabilities experienced less frequent defaults. This was especially true when these firms faced higher credit risk compared with their peers.

When we focus on the highest EDF group, the observed default rate of the improving liability momentum group is 10%, whereas the default rate of the deteriorating group is 15.1%. The results show that although liability momentum contributes to the momentum effect in leverage, it does not explain it fully; the impact is much smaller than the total impact of the momentum in leverage.

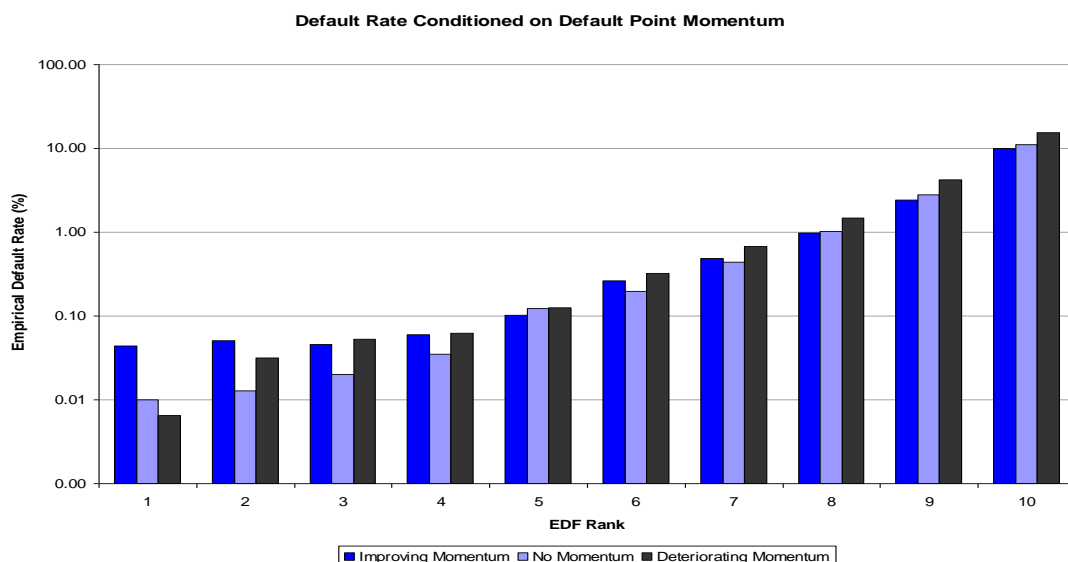


Figure 7 Default Rate Conditioned on Default Point Momentum

Next, we analyze the momentum in equity, the second input of market leverage. As discussed earlier, it has been well documented in the academic literature that intermediate horizon equity returns tend to exhibit momentum: past returns are positively related to future average returns. Jegadeesh and Titman (1993) document that strategies purchasing past stock winners and selling past stock losers provide significant profits. The study also indicates that the momentum is stronger for firms that have had poor performance. The momentum impact of recent, good performance is weaker. In light of the empirical evidence presented in the literature, in this study we analyze whether past equity returns are correlated with credit risk, as well as with future returns.

Our findings suggest that, similar to book liabilities, equity return momentum provides insights for credit risk. Also, equity return momentum impact is much higher than momentum in book liabilities, which suggests that momentum in equity returns is the largest driver of the momentum in EDF measures.

As shown in Figure 8, on average, firms that have experienced a low one-year equity return are more likely to default during the upcoming year than firms that have experienced a large equity return. However, this effect is observed only for the medium and large EDF groups. The correlation between the one-year equity return and the upcoming default

rate is stronger for firms with higher credit risk. For example, for the high-EDF group, the differences in the default rates of the deteriorating and improving equity momentum groups can be as high as 10.1%.

This result is also consistent with Avramov, Chordia, Jostova, and Philipov (2007), who show that equity return momentum is nonexistent for firms rated A and above, but becomes statistically significant and economically large as the ratings decline. Their results are consistent with our findings, in which past equity returns are positively related to upcoming default rates only for medium- and high-risk firms.

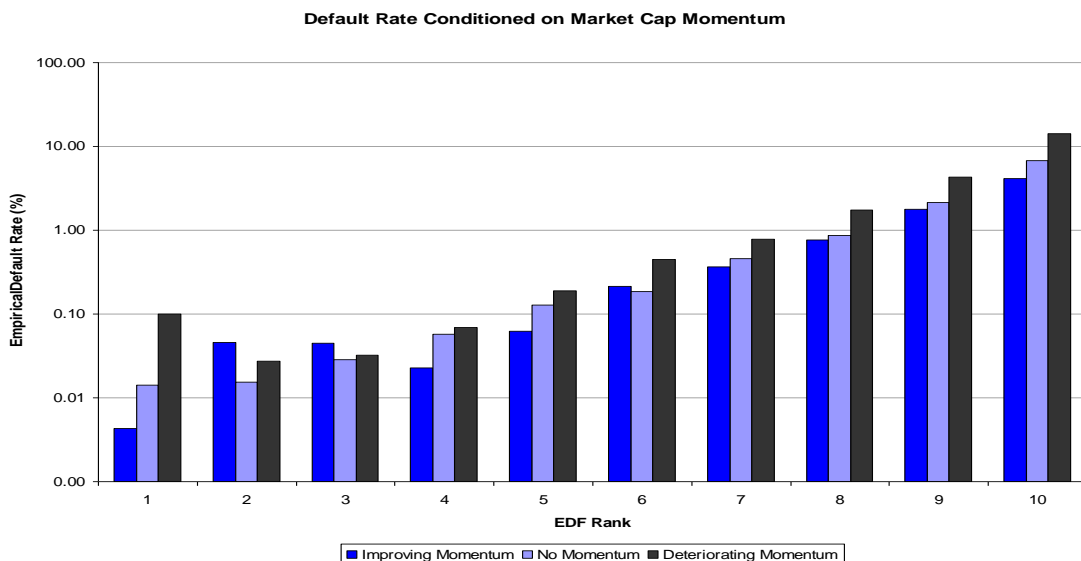


Figure 8 Default Rate Conditioned on Market Cap Momentum

7 Conclusion

Our study shows that analyzing EDF momentum provides insight into future credit risk events, above what is gained by looking at the EDF measure alone, especially for medium- and high-risk firms. We find that, at a given EDF level, deteriorating EDF momentum signals a much higher likelihood of default, whereas entities with improving EDF momentum show lower levels of default risk. In addition, Moody's rating changes are also highly correlated with the EDF momentum signals: deteriorating momentum results in higher downgrade rates, whereas downward momentum results in higher upgrades. We believe that risk managers can utilize our findings with EDF momentum to separate entity-specific moves from market developments, possibly enhancing the credit information that can be derived from EDF level itself.

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