

Identifying At-Risk Firms in Your Private Firm Portfolio

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Agenda

1. Dive into Five Risk Metrics
2. Two Additional Signals
3. Conclusions

The Problem

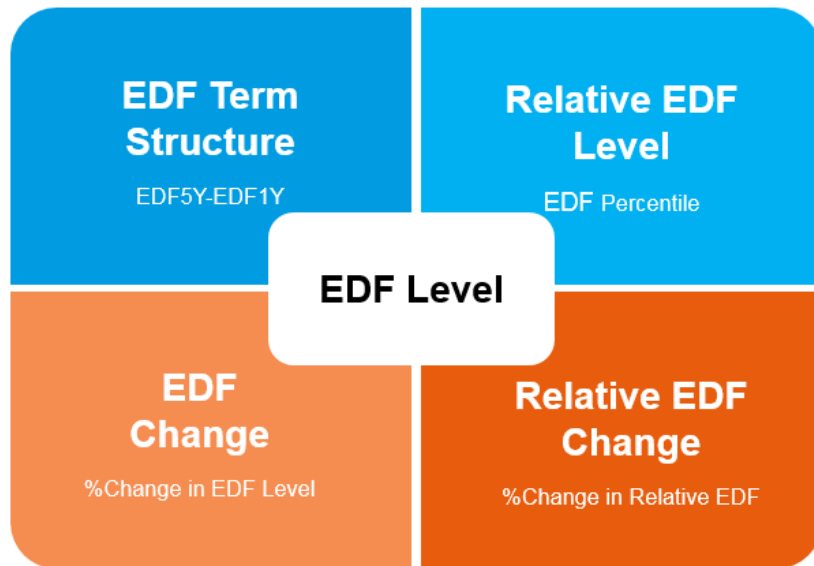
RiskCalc™ generates accurate and forward-looking EDF™ (Expected Default Frequency) measures for private companies.

» The Problem

When do changes with the credit cycle or financial statements of a private firm warrant immediate attention?

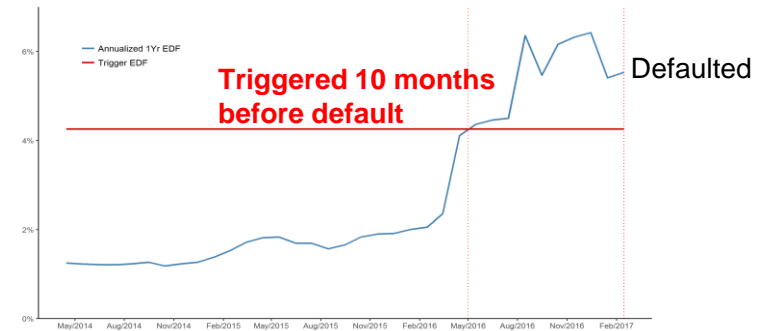
EWTK as a Solution

Five Risk Metrics



Two Additional Signals

Trigger EDF



Deterioration Propensity



EWTK as a Solution

MOODY'S ANALYTICS

Current Please log in. Lookbar 12 months Previous

REFRESH

Firm Type: Private Public

EDF Above Trigger Level: No Yes

TY IR: Aaa A1 A2 A3 Aa1 Aa2

TY EDF Change: Deteriorating Improving No Change

Relative EDF Change: Deteriorating Improving No Change

Region: Japan Australia & New Zealand Canada Chile Finland Germany Greece Italy Lithuania Mexico Mexico & South America Netherlands New Zealand

Industry: Agriculture BanksAndSL Business_Products CommHTech Construction Consumer_Durables Consumer_Products Consumer_Products MojoTrasLibili Pharmaceuticals

Rank	Firm Type	Firm Name	Exposure Amount	TY IR	CY TY AnnEDF	Deterioration Probability	TY EDF Change	Term Structure Inversion	Relative EDF	Relative EDF Change	LGD %	EL %
1	Private	EMM4	826,462.00	Caa-C	14.00%	20.28%	Deteriorating	No	Above 90th Pctl	No Change	45.00%	6.30%
2	Private	FIN5	15,613.00	Caa-C	11.65%	20.72%	Improving	Yes	Above 90th Pctl	No Change	45.00%	5.24%
3	Public	Bausch Health Companies Inc.	791,308.00	Ca	10.56%	22.42%	Improving	Yes	75th Pctl < 90th Pctl	Improving	57.26%	6.05%
4	Public	Avon Products, Inc.	727,755.00	Caa3	9.13%	20.05%	Deteriorating	Yes	Above 90th Pctl	No Change	60.85%	5.56%
5	Public	Lannet Company, Inc.	246,959.00	Caa3	8.57%	31.47%	Deteriorating	Yes	75th Pctl < 90th Pctl	Deteriorating	57.26%	4.91%
6	Private	EMM1	924,896.00	B3	6.68%	19.93%	Deteriorating	Yes	75th Pctl < 90th Pctl	No Change	45.00%	3.01%
7	Private	MEM4	18,970.00	B3	6.10%	19.57%	No Change	Yes	75th Pctl < 90th Pctl	No Change	45.00%	2.75%
8	Private	Test1	18,970.00	B3	6.10%	19.57%	No Change	Yes	75th Pctl < 90th Pctl	No Change	45.00%	2.75%
9	Private	Test2	18,970.00	B3	6.10%	19.57%	No Change	Yes	75th Pctl < 90th Pctl	No Change	45.00%	2.75%
10	Private	Test3	18,970.00	B3	6.10%	19.57%	No Change	Yes	75th Pctl < 90th Pctl	No Change	45.00%	2.75%
11	Private	RUS1	684,891.00	B2	5.26%	17.99%	Improving	Yes	50th Pctl < 75th Pctl	No Change	45.00%	2.37%
12	Private	RUS4	35,470.00	B2	3.84%	16.99%	No Change	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.73%
13	Private	JFN 3.2 #2	793,168.00	B2	3.78%	18.20%	Deteriorating	Yes	75th Pctl < 90th Pctl	No Change	45.00%	1.70%
14	Public	Revlon Consumer Products Corporation	364,844.00	Caa2	3.74%	23.43%	Deteriorating	Yes	50th Pctl < 75th Pctl	Improving	60.85%	2.27%
15	Private	German Private #1	164,831.00	B1	3.62%	17.86%	No Change	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.63%
16	Private	Italian v3.1 #3	930,161.00	B1	3.56%	18.17%	Improving	Yes	75th Pctl < 90th Pctl	Improving	45.00%	1.60%
17	Private	MEX1	1,598,198.00	B1	3.56%	16.95%	Improving	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.60%
18	Private	German Private #2	673,776.00	B1	3.37%	17.66%	Deteriorating	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.52%
19	Private	RUS3	94,890.00	B1	3.32%	16.09%	Improving	No	50th Pctl < 75th Pctl	No Change	45.00%	1.49%
20	Private	EMM5	734,291.00	B1	3.05%	16.56%	Deteriorating	No	50th Pctl < 75th Pctl	Deteriorating	45.00%	1.37%
21	Public	AMAG Pharmaceuticals, Inc.	176,127.00	Caa2	2.97%	36.22%	Improving	No	50th Pctl < 75th Pctl	Improving	57.26%	1.70%
22	Private	Italian v3.1 #4	549,481.00	B1	2.94%	17.95%	No Change	Yes	75th Pctl < 90th Pctl	No Change	45.00%	1.32%
23	Private	EMM6	762,934.00	B1	2.91%	15.89%	Deteriorating	No	50th Pctl < 75th Pctl	No Change	45.00%	1.31%
24	Private	Netherlands 2	675,862.00	B1	2.88%	17.84%	No Change	No	75th Pctl < 90th Pctl	No Change	45.00%	1.30%
25	Private	JFN 3.2 #3	567,042.00	B1	2.75%	17.43%	No Change	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.24%
26	Private	MEX3	18,916.00	Ba3	2.38%	15.44%	Improving	Yes	25th Pctl < 50th Pctl	Improving	45.00%	1.08%
27	Private	JFN 3.2 #1	71,359.00	Ba3	2.28%	16.95%	Deteriorating	Yes	50th Pctl < 75th Pctl	No Change	45.00%	1.03%
28	Private	EMM2	965,041.00	Ba3	2.05%	14.41%	Improving	No	25th Pctl < 50th Pctl	No Change	45.00%	0.92%
29	Private	Netherlands 1	959,244.00	Ba3	2.01%	17.25%	Deteriorating	Yes	75th Pctl < 90th Pctl	No Change	45.00%	0.90%
30	Private	UK 4.0 Test #2	920,688.00	Ba3	1.86%	15.90%	No Change	No	50th Pctl < 75th Pctl	No Change	45.00%	0.84%

EWTK in Practice

- » Company X manufactured kitchen cabinets and bathroom vanities in Washington.
- » Beginning in 2014, the company suffered from a significant decrease in sales and, at the same time, a sharp increase in current liabilities.
- » The company eventually defaulted in March 2017.

EWTK captured credit deterioration signals as early as April 2015

EWTK in Practice

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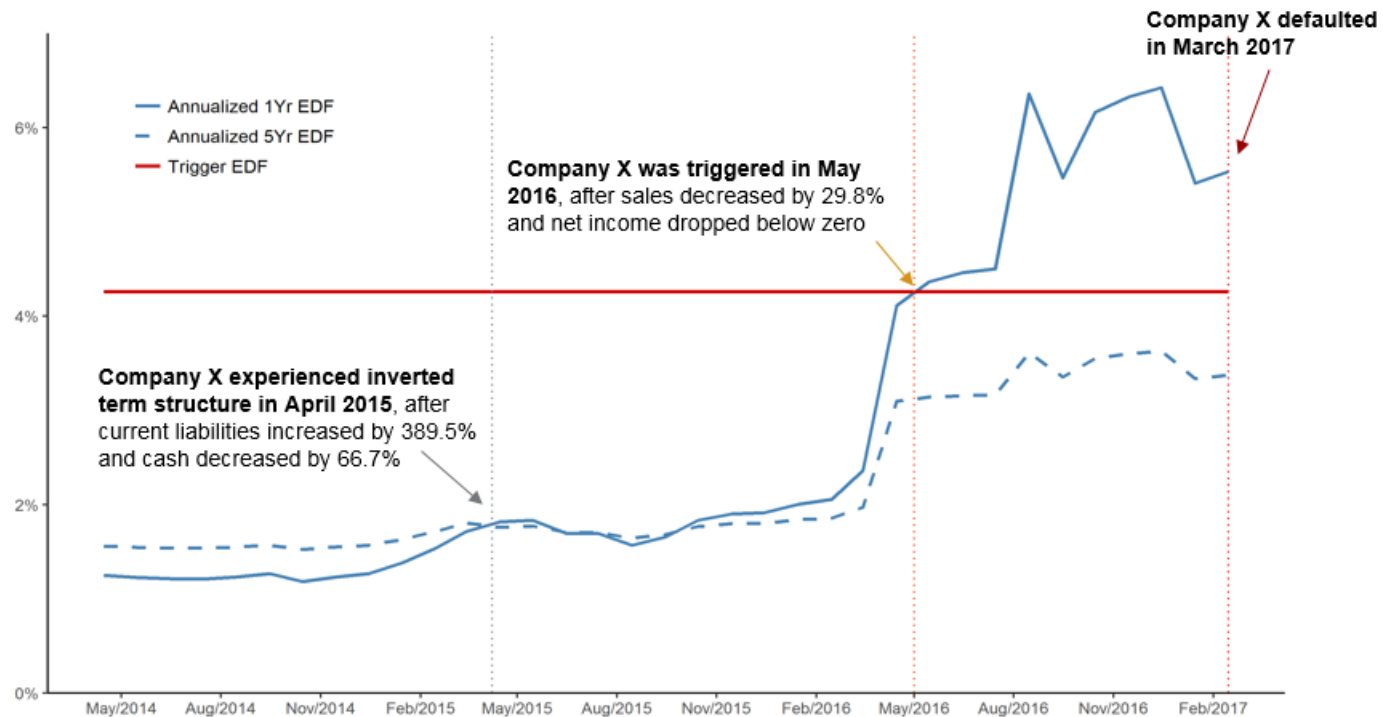
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- » The company's one-year EDF continued rising beginning 2014, ranking above the 85th percentile among its peers before default.
- » The company exhibited inverted term structure starting April 2015.
- » The company's EDF rose above trigger level in May 2016 after a significant decrease in sales and net income.

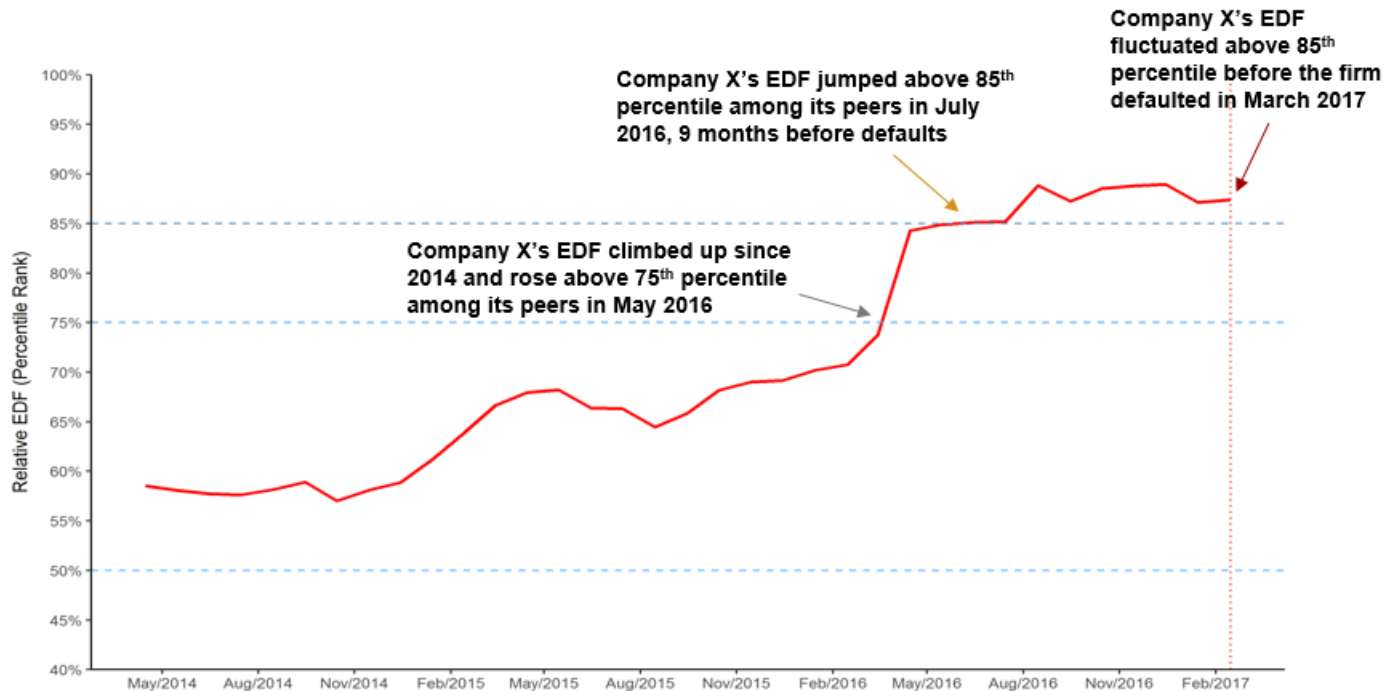
EDF Measure Soared with Deteriorating Financial Conditions

Company X's EDF measure trended upward beginning in 2014, rising from 1.25% at the beginning of 2014 to 5.45% just before default.



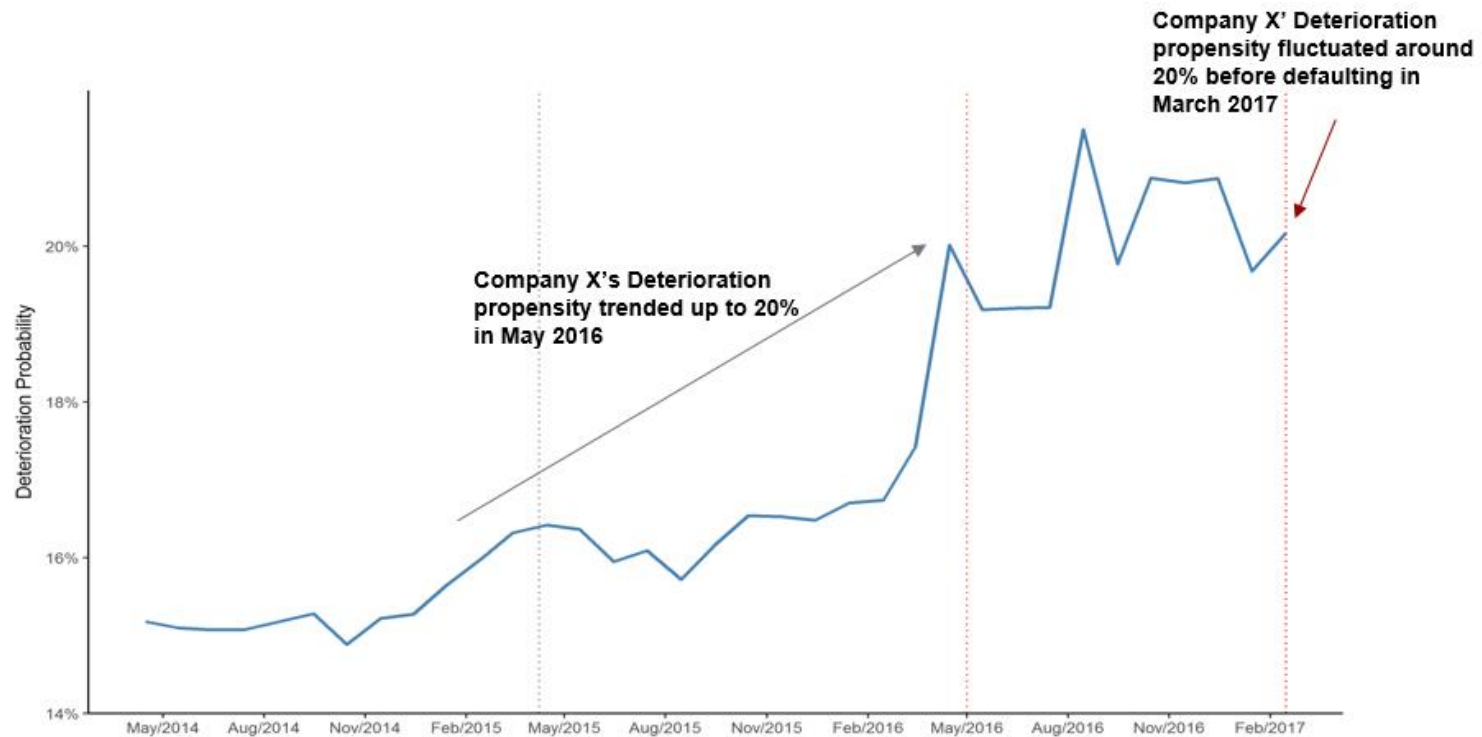
EDF Measure Rose above the 85th Percentile of Peers Before Default

Company X's relative EDF (percentile ranking among its peers) measure rose from the 60th percentile at the beginning of 2014 to above the 85th percentile just before default.



Steady Increase in Deterioration Propensity Before Default

Company X's deterioration propensity increased from 15% at the beginning of 2014 to more than 20% just before default.

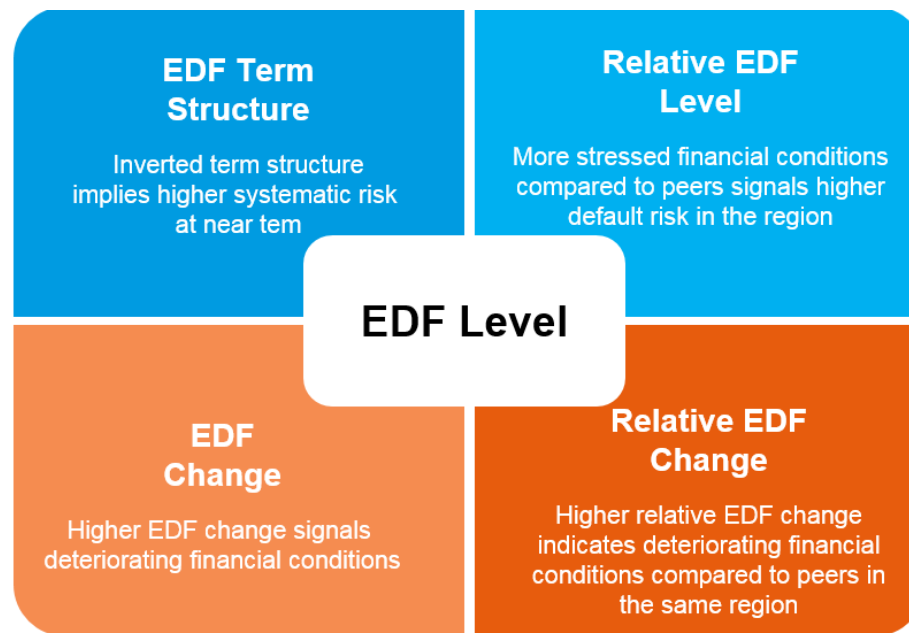


2

Dive into
Five Risk Metrics

EWTK Incorporates Four Additional Risk Metrics Besides EDF Level

- » RiskCalc generates accurate and forward-looking EDF (Expected Default Frequency) measures. The higher the credit risk, the higher the EDF measure.
- » In addition to RiskCalc EDF, we incorporate four other risk metrics that complement EDF and help to identify at-risk names with similar EDF levels.



Relative EDF, EDF Change, Relative EDF Change

- » **Relative EDF — EDF percentile ranking of the company relative to its peers**
 - The higher the percentile, the higher the company's credit risk compared to its peers.
- » **EDF change**
 - A sharp increase in EDF measure signals deteriorating financial conditions.
- » **Relative EDF change**
 - A sharp increase in relative EDF signals deteriorating financial conditions compared to the company's peers.

EDF Term Structure

RiskCalc produces annualized EDF measures from one-year to five-year horizons.

» **Short-term EDF vs. Long-term EDF Measures**

- Short-term EDF fluctuates more compared to long-term EDF measure
- Short-term EDF captures more systematic risk in the market
- Long-term EDF reflects more firm-specific credit risk

» **EDF Term structure**

- We generally expect upward term structure, where annualized, long-term EDF is higher than short-term EDF during expansionary periods, and downward term structure during recessionary periods
- An inverted term structure, where short-term EDF surpasses long-term EDF, indicates rising systematic risk in near-term

3

Two Additional
Signals

Two Additional Signals

Trigger EDF and Deterioration Propensity

The Early Warning Toolkit helps enhance internal credit monitoring processes by providing clients with two additional signals:

» **Trigger EDF**

At which EDF level, should we start managing down the exposure?

- EWTK computes Trigger EDF based on spread and LGD information to help clients control for economic losses.

» **Deterioration Propensity**

How do we identify a borrower whose credit risk is important and increasing?

- EWTK aggregates five risk metrics into one additional Deterioration Propensity signal to help clients identify at-risk names.

Economic Value of a Trigger

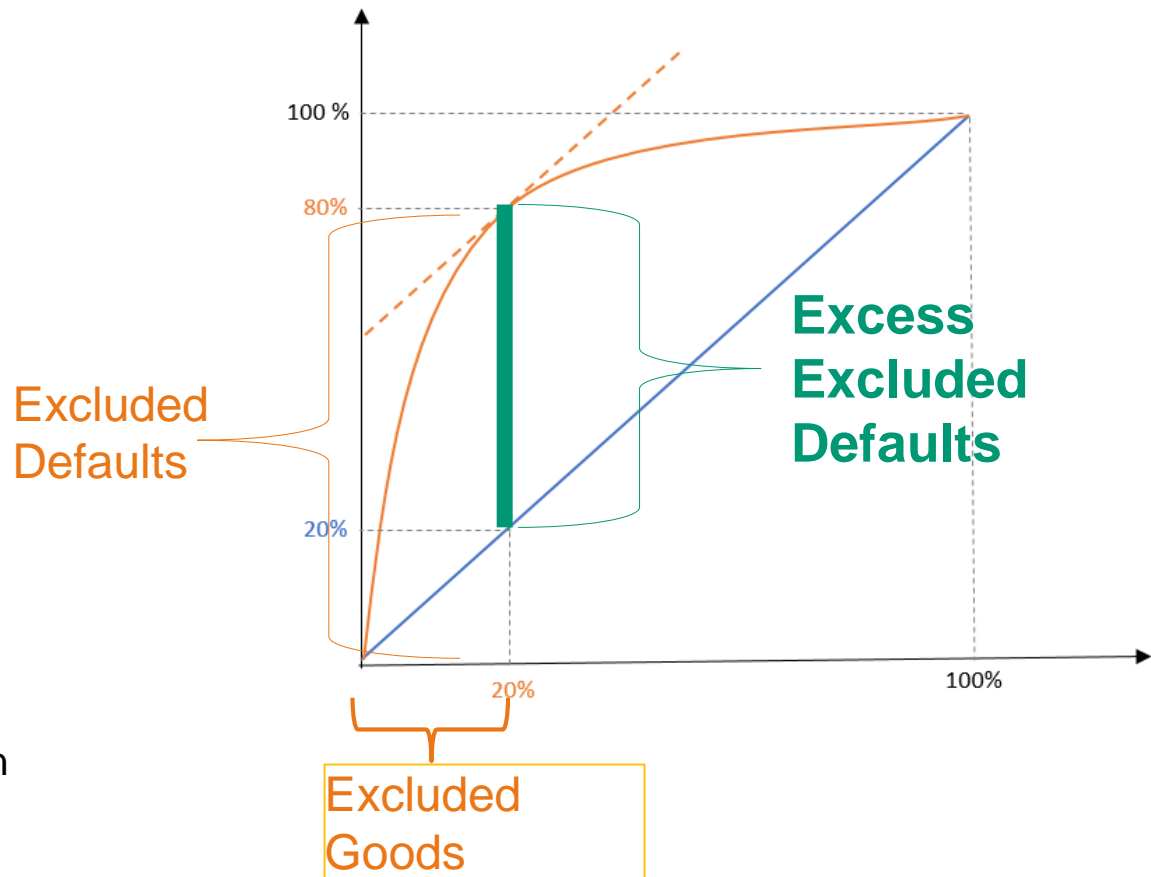
Given a portfolio, if in average, the expected income equals to the expected loss - i.e.,

$$\text{Spread} * (1 - \text{CDT}) = \text{LGD} * \text{CDT},$$

Then, we can show that the **Optimal Trigger** is the one which **maximizes the “Excess Excluded Defaults.”**

In this example, the optimal trigger excludes 20% of the goods but 80% of defaults — the excess defaults are 60%. Consequently, the trigger’s economic benefit is $\text{LGD} * \text{CDT} * 0.6$ per dollar lent.

For a \$1 billion dollar portfolio with a 2% CDT and a 50% LGD, this results in a savings of \$6mm!



LGD is “Loss Given Default,” and CDT is the “Central Default Tendency,” which represents the average default rate of the portfolio.

Trigger EDF — Methodology

The Trigger EDF is the **break-even risk level**, where lenders may start from when reviewing loan terms or managing exposure to avoid economic loss.

» Theory

Given spread and LGD, the maximum level of default risk (EDF) a lender can bear satisfies:

$$\begin{aligned} \textit{Expected Income} &= \textit{Expected Loss} \\ (1 - \mathbf{EDF}) * \mathbf{Spread} &= \mathbf{EDF} * \mathbf{LGD} \end{aligned}$$

This break-even EDF is the Trigger EDF.

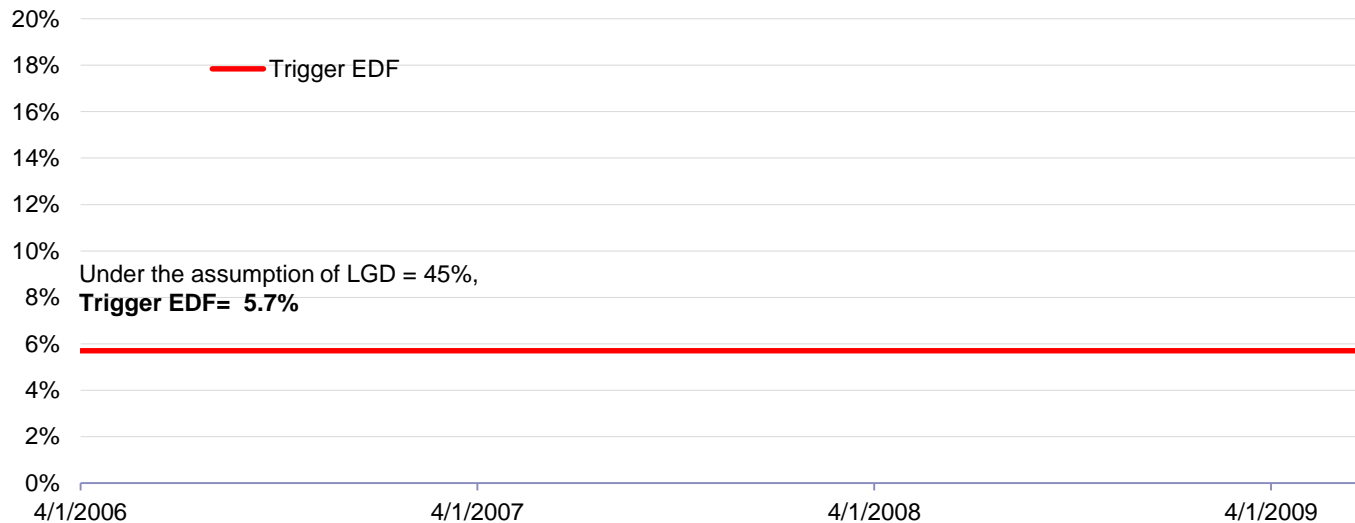
» Properties

Within the toolkit, clients can either

- Input their own spread and LGD information
- Use prepopulated spread and LGD based on Moody's CRD database

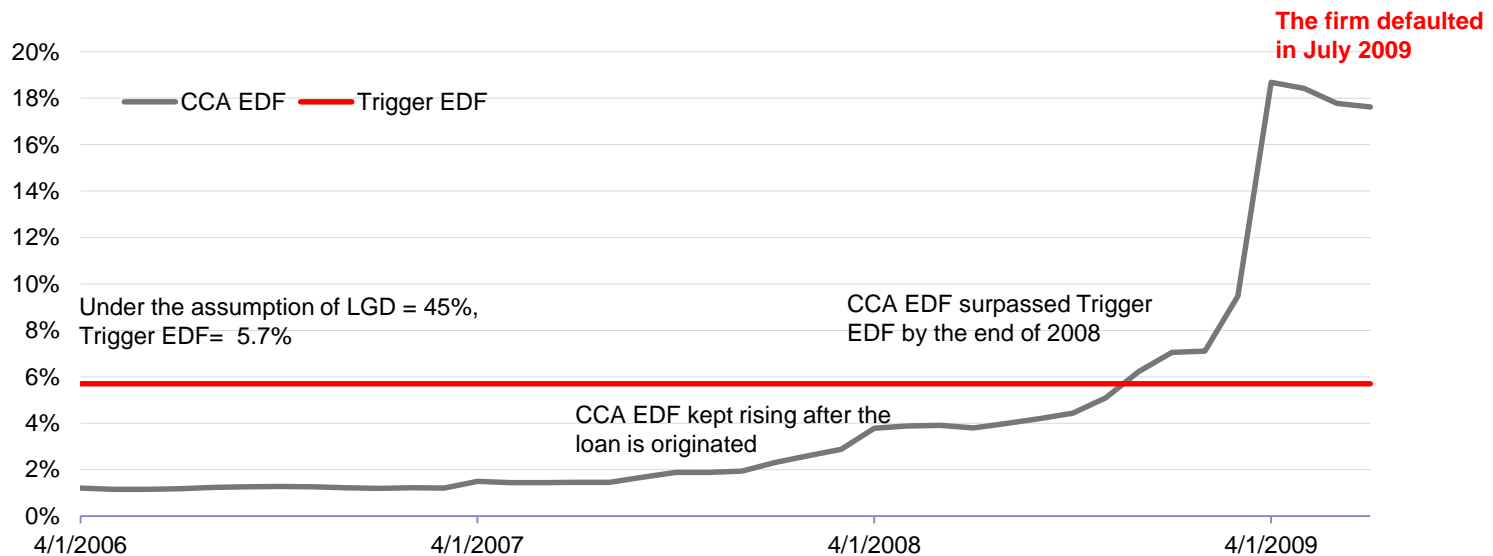
Trigger EDF — Example

Bank X issues a 20-year term loan in 2006 with a 2.7% spread over the five-year LIBOR to a retail firm in mountain states. The spread rate remains the same since origination.



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Deterioration Propensity — Methodology

» Objective

An additional signal aggregating information in five risk metrics

» Challenges

- The additional signal is designed to remain consistent with the deterioration probability measure in the public EWTK, which predicts downgrade events of rated firms.
- Private firms are usually not rated.
- The lack of rating history eventually reduces model power for private firms.
- EWTK risk metrics are all EDF related, thus correlated.

» Solution

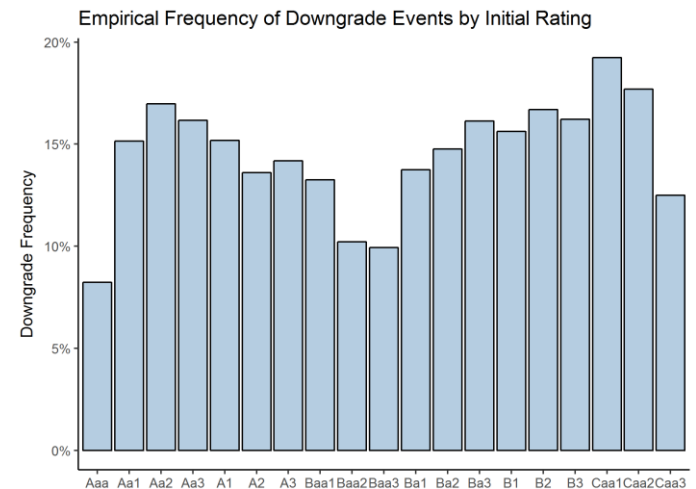
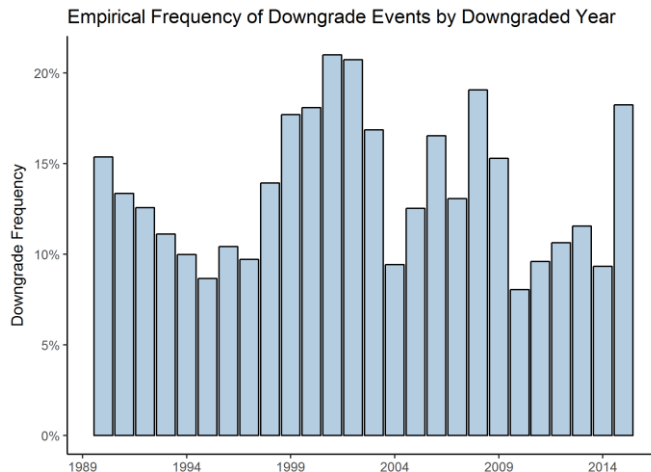
- Construct a sample of rated firms worldwide and compute EWTK risk metrics.
- Apply PCA analysis on the sample and extract first principal component.
- Estimate a logistical model for downgrade events with first PC.

Deterioration Propensity — Development

» Data Description

Development population is Moody's rated companies from various countries.

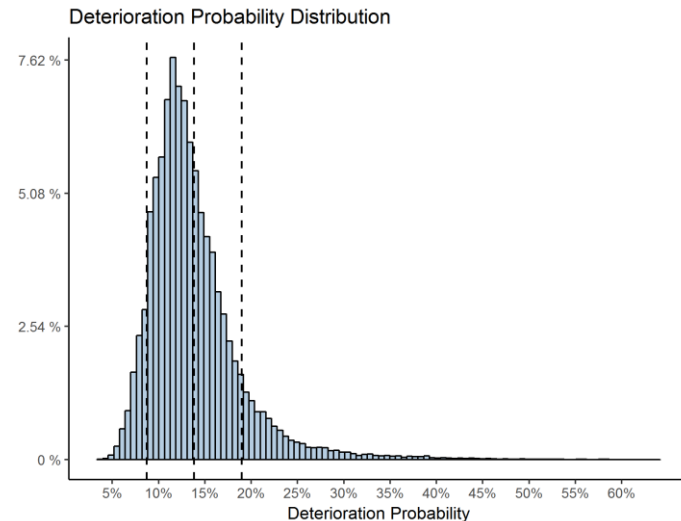
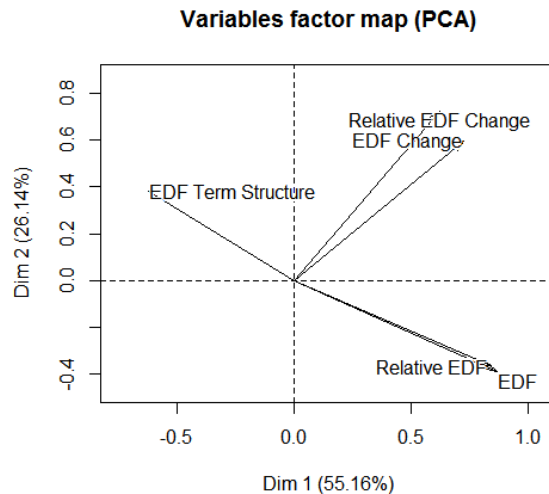
# Unique Countries	# Unique Borrowers	# Observations	# Downgrade Events	Time Period
65	4,488	39,391	5,446	1989 - 2014



Deterioration Propensity — Development

» Development Results

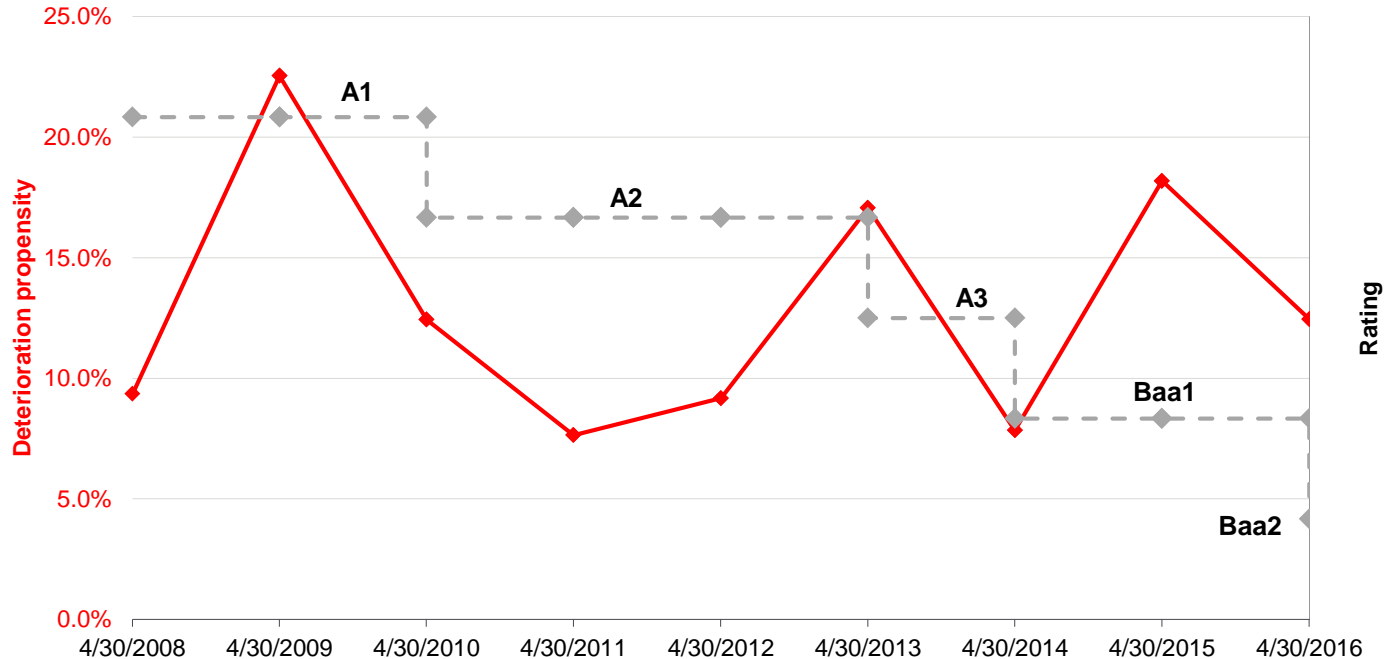
- PCA analysis shows that 1) EWTK risk metrics are highly correlated, and 2) more than 50% of data variance is explained by first PC.
- Logistical Regression on PCs shows that only the first PC has a significant impact on downgrade probability.
- Model AR is 23.25%, which is relatively low, as expected.



Deterioration Propensity — Example

Company X, an Austrian energy company, downgraded multiple times since 2008 due to deteriorating financial condition.

Deterioration propensity peaked one year before downgrade events occurred.



4

Conclusions

Conclusions

RiskCalc generates accurate and forward-looking EDF (Expected Default Frequency) measures for private companies.

The Early Warning Toolkit leverages RiskCalc results and helps clients identify at-risk names by providing:

- » **Five risk metrics:** EDF, Relative EDF, EDF change, Relative EDF change, and EDF term structure
- » **Two additional signals:** EDF Trigger and Deterioration Propensity

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