

Tracking the Impact of COVID-19 on Credit Risk



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Overview

- » The COVID-19 pandemic has been a major risk driver across the globe in 2020.
- » Financial institutions need to re-assess expected losses while portfolio managers need to adjust exposures.
- » The Moody's Analytics Expected Default Frequency (EDF™) measures reflect the current state of the credit cycles and are shown to be responsive.
- » We observed a sharp increase followed by a significant pull-back in expected losses for [public and private companies](#) in the United States.

Agenda

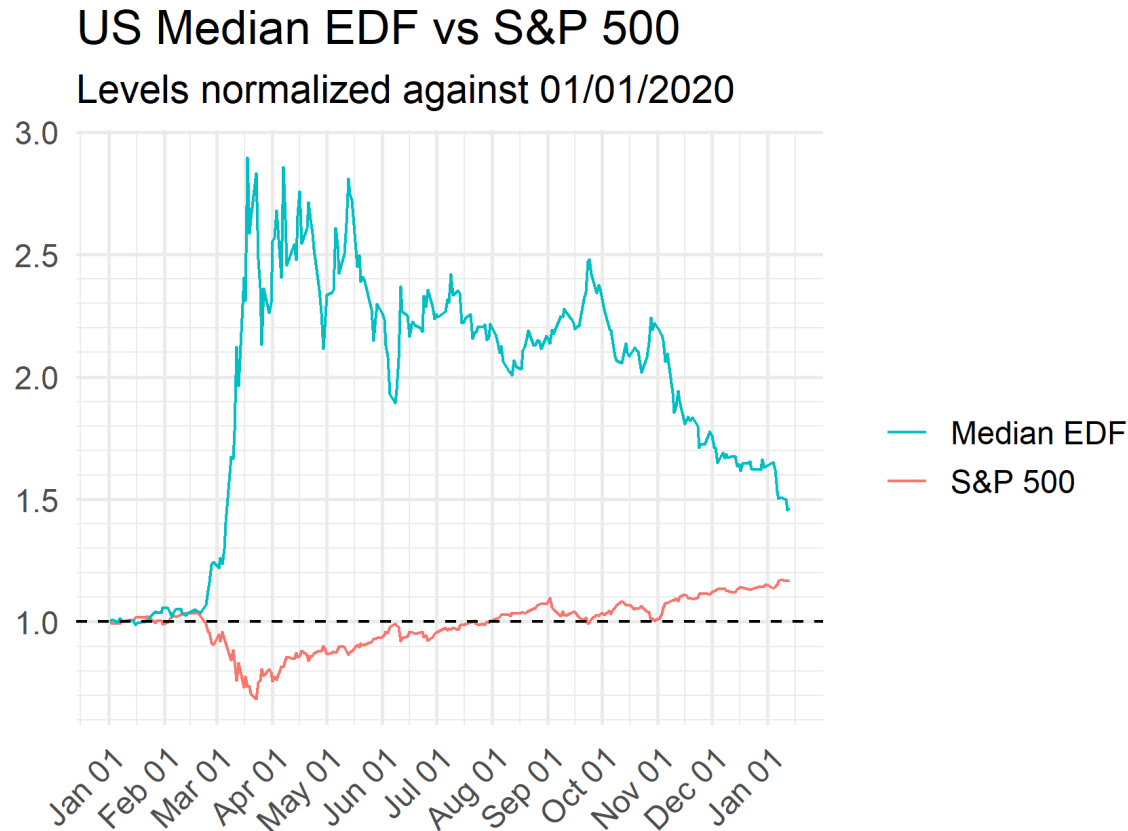
1. Public Firm EDFs respond globally to stock market turbulence
 - Overall Risk Assessments
 - Industry Analysis and Case Study
 - Implications for Expected Loss
 - Summary
2. Private Firm EDFs respond to increasing Public Firm EDFs
 - Impact by Sector for US Corporates and Large Firms
 - Implications for Expected Loss
 - Case Study
3. Summary

1.1

Overall Risk Assessments

** Compiled with data up to January 13th, 2021*

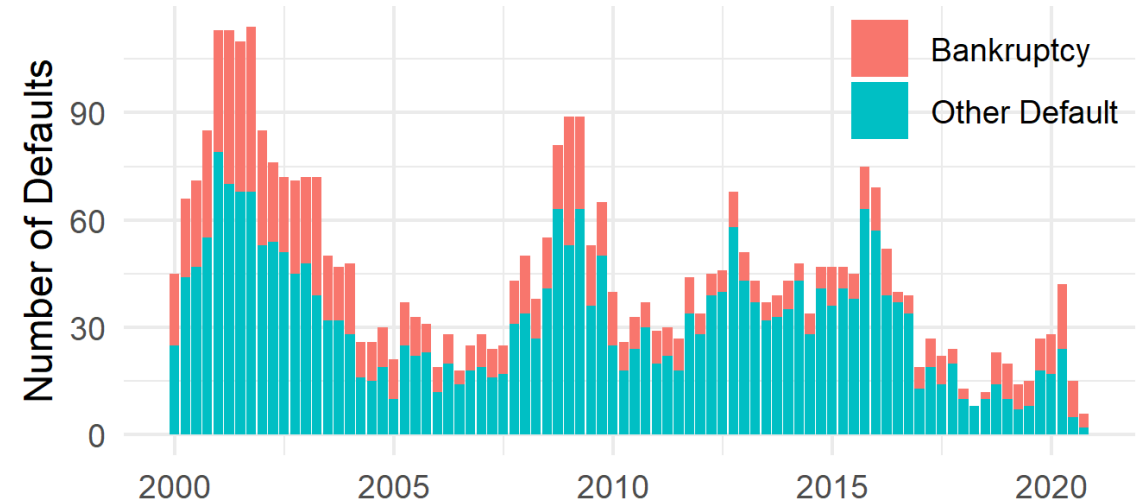
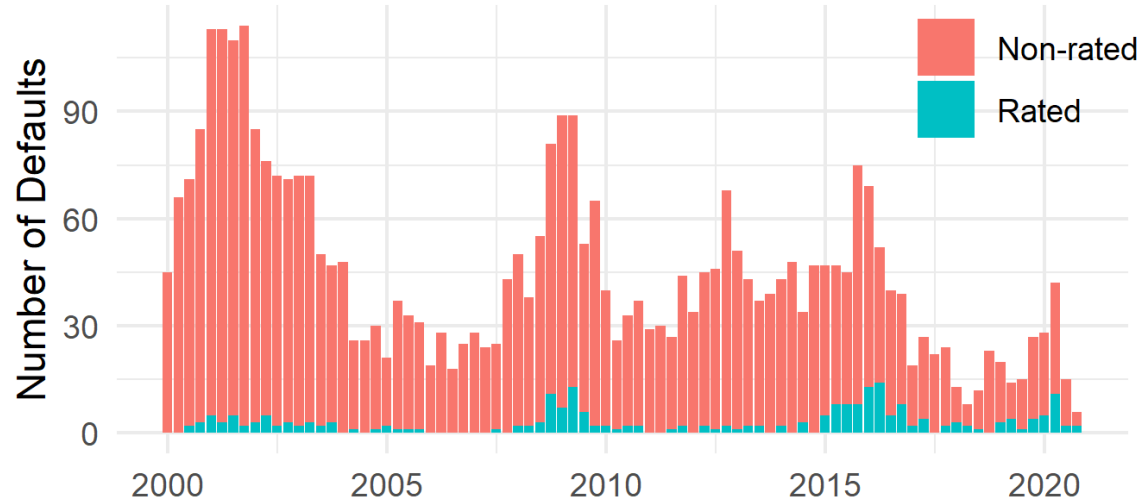
EDF Measures vs. Stock Market Signals



- » With equity price as a key input, the model responds to the market movement in real time, translating the market signal to credit risk metrics.
- » The breadth and depth of the Moody's Analytics CreditEdge™ coverage, together with the daily update of EDF values, makes the model a very capable tool to monitor and manage the credit risk of their exposure.

Number of Collected Defaults

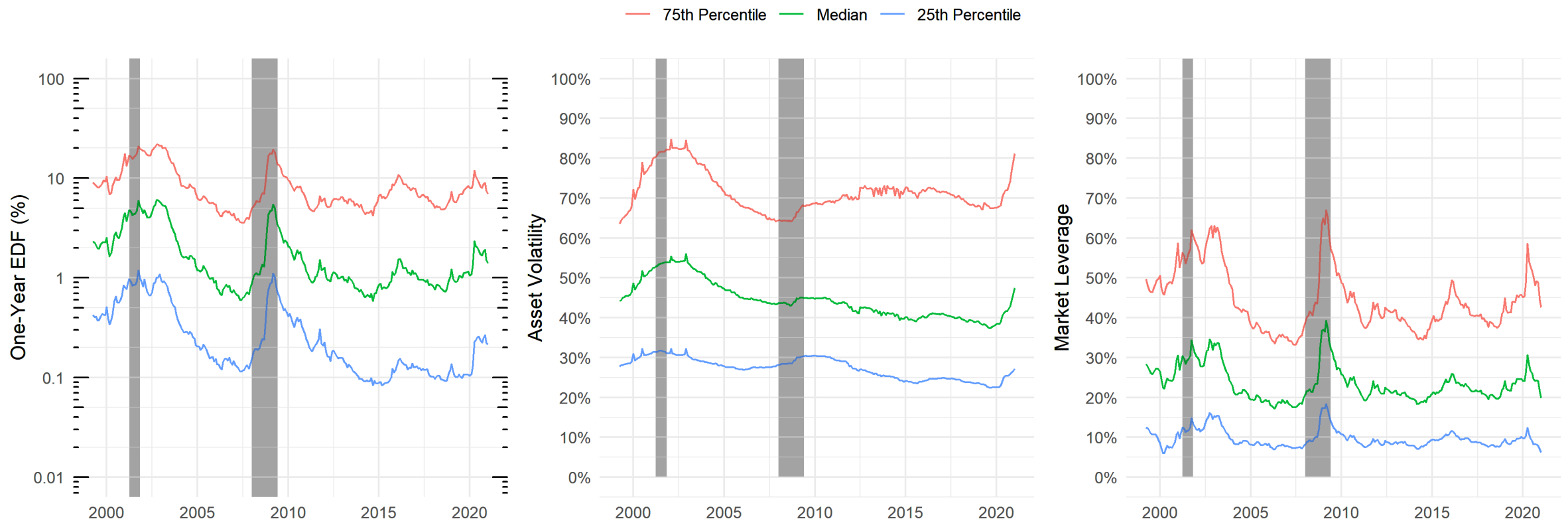
Default counts remained moderate throughout 2020



* Charts showing default counts for North American corporates

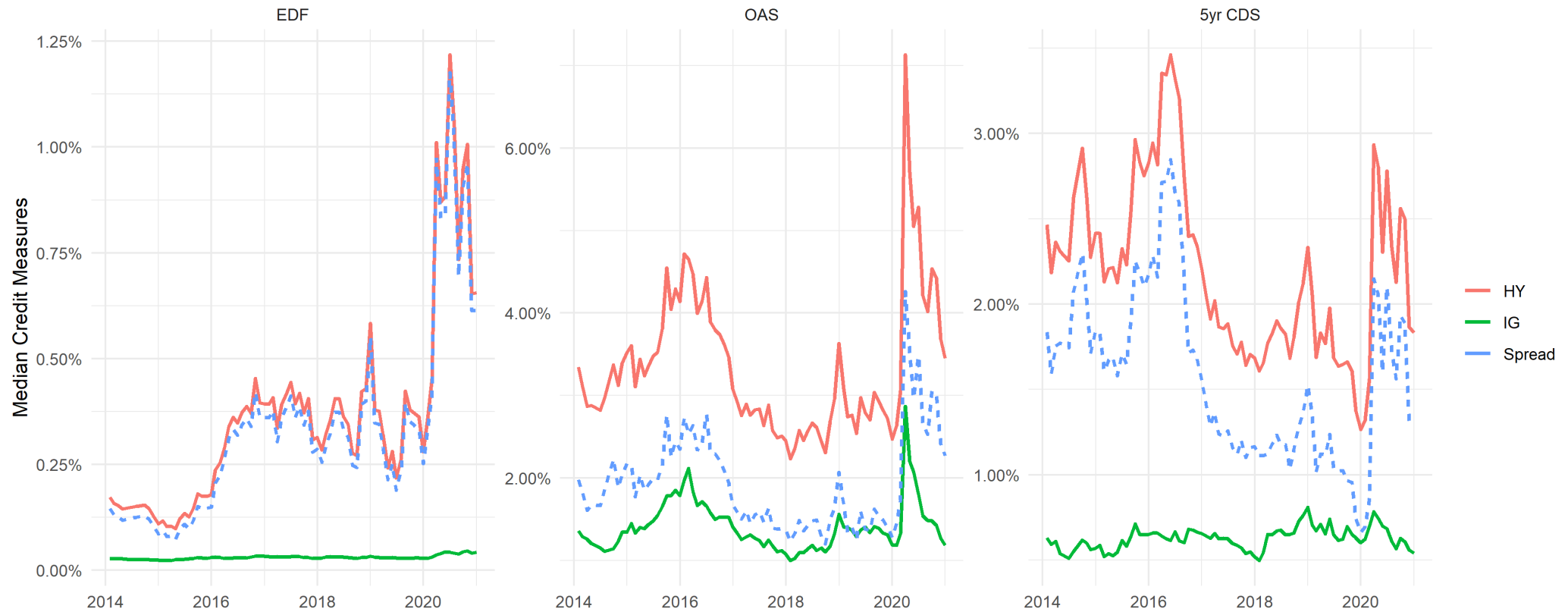
EDF Levels and Drivers in NA Corporates

EDF levels have retreated from the highs in March with the recovery in market leverage, while volatility stays elevated.



EDF Levels vs. OAS and 5-year CDS

The spread between HY and IG is still at multi-year high.



Market Price of Risk Movement in 2020

Inverted V shape with high short-term volatility.

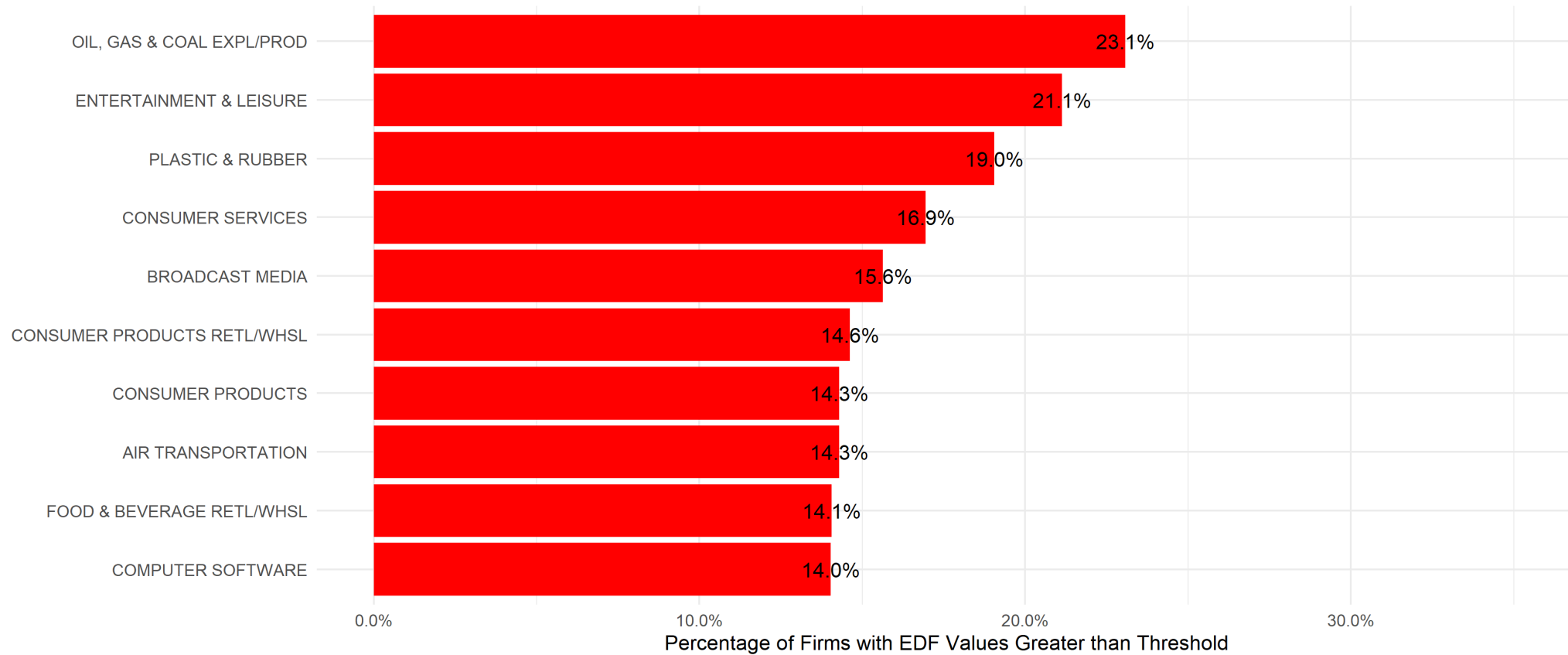


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Industry Analysis &
Case Study

Riskiest Industry in the US (December 2020)

Ranked by percentage of firms with EDF values greater than threshold

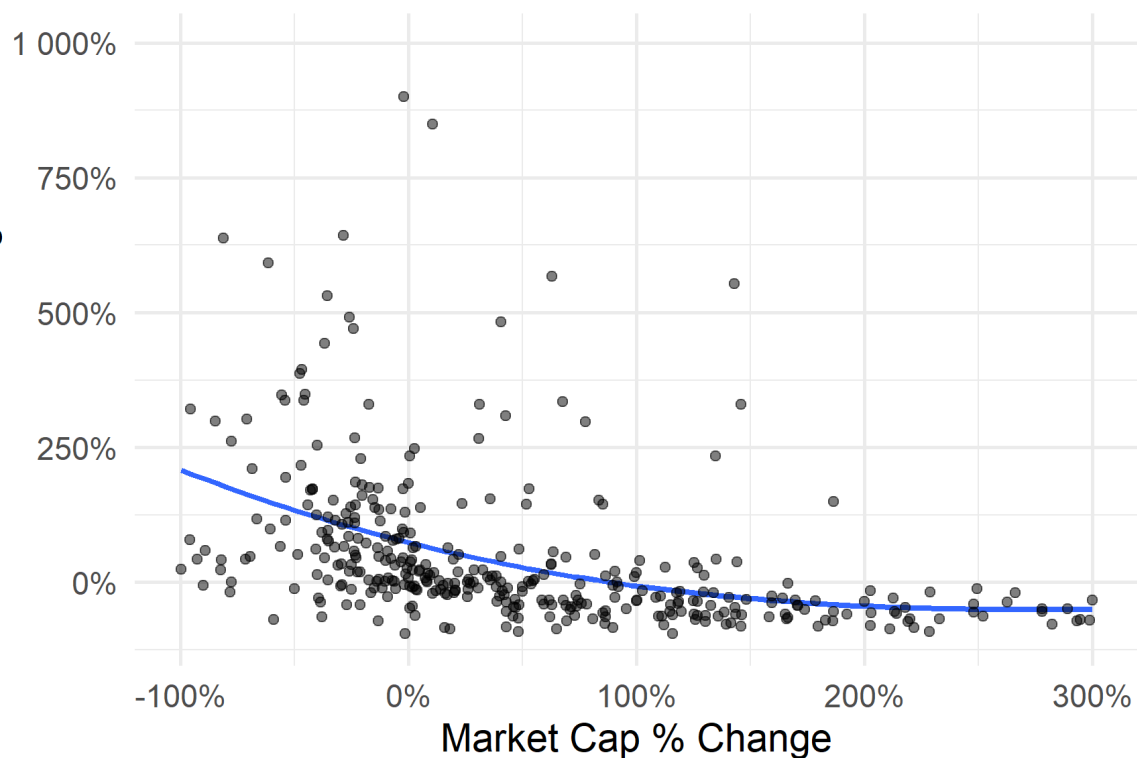


Case Study

Pharmaceutical Industry

EDF Change vs Market Cap Change

US PHARMACEUTICALS



Pharmaceuticals Industry Top 15 EDF Change

PID	Name	1/1/2020	1/13/2021	EDF % Change	Mktcap % Change
B00443	BIOVIE, INC.	26.35	0.20	-99.25%	2040.88%
B00611	COGENT BIOSCIENCES, INC.	16.59	0.12	-99.25%	3322.67%
N22399	MYOS RENS TECHNOLOGY, INC.	3.37	0.05	-98.38%	4110.84%
N25766	HISTOGENICS CORP.	30.94	0.65	-97.89%	4767.40%
N02070	NOVAVAX, INC.	32.57	0.94	-97.11%	7495.63%
N25180	ZAFGEN, INC.	10.36	0.37	-96.40%	625.51%
B03197	FREQUENCY THERAPEUTICS, INC.	4.39	0.18	-95.87%	115.79%
N14272	CELLDEX THERAPEUTICS, INC.	7.27	0.31	-95.77%	1831.60%
N05234	GEOVAX LABS, INC.	36.32	1.65	-95.45%	9987.55%
B01758	GENPREX, INC.	3.05	0.14	-95.40%	2623.84%
N26218	SERES THERAPEUTICS, INC.	4.28	0.23	-94.73%	876.93%
N25852	TRACON PHARMACEUTICALS, INC.	25.44	1.58	-93.80%	2065.61%
N20787	IBIO, INC.	32.07	1.99	-93.80%	3780.23%
B05974	GLUCOSE HEALTH, INC.	8.82	0.59	-93.27%	5045.03%
N24117	ONCONOVA THERAPEUTICS, INC.	32.21	2.20	-93.17%	5203.38%

Case Study

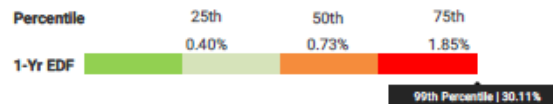
Hertz Global Holdings, Inc. (428040)

On May 22, 2020, Hertz Global Holdings Inc., a US-based car rental company, filed for bankruptcy, after it failed to get another extension from the lenders. In April, company defaulted on the interest payment and got extension from the creditors till May. The coronavirus pandemic suddenly diminished demand for the company's car rental business.

HERTZ GLOBAL HOLDINGS, INC.

PID: 428040
CUSIP: 42806J
ISIN: US42806J1060
COUNTRY: UNITED STATES

BENCHMARK GROUP: GLOBAL LESSORS GROUP



30.11% As of Dec 08, 2020 1-Yr EDF	+28.95% 1-Yr EDF 1 Year Change	C As of Dec 08, 2020 Implied Rating	N/A Not Available Moody's SRA Rating
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* Amounts are in USD

Key Financial Metrics*

Total Sales	9,779.00M
Total Book Assets	24,627.00M
EBITDA	3,753.00M
EBITDA Margin	38.38%
Debt to Assets	76.90%

* As of Dec 31, 2019 - Currency: USD

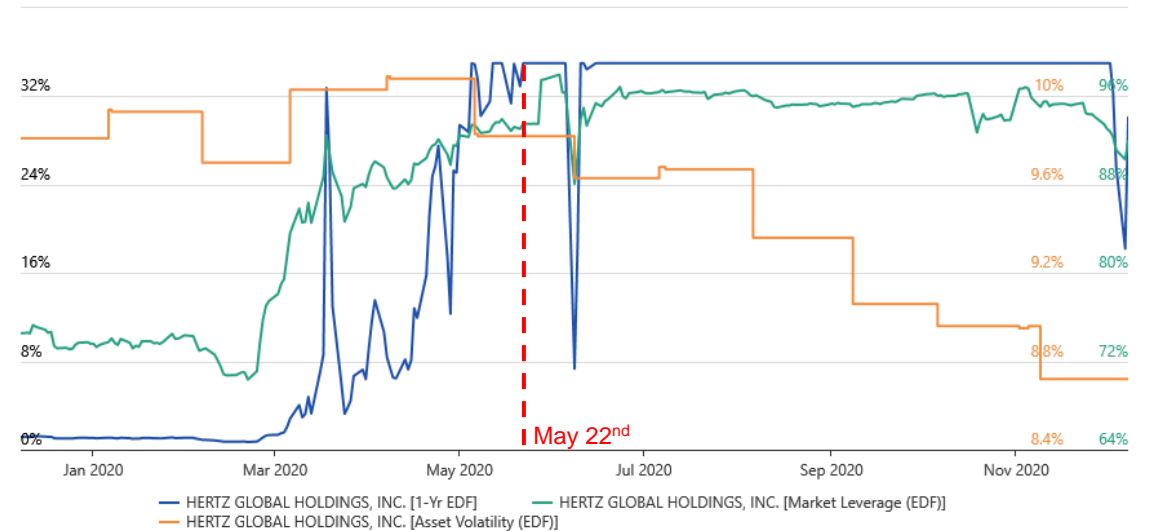
Industry & Sector

Moody's Analytics Industry	LESSORS
Sector	Finance Cos. / Brokers & Dealers

Market Data**

Market Capitalization	313.98M
Share Price	2.01

** As of 12/8/2020 - Currency: USD



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* Source: Hertz in talks with creditors to avoid debt default, faces May 4 deadline, Reuters, April 30, 2020

1.3

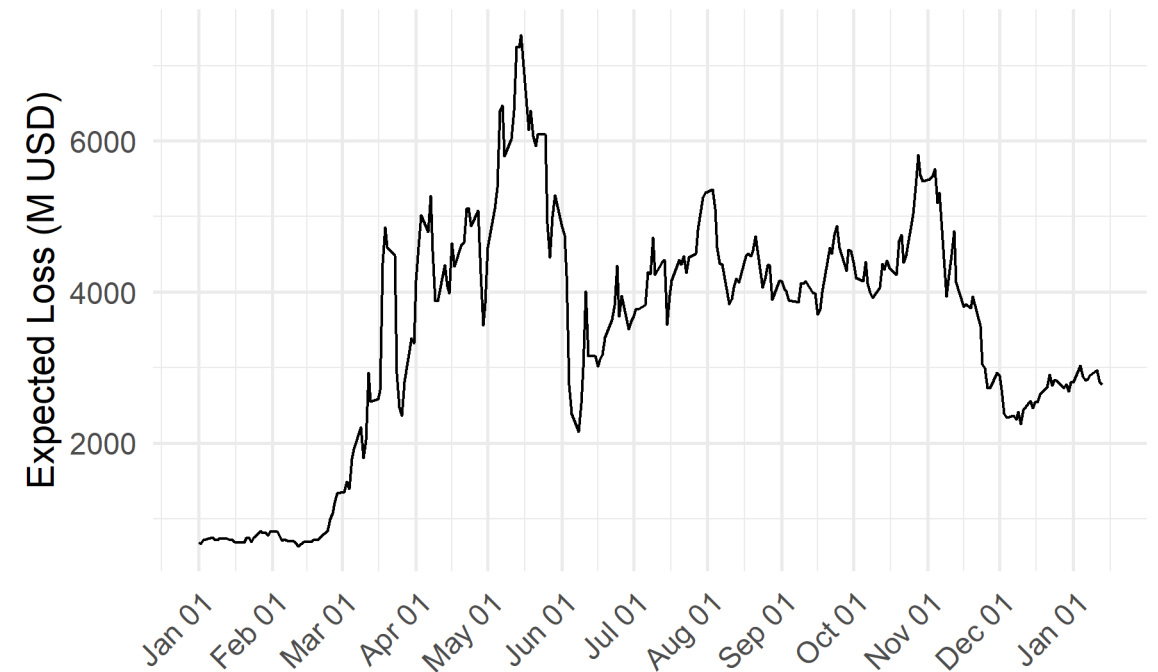
Implications on Credit Loss

Expected Loss

A Volatile Year for US Air Transportation

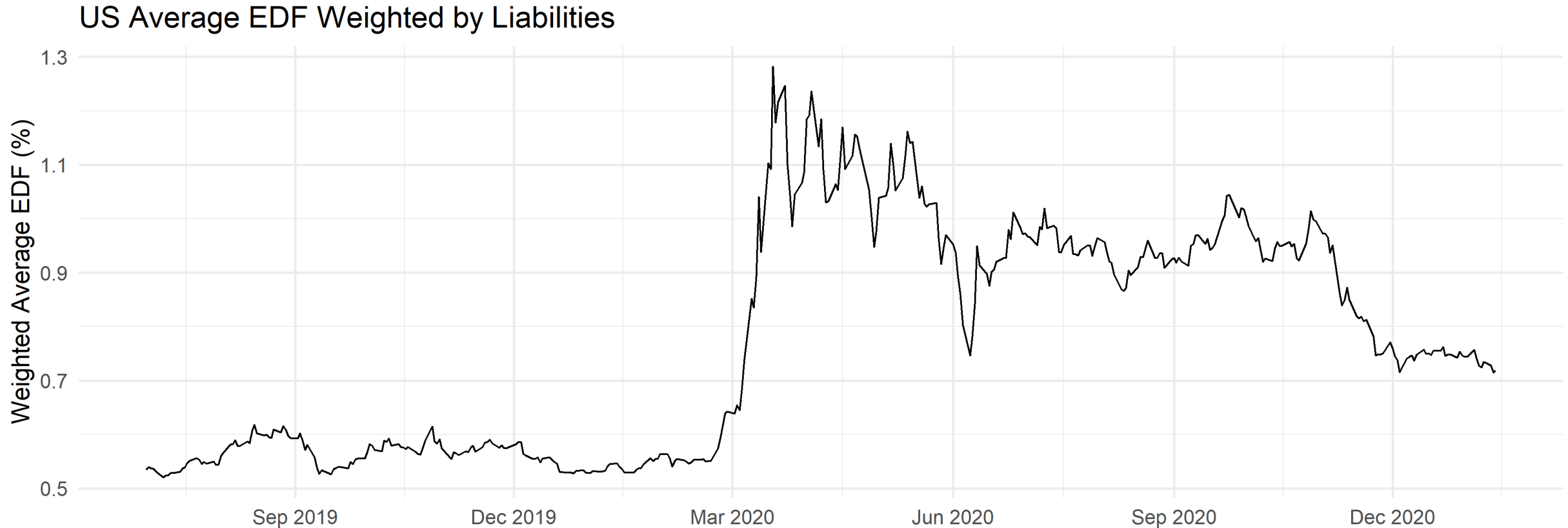
PID	Name	1/1/2020			1/13/2021		
		Total Liability (M USD)	EDF (%)	EL (M USD)	Total Liability (M USD)	EDF (%)	EL (M USD)
001765	AMERICAN AIRLINES GROUP, INC.	\$ 61,015	0.92	\$ 394.64	\$ 68,301	2.69	\$ 1,284.25
313309	FEDEX CORP.	\$ 48,223	0.09	\$ 29.75	\$ 52,080	0.07	\$ 27.32
247361	DELTA AIR LINES, INC.	\$ 46,906	0.05	\$ 17.55	\$ 52,927	0.52	\$ 191.10
902549	UNITED AIRLINES HOLDINGS, INC.	\$ 39,304	0.07	\$ 18.44	\$ 53,797	1.93	\$ 727.94
844741	SOUTHWEST AIRLINES CO.	\$ 13,893	0.04	\$ 4.09	\$ 24,012	0.20	\$ 33.87
011659	ALASKA AIR GROUP, INC.	\$ 8,023	0.13	\$ 7.28	\$ 10,796	0.82	\$ 61.62
N08526	JETBLUE AIRWAYS CORP.	\$ 5,356	0.11	\$ 4.07	\$ 8,624	1.34	\$ 80.96
N20700	SPIRIT AIRLINES, INC.	\$ 3,948	0.62	\$ 17.23	\$ 4,907	2.45	\$ 84.18
830879	SKY WEST, INC.	\$ 3,885	0.20	\$ 5.31	\$ 3,935	1.12	\$ 30.78
N01412	ATLAS AIR WORLDWIDE HOLDINGS, INC.	\$ 3,589	3.79	\$ 95.33	\$ 3,659	1.21	\$ 31.07
N10766	MACQUARIE INFRASTRUCTURE CORP.	\$ 3,376	0.03	\$ 0.80	\$ 4,058	0.67	\$ 19.02
N01376	HAWAIIAN HOLDINGS, INC.	\$ 2,739	1.90	\$ 36.47	\$ 3,138	4.35	\$ 95.52
N09738	AIR TRANSPORT SERVICES GROUP, INC.	\$ 2,139	0.66	\$ 9.93	\$ 2,101	0.46	\$ 6.76
N24633	FORTRESS TRANSPORTATION & INFRASTRUCTURE	\$ 2,029	0.08	\$ 1.19	\$ 2,174	0.23	\$ 3.52
N12001	ALLEGiant TRAVEL CO.	\$ 1,796	0.12	\$ 1.57	\$ 2,219	0.38	\$ 5.89
590481	MESA AIR GROUP, INC.	\$ 971	4.28	\$ 29.08	\$ 980	7.57	\$ 51.94
N21932	ERA GROUP, INC.	\$ 202	0.88	\$ 1.25	\$ 1,145	3.08	\$ 24.66
009224	AIR T, INC.	\$ 109	3.08	\$ 2.34	\$ 122	4.25	\$ 3.64
N02553	EXELED HOLDINGS, INC.	\$ 22	29.84	\$ 4.64	\$ 22	28.36	\$ 4.41
B08151	STAR JETS INTERNATIONAL, INC.	\$ 2	34.04	\$ 0.53	\$ 3	31.63	\$ 0.62
Total		\$ 247,527		\$ 681.49	\$ 299,001		\$ 2,769.08
Loss Rate				0.28%			0.93%

Expected Loss USA AIR TRANSPORTATION
Assuming 70% LGD



US Liability-Weighted EDF

Liability-weighted average EDF has gone from doubled to almost recovered.



US Liability-Weighted EDF

Liability-weighted average EDF has gone from doubled to almost recovered.

US Average EDF Weighted by Liabilities



US Liability-Weighted EDF

The recent spike is still dwarfed by the level seen in the financial crisis.



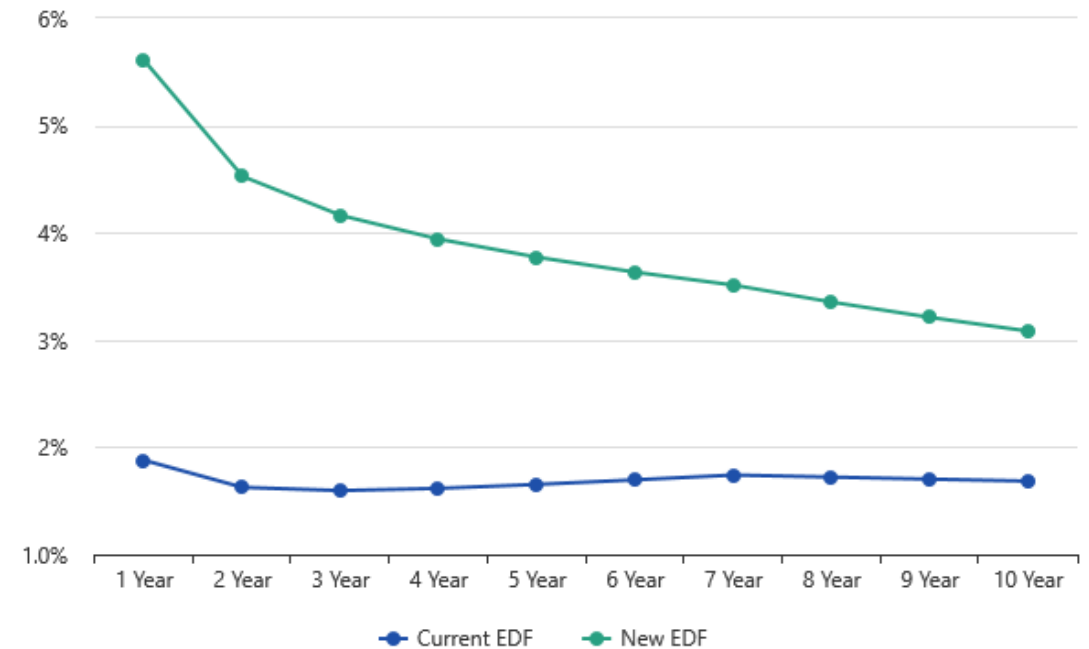
What-if Analysis

What happens to United Airlines' EDF if volatility is back to all-time high?

Drivers & Market Data All amounts are in millions (except for Share Price) Auto-Refresh Market Data Overrides Daily

Driver	Current	Override	Change	% Change
Asset Volatility	13.18%	<input type="text" value="17.15%"/>	3.97%	30.16%
Market Leverage	71.20%	<input type="text" value="74.61%"/>	3.41%	4.79%
Market Value of Assets	38,679.70	<input type="text" value="36,912.54"/>	-1,767.16	-4.57%
Market Capitalization	6,074.80	<input type="text" value="6,074.80"/>	0.00	0.00%
Share Price	24.50	<input type="text" value="24.50"/>	0.00	0.00%
Shares Outstanding	247.95	<input type="text" value="247.95"/>	0.00	0.00%
Default Point	27,540.80	<input type="text" value="27,540.80"/>	0.00	0.00%
Short-Term Liabilities	14,938.00	<input type="text" value="14,938.00"/>	0.00	0.00%
Long-Term Liabilities	24,406.00	<input type="text" value="24,406.00"/>	0.00	0.00%
Adjusted Total Liabilities	39,344.00	<input type="text" value="39,344.00"/>	0.00	0.00%

UNITED AIRLINES HOLDINGS, INC.
Annualized EDF Term Structure



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Summary

- » Moody's Analytics EDF measures have shown acute and accurate responses to COVID-19, providing timely early warning signals for global companies.
- » As in most events that impact credit risk, there are losers (for example, the Airline industry) and winners (for example, certain pharmaceutical companies).
- » The expected loss for US corporates was almost doubled at the height of the pandemic, but has since trended down with the remarkable recovery in the equity market.

2

Private Firm PDs Respond
to the movement in Public
Firm PDs

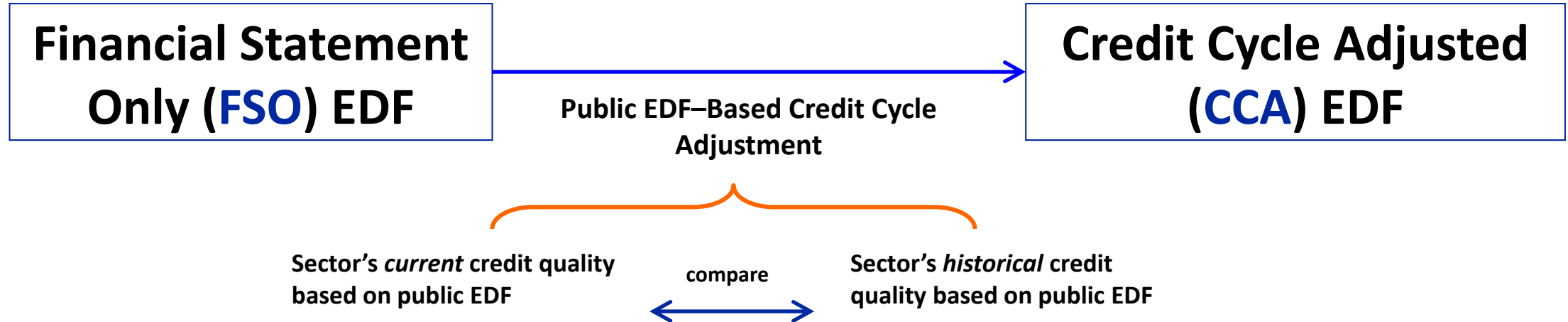
Setting the Stage

- Analyzing the impact on the risk of private firms as measured through the Credit Cycle Adjustment for two key models:
 - RiskCalc™ Large Firm model v3.1
 - RiskCalc US Corporate model v4.0
- Credit Cycle Adjustment for the Large Firm Model is driven solely by public firm EDF metrics, while the US Corporate model depends on a combination of public firm EDF metrics and unemployment rates.
- Current results indicate forward-looking estimates of where point-in-time (PIT) metrics could be in the coming months:
 - We use market-based information up to December 18, 2020
 - We compare pre-Covid EDF, EDF at the credit-risk peak of the pandemic, and EDF based on the latest market information

2.1

Overview of the Credit Cycle
Adjustment in Private Firm
PD model

Credit Cycle Adjustment in Private Firm PD Models



- » If current credit quality is **better** than historical average, FSO EDF is adjusted **down** to arrive at CCA EDF.
- » If current credit quality is **worse** than historical average, FSO EDF is adjusted **up** to arrive at CCA EDF.

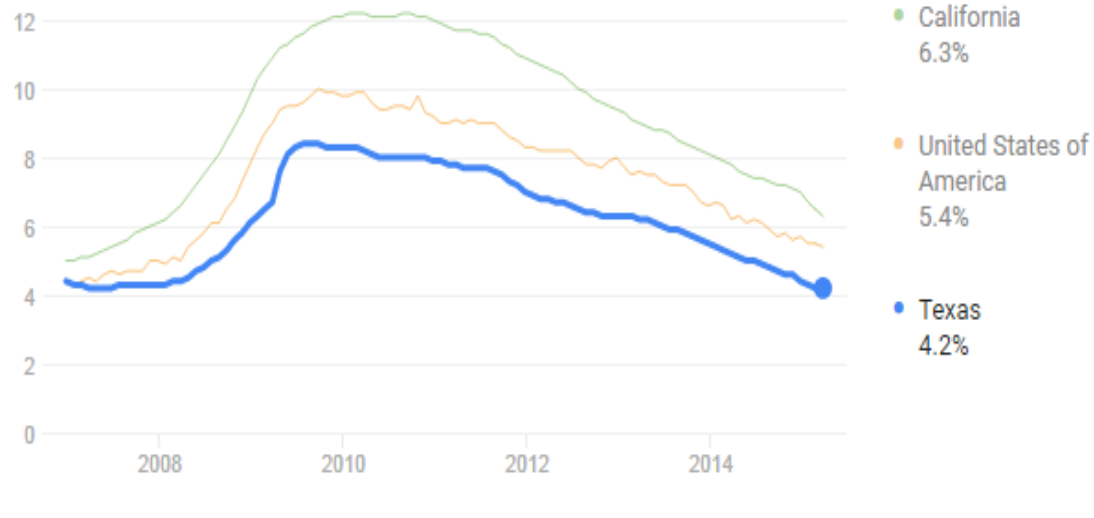
Credit Cycle Adjustment in Private Firm PD Models

For US Corporate Model

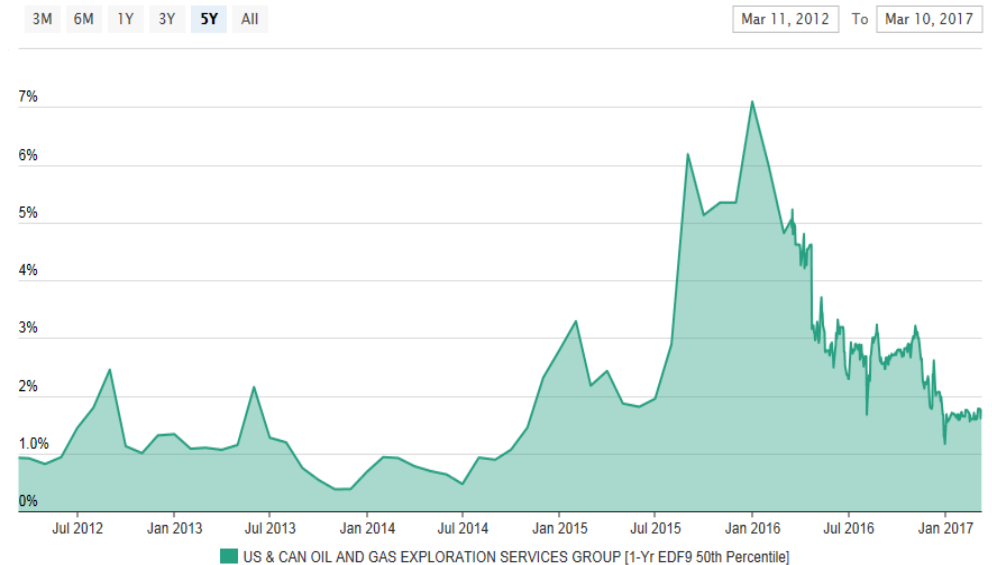
Financial Ratio Based PD (TTC PD)



Unemployment Rate Trend by State



Credit Trend of Publicly Traded Firms in the Same Sector

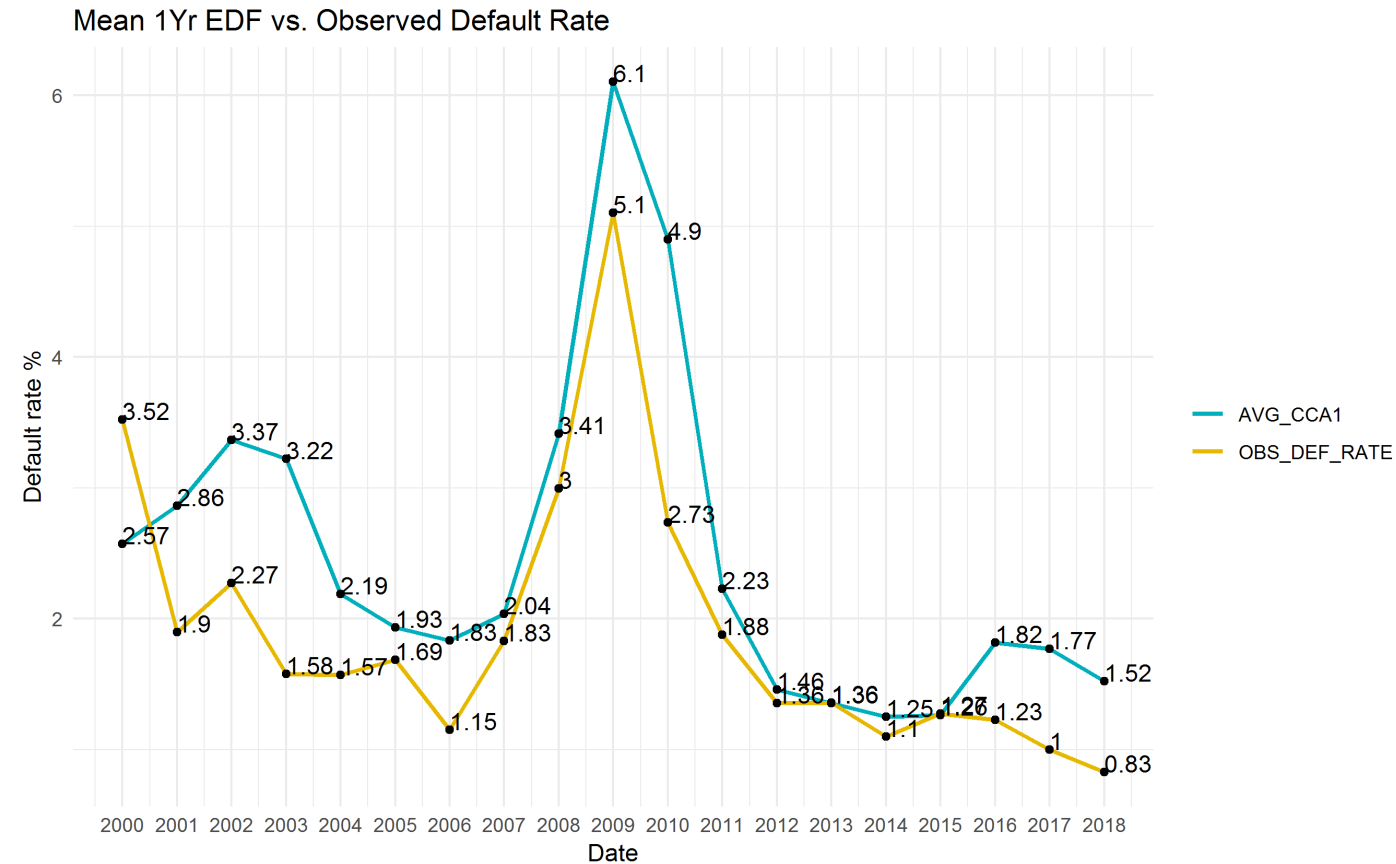


Point-in-Time Probability of Default (PD)

Credit Cycle Adjustment in Private Firm PD Models

CCA Adjustment in RiskCalc brings PD in Line with Actual Default Rate

- » Since default risk varies with the credit cycle, we adjust the private firm EDF measures by implementing a cycle adjustment factor.
- » Adjustment is based on a transformation of the Public Firm's Distance-to-Default (DD) measure by industry. The Large Firm model uses DDs from all publicly traded firms in North America aggregated by sector.
- » The DD factor is adjusted by a 36-month moving average of its own series.
- » If the DD factor for public firms in an industry indicates that risk is going **up**, EDFs are adjusted upward, or vice versa.



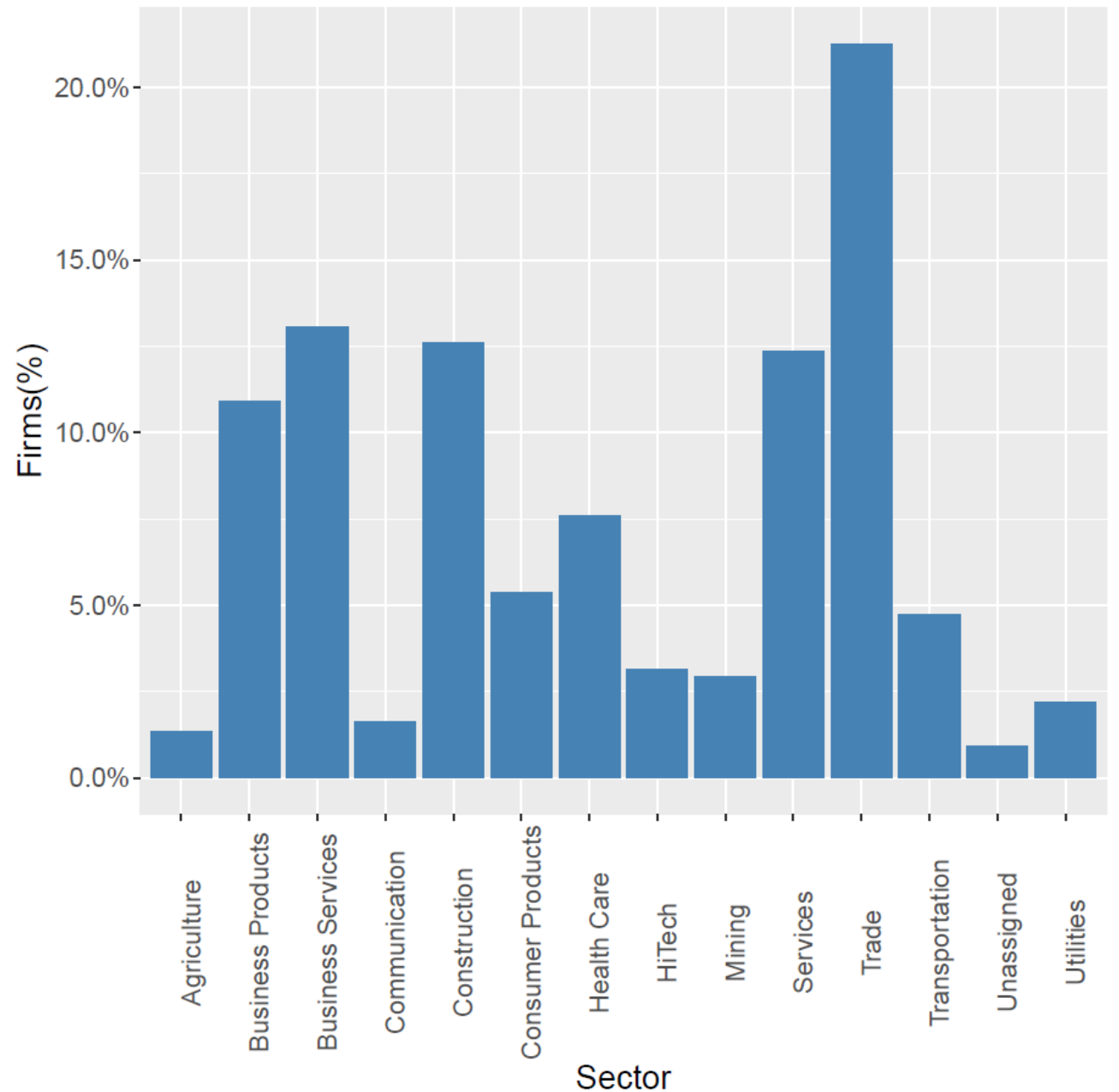
2.2

Impact by Sector for US
Corporates and Large
Firms

Data Description

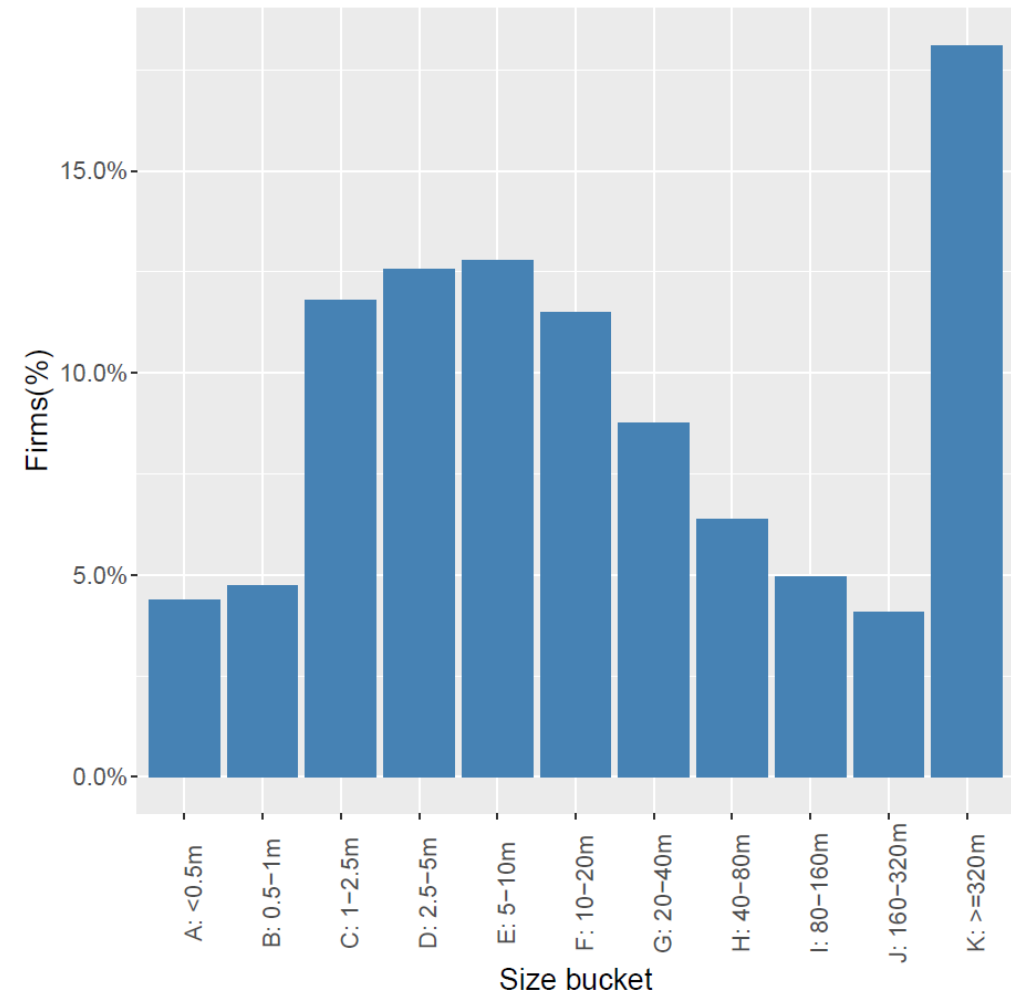
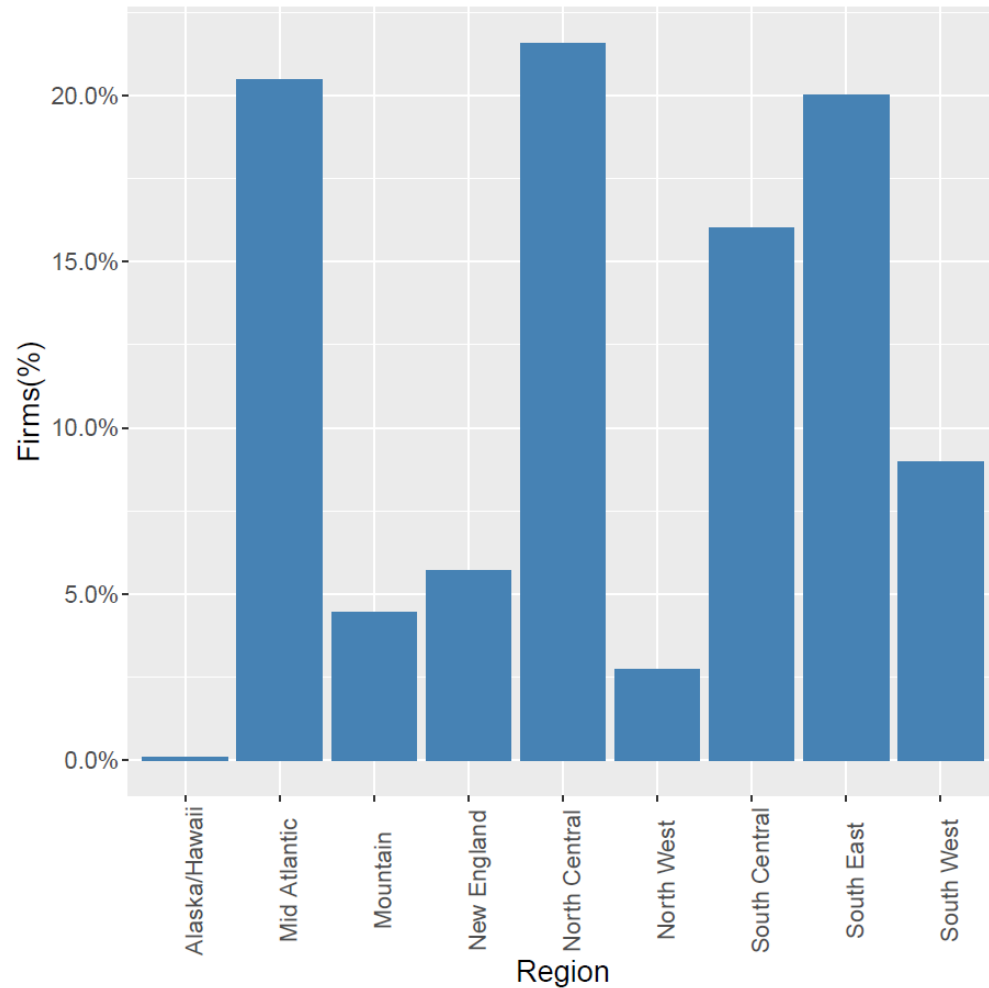
US Corporates

Sample includes more than 30,000 firms and its most recently available annual statement from Moody's Analytics Data Alliance (formerly known as Credit Research Database [CRD]).



Data Description: US Corporates

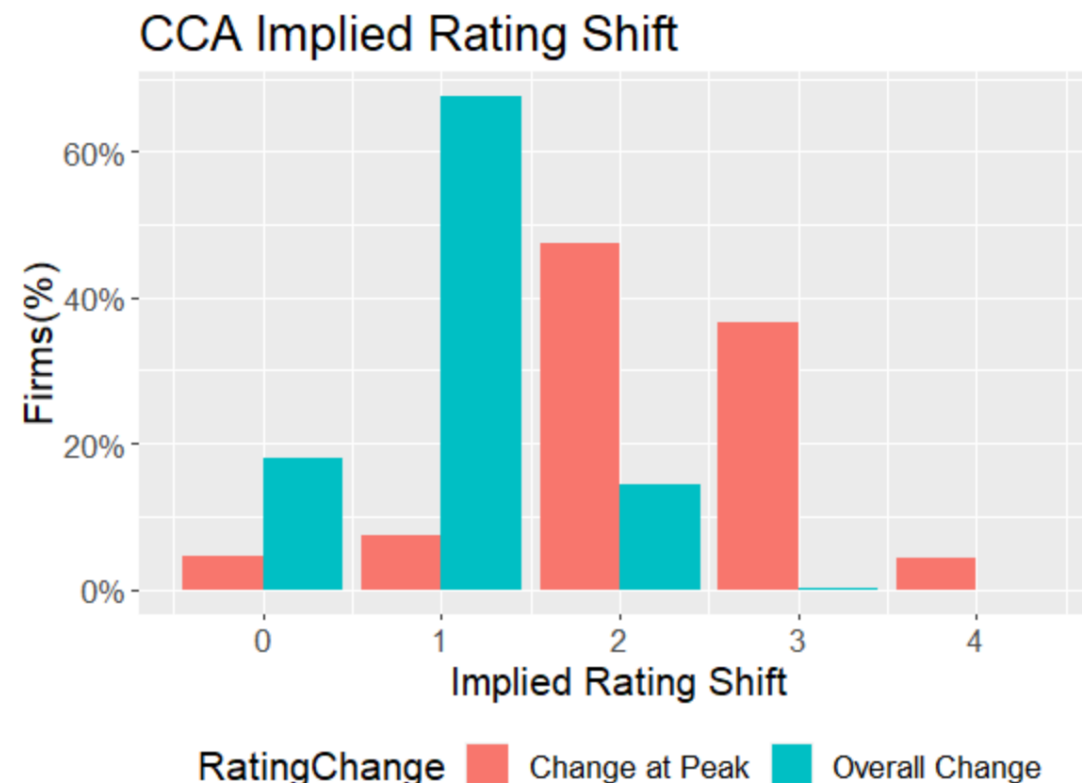
Distribution by region and total assets



Results: US Corporates

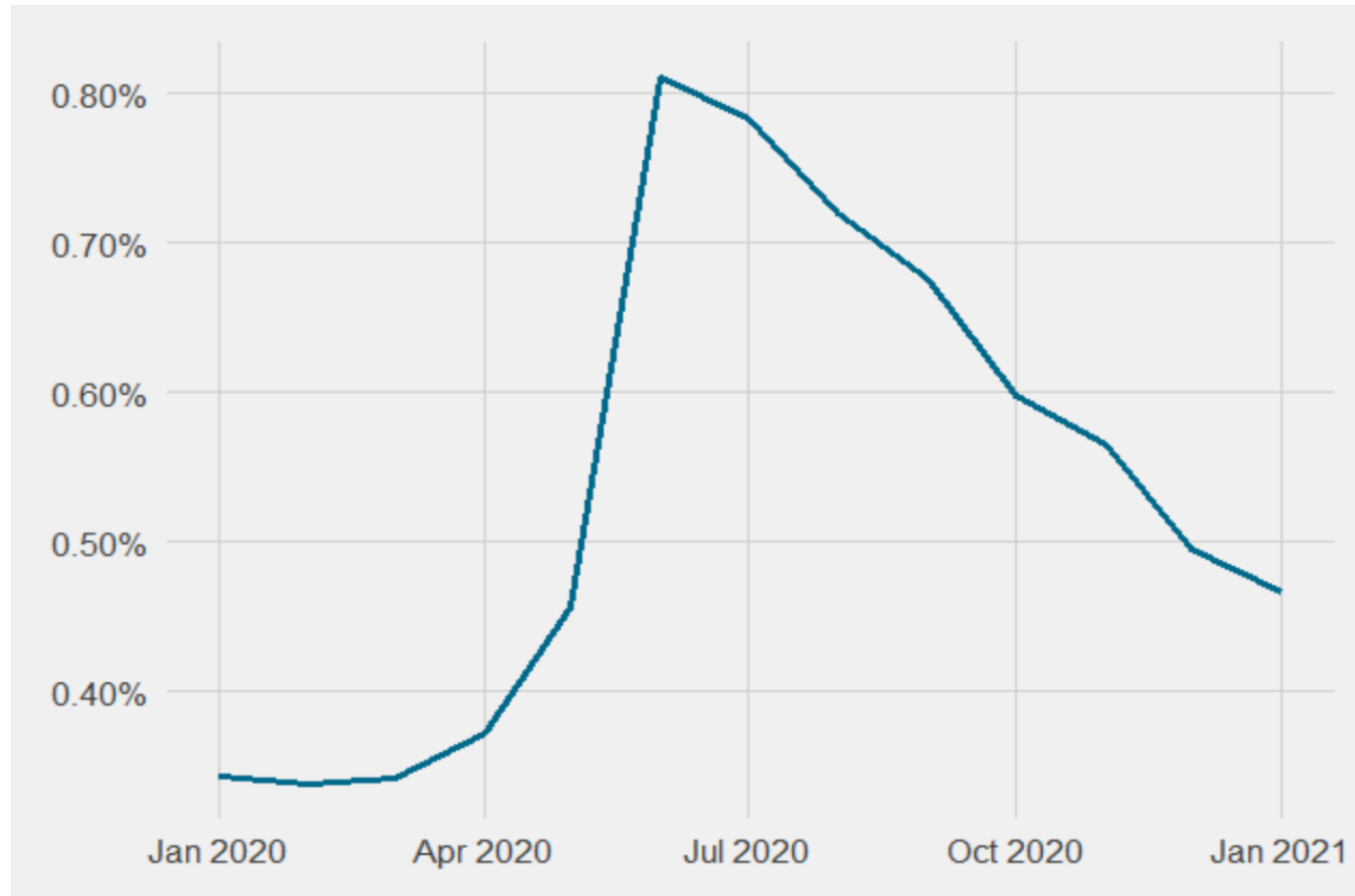
The change in Credit Cycle Adjustment reflects the average jump in Point-in-Time PD based on the most recent market conditions relative to a stable period in January 2020

Sector	Latest CCA change	Average Rating change (Jan to Jan)	Average Rating Change - Peak
Agriculture	91%	1.53	2.66
Construction	91%	1.47	2.85
Transportation	80%	1.39	2.46
Utilities	80%	1.47	2.74
Business Services	55%	1.04	2.29
Unassigned	51%	0.96	2.13
Services	50%	0.95	1.82
Mining	47%	0.94	2.37
Business Products	46%	0.89	2.22
Consumer Products	45%	0.79	1.97
Communication	42%	0.75	1.79
Health Care	39%	0.87	2.42
Trade	32%	0.66	2.24
HiTech	28%	0.61	2.14



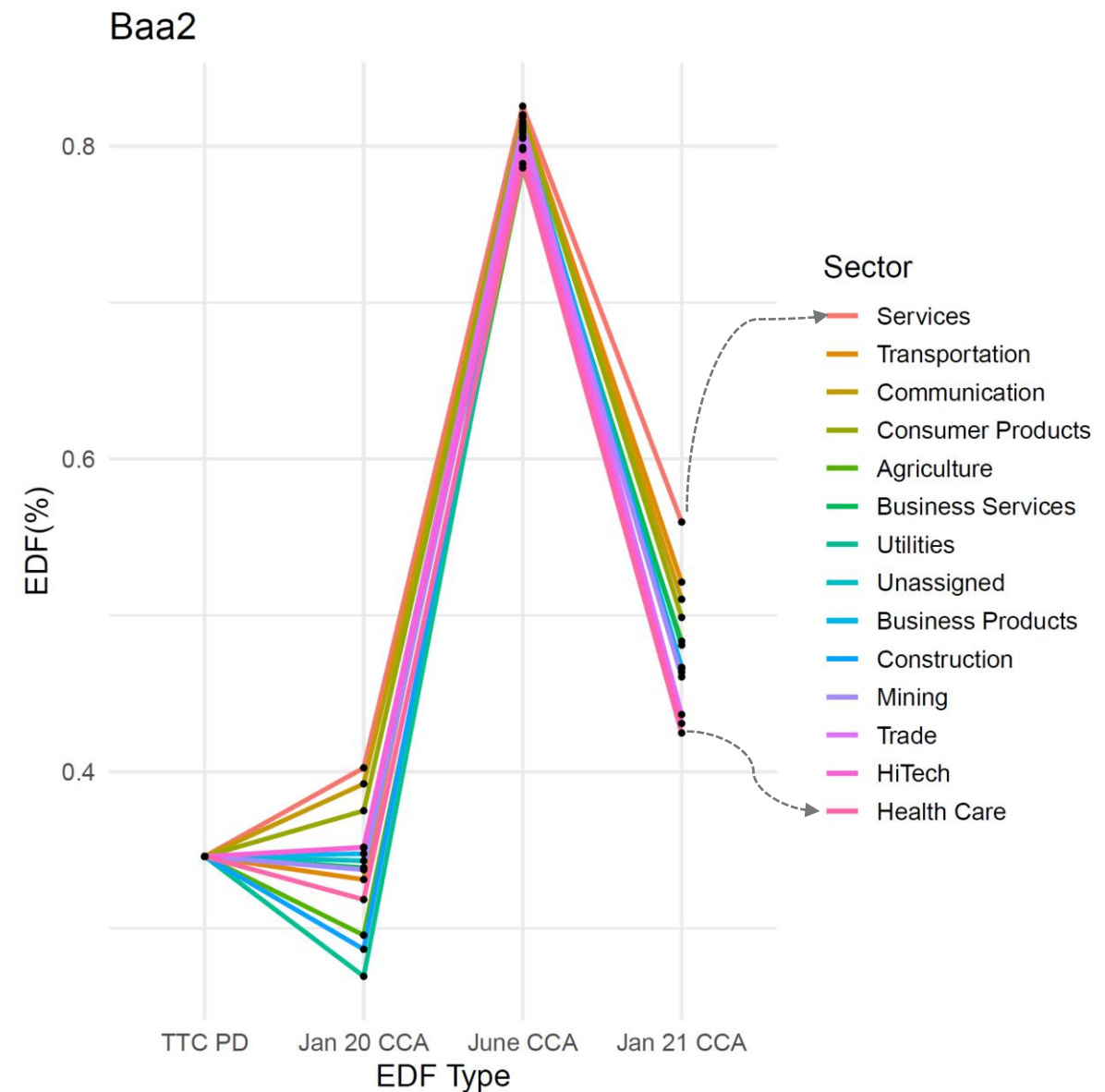
Results: Credit Cycle Adjusted EDF Time Series

CCA EDF Peaked in June and has been Recovering since



Results: US Corporates

- CCA EDFs for all the sectors have recovered from the peak in June
- The Services and Transportation sectors see the biggest jump in Credit Cycle Adjusted EDFs relative to Through-The-Cycle EDF
- The impact on HiTech and Health Care is at the lower end

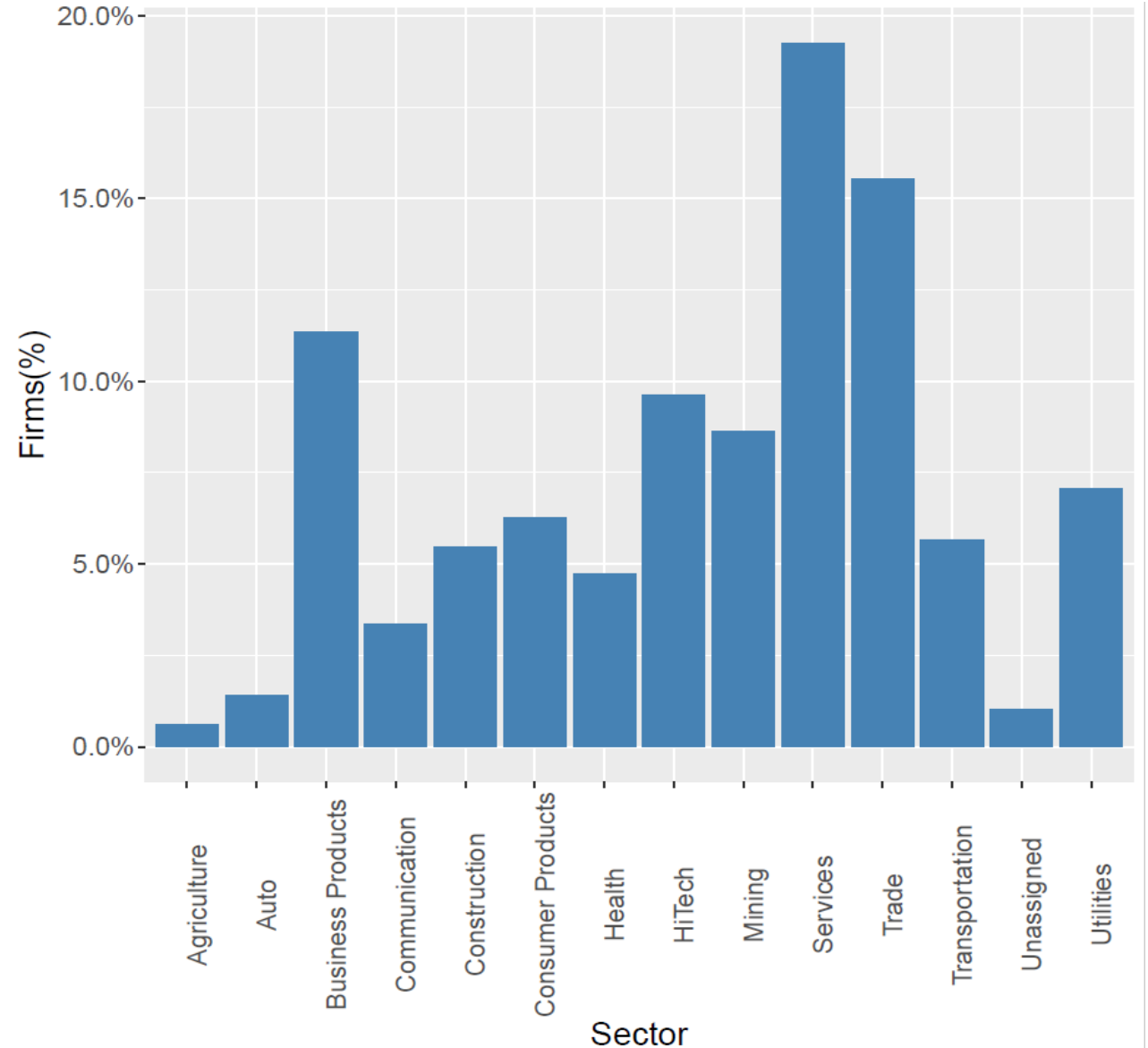


Credit Cycle Adjusted (CCA) EDF

Data Description

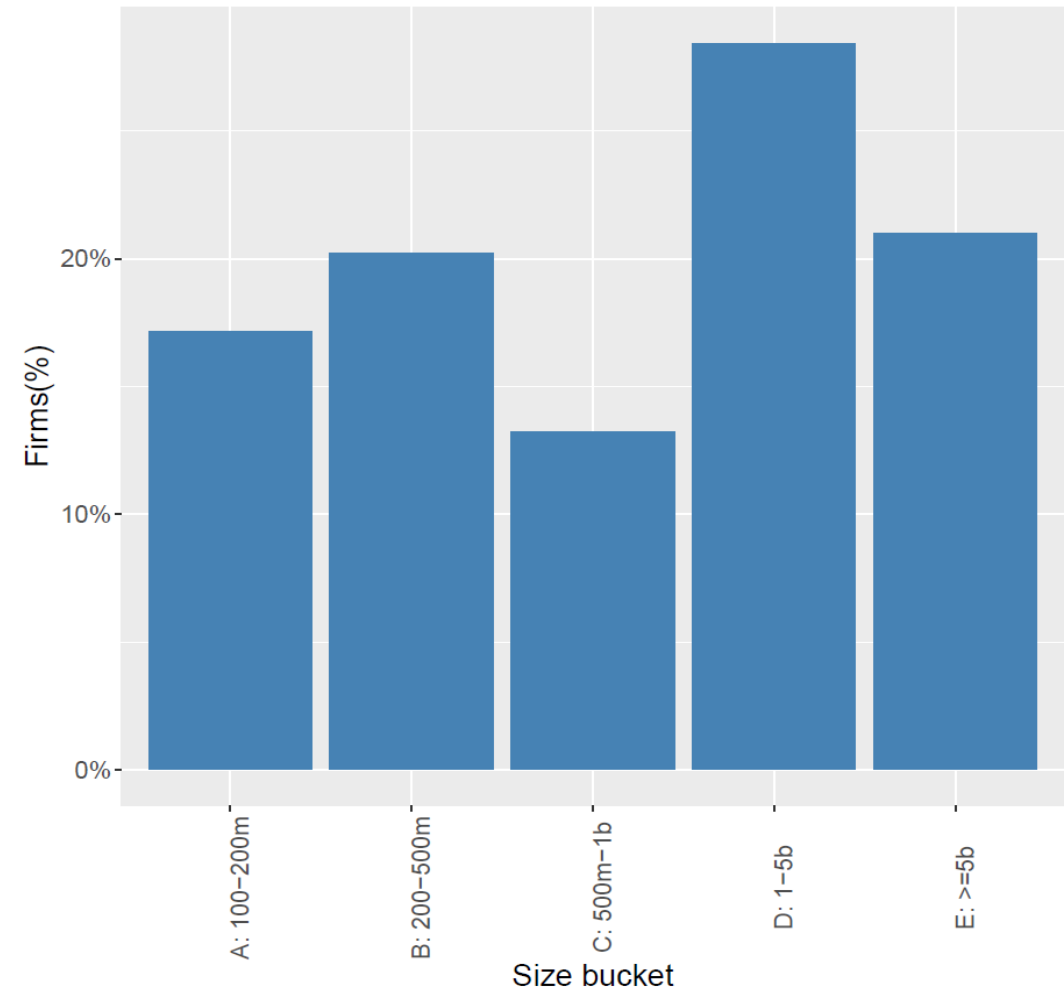
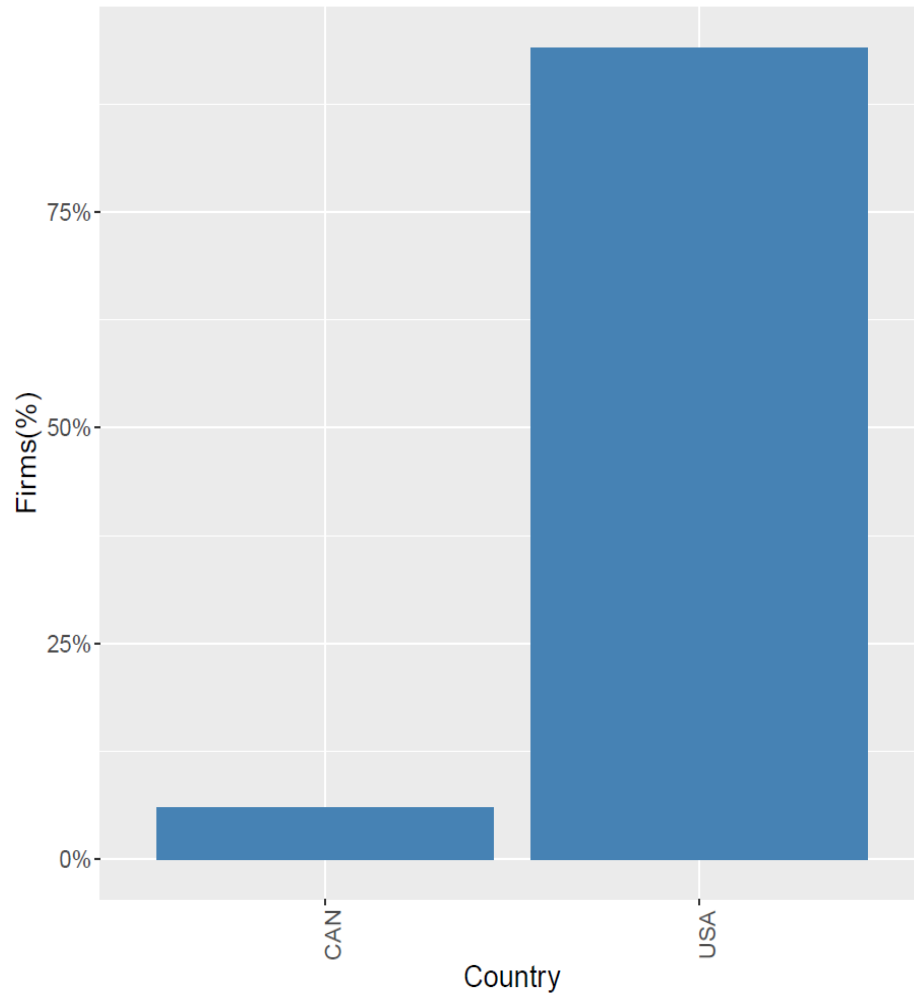
Large Firm Model

Sample includes more than 10,000 firms and its most recently available annual statements from Moody's Analytics Data Alliance (formerly known as Credit Research Database [CRD]).



Data Description: Large Firm Model

Distribution by region and total assets

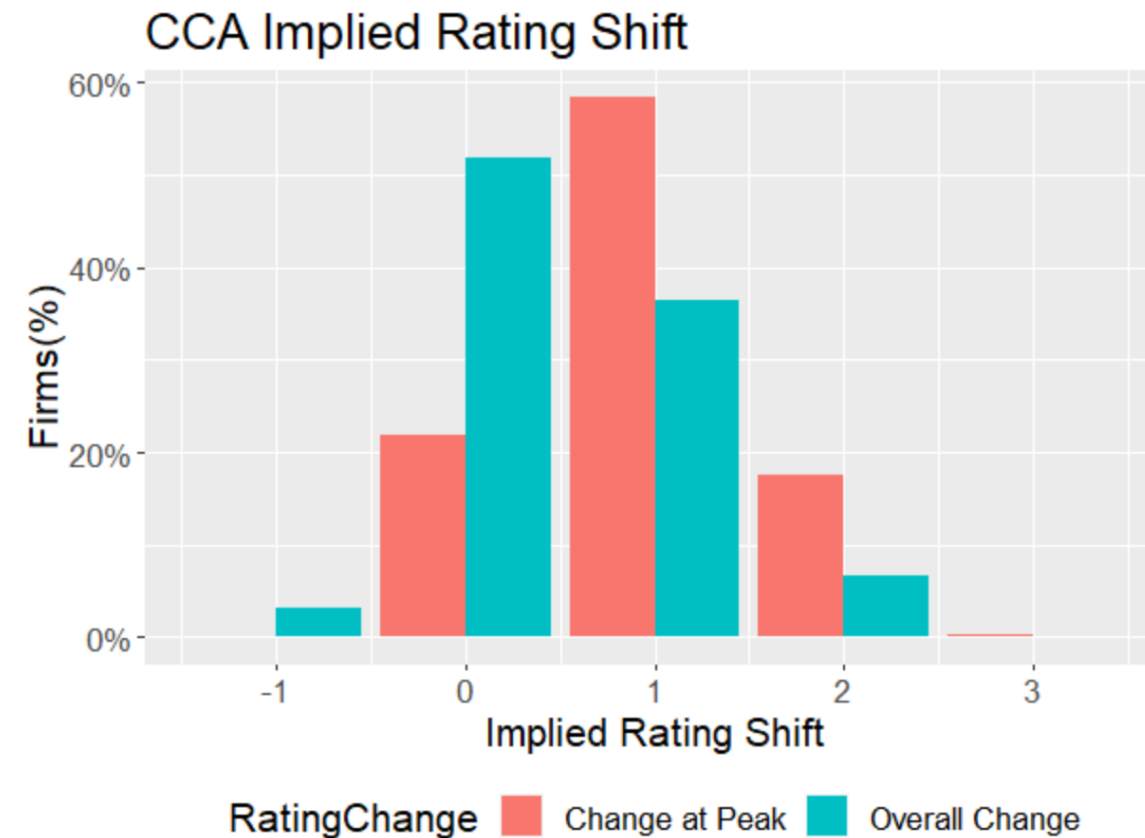


Results: Large Firm Model

The change in Credit Cycle Adjustment reflects the average jump in Point-in-Time PD based on the most recent market conditions relative to a stable period in January 2020

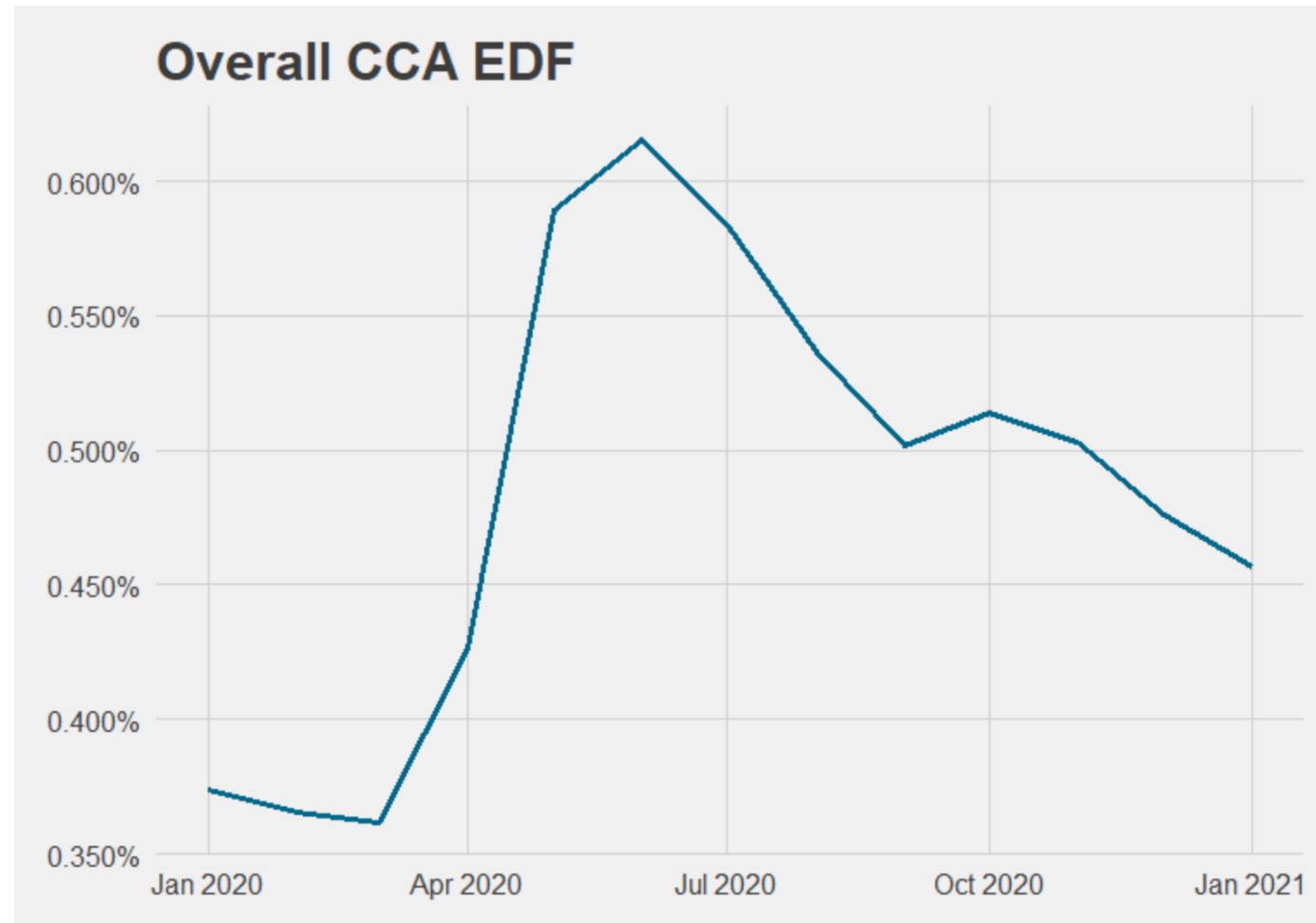
Sector	Latest CCA change	Average Rating change (Jan to Jan)	Average Rating Change - Peak
Agriculture	106%	1.76	2.15
Utilities	89%	1.80	1.68
Transportation	53%	1.13	1.84
Construction	33%	0.74	1.47
Consumer Products	26%	0.57	1.06
Communication	25%	0.60	0.83
Services	23%	0.53	1.00
Unassigned	23%	0.64	1.18
Business Products	17%	0.44	1.21
Health	15%	0.37	1.03
Trade	9%	0.19	0.55
HiTech	5%	0.13	0.49
Mining	-11%	-0.30	0.33
Auto	-16%	-0.47	0.58

Distribution of Implied Rating Downgrades



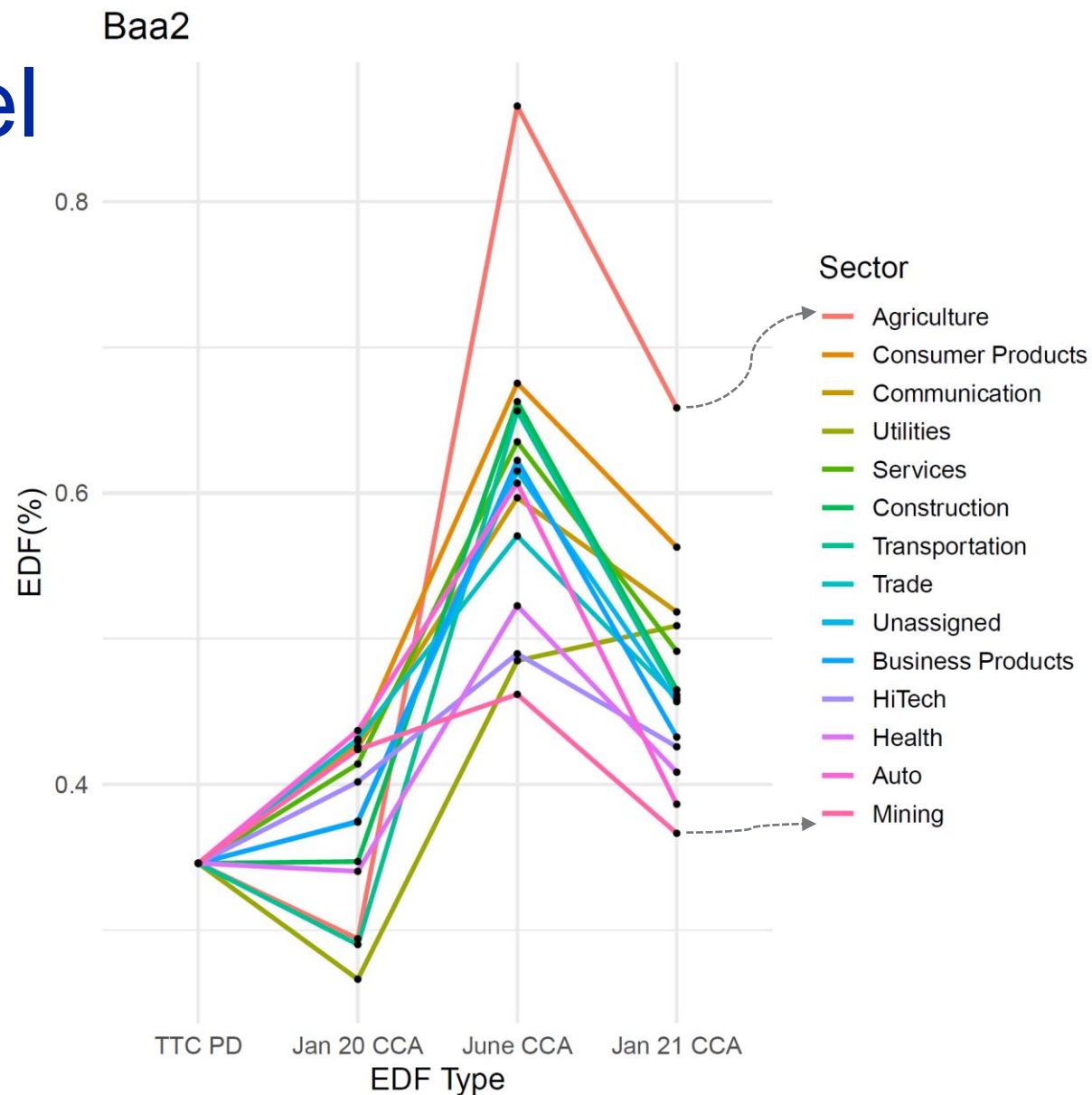
Results: Credit Cycle Adjusted EDF Time Series

CCA EDF Peaked in June and Continued to Decline



Results: Large Firm Model

- Agriculture, Consumer Products, and Communication sectors see the biggest jump in Credit Cycle Adjusted EDFs relative to Through-the-Cycle EDF
- The impact on Auto and Mining is at the lower end



Credit Cycle Adjusted (CCA) EDF

2.3

Implications for Expected Loss

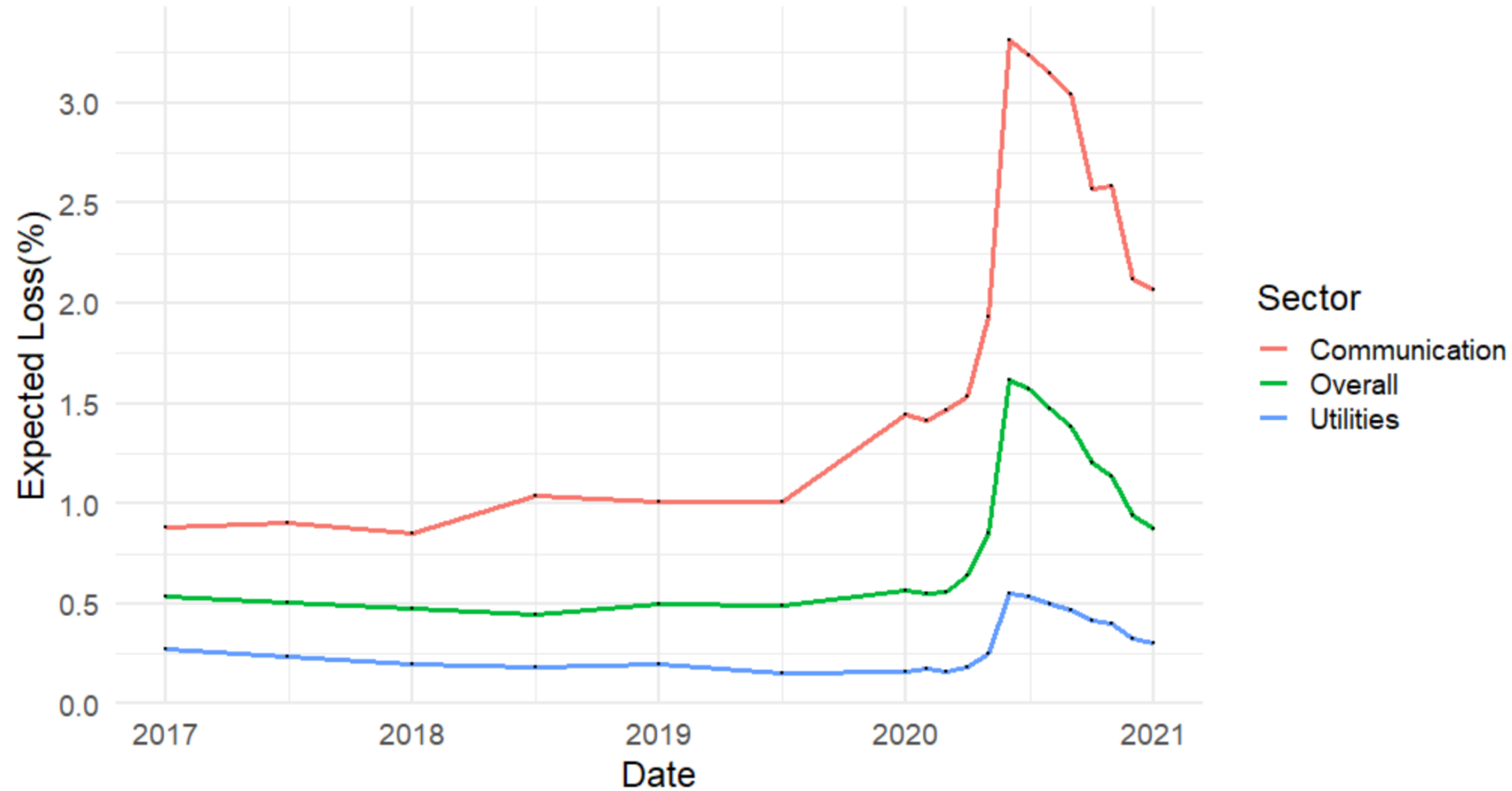
Results

Expected Loss – US Corporates and Large Firms

- Expected loss (EL) percent calculated from the CRD sample
- Assumptions
 - Size weighted exposures
 - Loss Given Default (LGD) of 50%
- $EL(\%) = \text{Size weighted Point-In-Time PD} * 50\%$

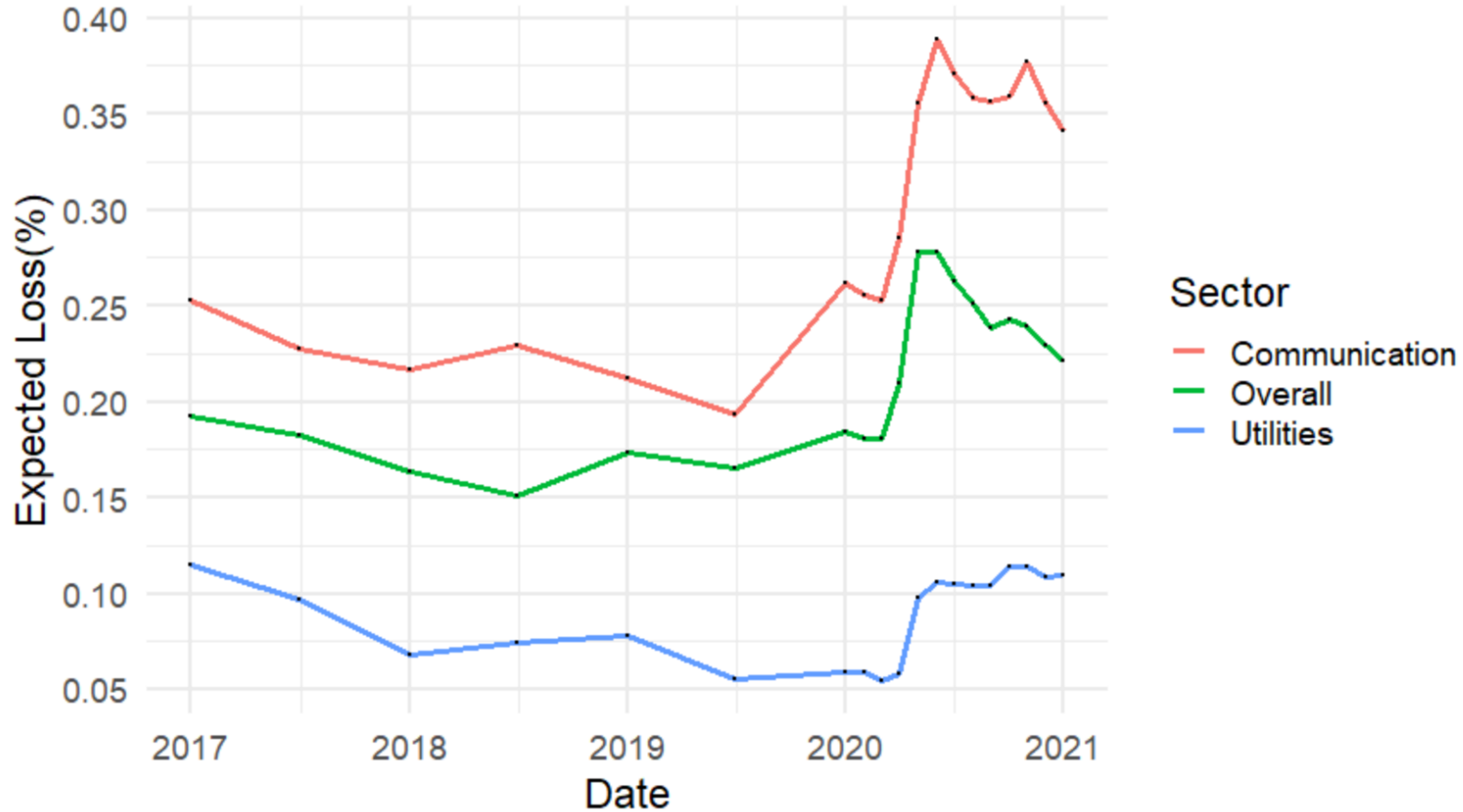
Results

Expected Loss – US Corporates



Results

Expected Loss – Large Firms

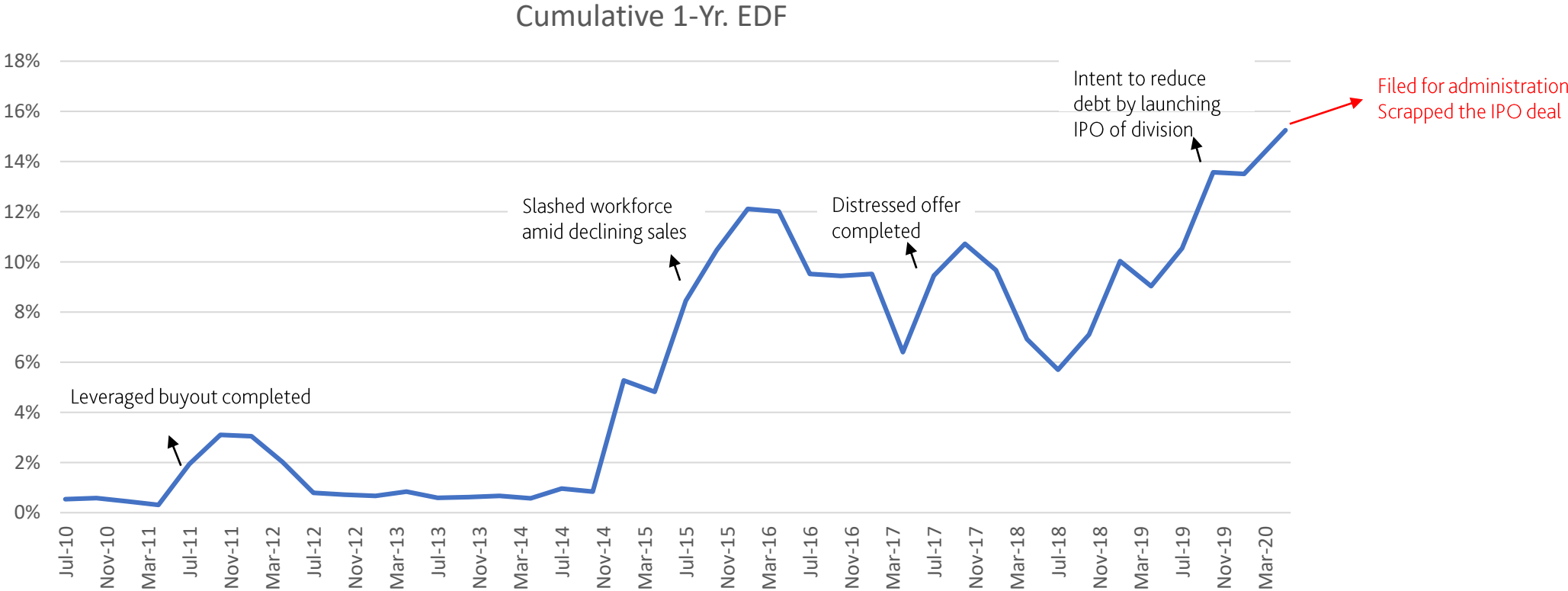


2.4

Case Study: J.Crew

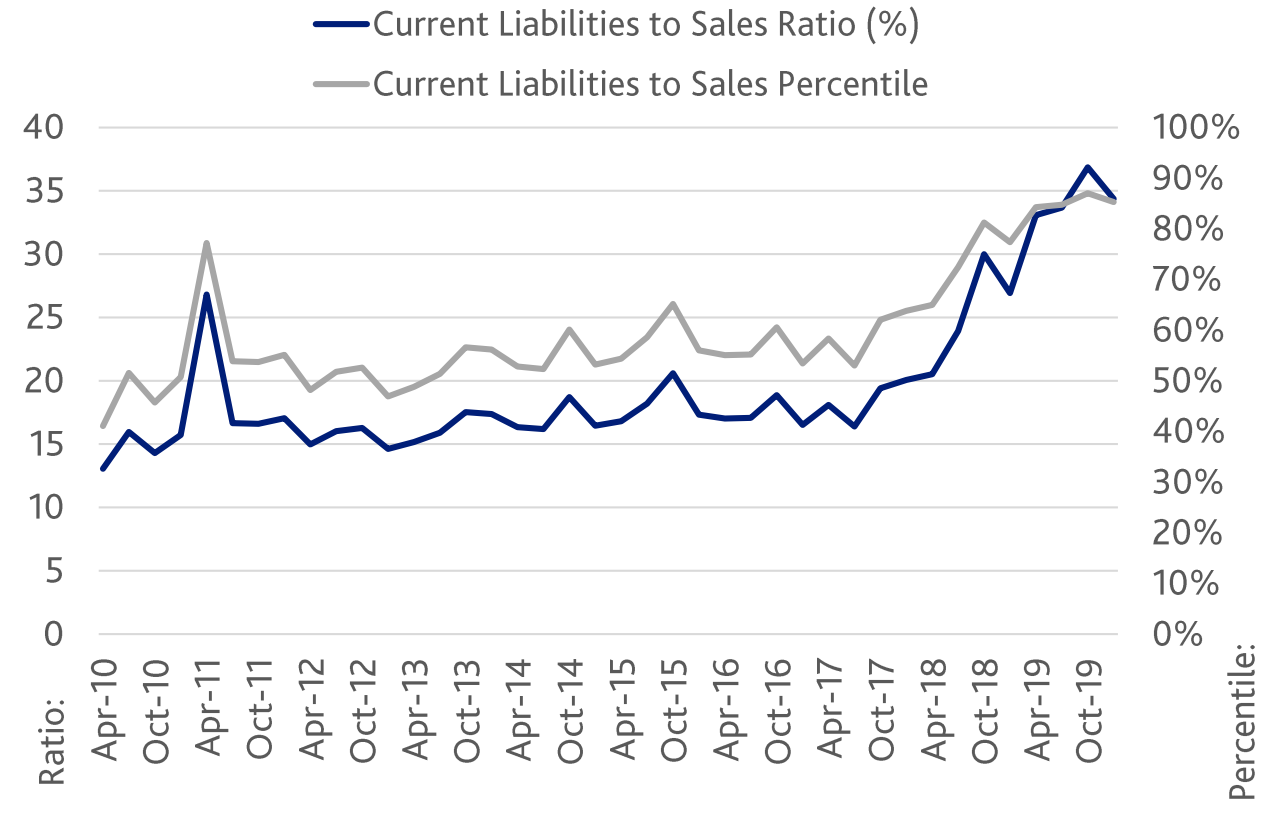
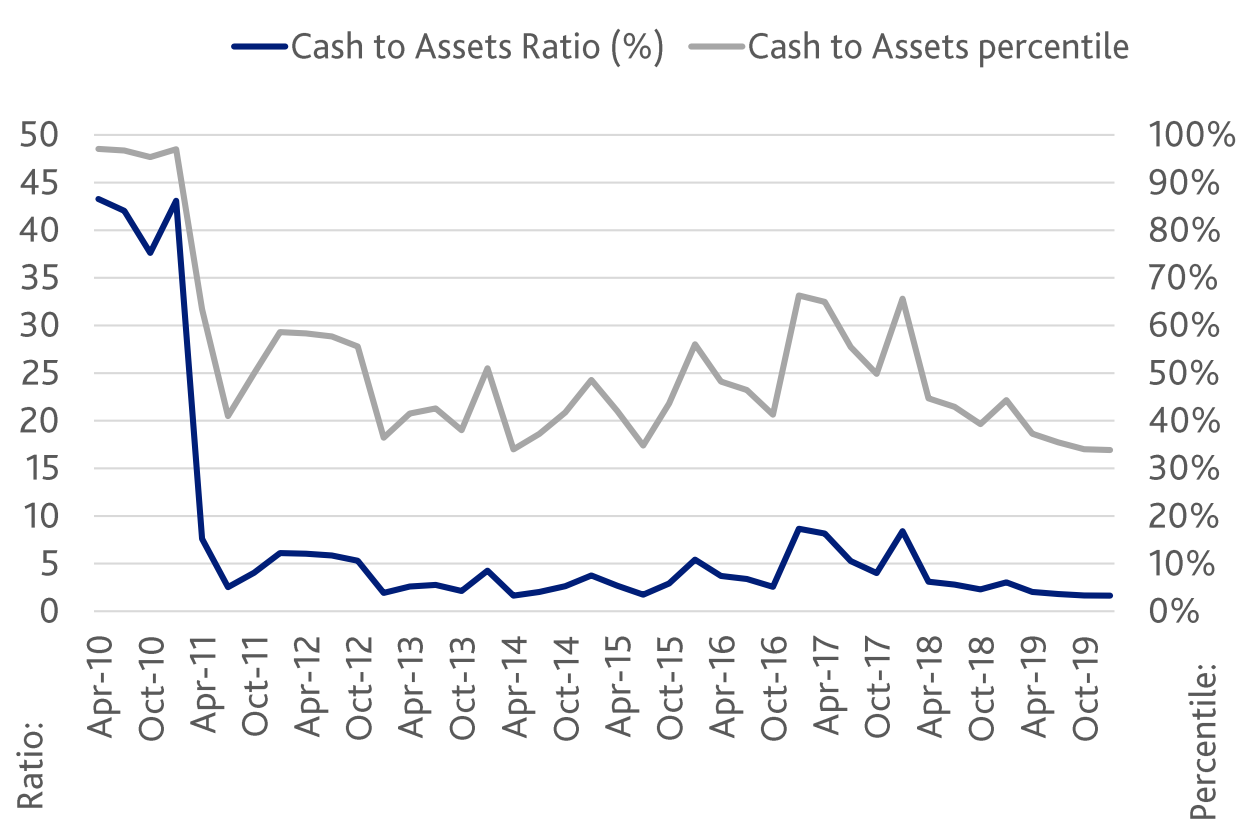
J.Crew Default

J. Crew Group's One-Year EDF value in PIT mode (%)



J.Crew Default

Financial ratios show elevated risk prior to COVID-19



Summary

- » COVID-19 was a major driver of credit risk over the period of 2020. Government spending and policies as well as vaccine development succeeded in mitigating the credit risk to a certain extent.
- » Private firms across all industries will see an increase in Credit Cycle Adjusted EDFs—with Transportation, Services, and Construction deteriorating the most.
- » Size-weighted Expected Loss was significantly for both US Corporates and Large Firms in June 2020 and continued to decline for both the portfolios.
- » We continue to monitor COVID-19 defaults from the Credit Research Database (CRD) to evaluate the model performance going forward.
- » The signal provided by EDF measures and insights from their interpretation may:
 - Help re-assess loss provisions as well as make proper adjustment to portfolios
 - Offer policy implications on maintaining the credit health of “mission-critical” companies as well as analyzing the cost and benefit of stimulus packages for various industries

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3.

Appendix

Heatmap – US Corporate

Sector	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3	Caa/C
Agriculture	17%	31%	47%	56%	64%	84%	107%	111%	118%	129%	145%	126%	58%
Business Products	10%	18%	26%	30%	34%	45%	52%	56%	58%	60%	73%	55%	30%
Business Services	12%	22%	32%	37%	42%	57%	65%	70%	73%	79%	94%	69%	37%
Communication	9%	18%	24%	26%	30%	44%	43%	48%	46%	60%	54%	36%	25%
Construction	16%	29%	45%	53%	62%	79%	105%	108%	116%	121%	139%	131%	58%
Consumer Products	9%	19%	25%	28%	33%	46%	47%	52%	51%	62%	61%	43%	27%
Health Care	10%	16%	25%	30%	33%	41%	55%	56%	61%	54%	78%	65%	32%
HiTech	7%	12%	17%	20%	22%	28%	34%	36%	39%	34%	48%	38%	21%
Mining	10%	19%	28%	32%	37%	47%	56%	60%	63%	64%	82%	62%	33%
Services	12%	24%	32%	34%	39%	58%	58%	64%	59%	82%	65%	43%	32%
Trade	7%	13%	19%	22%	24%	30%	37%	39%	42%	38%	52%	40%	22%
Transportation	16%	30%	44%	50%	57%	80%	92%	98%	98%	115%	129%	90%	50%
Unassigned	10%	19%	28%	32%	36%	48%	55%	59%	62%	64%	79%	59%	32%
Utilities	19%	33%	51%	63%	73%	94%	124%	133%	142%	150%	169%	170%	70%

Heatmap – US Large firms

Sector	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3	Caa/C
Agriculture	59%	122%	148%	88%	65%	62%	83%	124%	134%	117%	104%	115%	200%	196%	193%	145%
Auto	-8%	-28%	-13%	-13%	-6%	-11%	-8%	-12%	-13%	-16%	-13%	-11%	-22%	-24%	-23%	-19%
Business Products	9%	31%	15%	19%	8%	13%	9%	15%	16%	16%	15%	15%	27%	28%	28%	23%
Communication	14%	37%	25%	6%	15%	14%	21%	22%	35%	18%	19%	15%	37%	44%	38%	32%
Construction	17%	51%	45%	35%	20%	27%	19%	34%	38%	32%	30%	24%	57%	60%	59%	47%
Consumer Products	18%	43%	33%	9%	20%	15%	29%	31%	39%	21%	21%	25%	42%	48%	42%	35%
Health	7%	11%	28%	27%	16%	17%	9%	20%	19%	13%	16%	17%	24%	21%	25%	20%
HiTech	3%	12%	2%	7%	2%	4%	2%	6%	5%	5%	5%	6%	8%	8%	8%	7%
Mining	-6%	-14%	-15%	-16%	-7%	-11%	-7%	-14%	-12%	-8%	-10%	-13%	-17%	-16%	-17%	-14%
Services	12%	39%	22%	8%	10%	13%	16%	19%	28%	20%	17%	11%	35%	41%	36%	30%
Trade	5%	15%	12%	2%	3%	5%	5%	6%	8%	9%	7%	2%	14%	16%	14%	12%
Transportation	24%	59%	68%	59%	28%	36%	28%	59%	65%	67%	53%	40%	89%	95%	100%	76%
Unassigned	13%	46%	28%	21%	10%	18%	14%	22%	24%	24%	21%	16%	42%	45%	44%	35%
Utilities	39%	102%	155%	83%	51%	60%	69%	91%	117%	98%	84%	76%	125%	186%	183%	145%

Static Mapping

Rating	Average PD
Aaa	0.01%
Aa1	0.02%
Aa2	0.04%
Aa3	0.07%
A1	0.11%
A2	0.16%
A3	0.20%
Baa1	0.25%
Baa2	0.35%
Baa3	0.53%
Ba1	0.85%
Ba2	1.35%
Ba3	2.02%
B1	3.03%
B2	4.55%
B3	6.82%
Caa/C	17.10%

PIT Converter

TTC to PIT PD

Converts any TTC PD to a PIT PD term structure, leveraging our Private Firm Model RiskCalc suite

Inputs	Outputs
TTC PD Analysis Date Industry Classification Private Firm Model Name State (optional)	PIT PD Term Structure

Sector Composition

Description	Count	sector
AGRICULTURE	14	Agriculture
AUTOMOTIVE	57	Auto
CHEMICALS	100	Business Products
MACHINERY & EQUIPMENT	131	Business Products
PAPER	30	Business Products
PLASTIC & RUBBER	29	Business Products
PRINTING	15	Business Products
PUBLISHING	22	Business Products
STEEL & METAL PRODUCTS	61	Business Products
TRANSPORTATION EQUIPMENT	12	Business Products
BROADCAST MEDIA	26	Communication
CABLE TV	13	Communication
TELEPHONE	73	Communication
CONSTRUCTION	56	Construction
CONSTRUCTION MATERIALS	36	Construction
APPAREL & SHOES	44	Consumer Products
CONSUMER DURABLES	21	Consumer Products
CONSUMER PRODUCTS	44	Consumer Products
FOOD & BEVERAGE	107	Consumer Products
FURNITURE & APPLIANCES	30	Consumer Products
TEXTILES	9	Consumer Products
TOBACCO	5	Consumer Products
MEDICAL SERVICES	84	Health

Description	Count	sector
AEROSPACE & DEFENSE	50	HiTech
COMPUTER HARDWARE	41	HiTech
COMPUTER SOFTWARE	166	HiTech
ELECTRICAL EQUIPMENT	68	HiTech
ELECTRONIC EQUIPMENT	144	HiTech
MEASURE & TEST EQUIPMENT	68	HiTech
MEDICAL EQUIPMENT	168	HiTech
PHARMACEUTICALS	656	HiTech
SEMICONDUCTORS	89	HiTech
LUMBER & FORESTRY	24	Mining
MINING	970	Mining
OIL REFINING	27	Mining
OIL, GAS & COAL EXPL/PROD	393	Mining
BUSINESS SERVICES	535	Services
CONSUMER SERVICES	33	Services
ENTERTAINMENT & LEISURE	75	Services
HOTELS & RESTAURANTS	64	Services
BUSINESS PRODUCTS WHSL	118	Trade
CONSUMER DURABLES RETL/WHSL	62	Trade
CONSUMER PRODUCTS RETL/WHSL	127	Trade
FOOD & BEVERAGE RETL/WHSL	34	Trade
AIR TRANSPORTATION	23	Transportation
TRANSPORTATION	61	Transportation
TRUCKING	24	Transportation
UNASSIGNED	84	Unassigned
UTILITIES NEC	45	Utilities
UTILITIES, ELECTRIC	83	Utilities
UTILITIES, GAS	52	Utilities

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