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Managing Credit Risk and Emerging Threats: Lessons from the Gaps Revealed by the Pandemic




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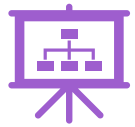
Moody's Corporation is comprised of two separate companies: Moody's Investors Service (MIS) and Moody's Analytics (MA).

Moody's Investors Service (MIS) provides investors with a comprehensive view of global debt markets through credit ratings and research. Moody's Analytics (MA) provides data, analytics, and insights to equip leaders of financial, non-financial, and government organizations with effective tools to understand a range of risks.

Goals for This Session



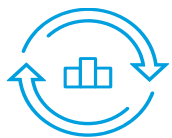
Review the gaps in credit models revealed by the COVID-19 Pandemic



Outline a cohesive credit risk framework that assesses emerging threats, such as cyber risk and supply-chain disruptions



Review qualitative methods used in fundamental analysis that overcome data challenges inherent in emerging risks



Use alternative data to describe the varying impact of emerging risks across credit segments



Live Q&A



Articulating the Impact of Emerging Risks on Credit

An inherent challenge

Fundamental Analysis

- Based on analyst's expertise
- Considers nuanced aspects of each counterparty, along with terms and conditions
- Useful in agency and internal ratings
- Naturally incorporate emerging risks through qualitative overlay

Limitations:

- Difficult to update for portfolios with varying characteristics
- Difficult to level set across segments

Quantitative Credit Models

- Based on statistical analysis
- Automated and applicable to large portfolios
- Useful as early warning indicator
- Useful with level setting across segments
- Needed for regulatory reporting/accounting

Limitations:

- Generic by their nature
- Challenged when environment deviates from historical patterns (emerging risks)

Challenges with Quantifying Emerging Risks

Traditional Expected Credit Loss Models Used in Stress Testing/Impairment

- » Economic scenarios are based on models calibrated to experience with broad-brush variables such as unemployment or GDP, and in of themselves cannot differentiate across credit segments or describe emerging risks
- » Credit data often segmented coarsely, not allowing for variation in sensitivity to emerging risks

Lessons from COVID-19

- » An overlay anchored to traditional models can account for COVID's unique cross-sectional impact
- » That style of overlay can be applied to other emerging risks

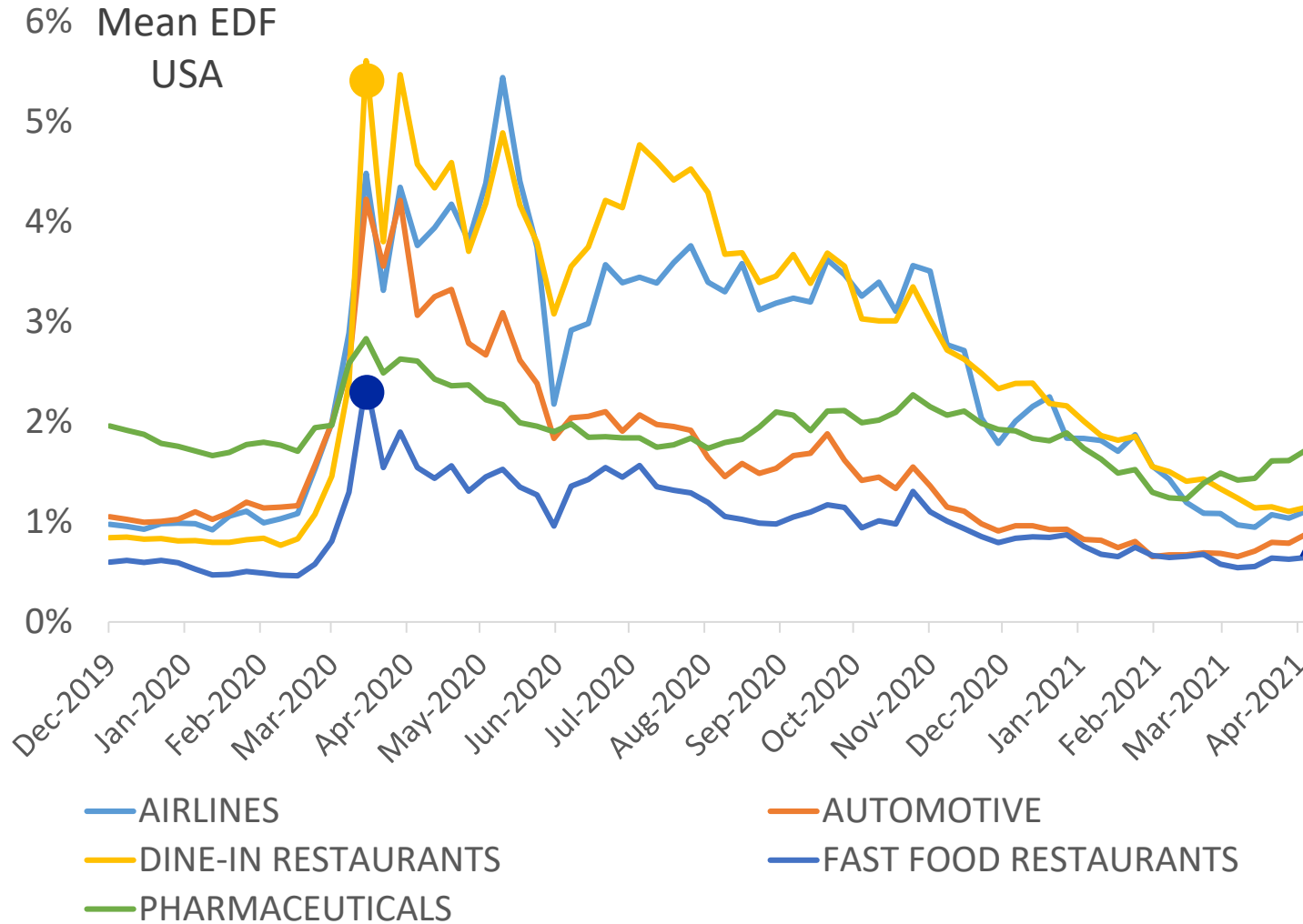
Quantifying the cross-sectional impact of emerging risks requires an assessment of:

Segment Granularity

Alternative Data

The Pandemic's Cross-Industry Impact

Empirical patterns lead to new thinking about granularity & data

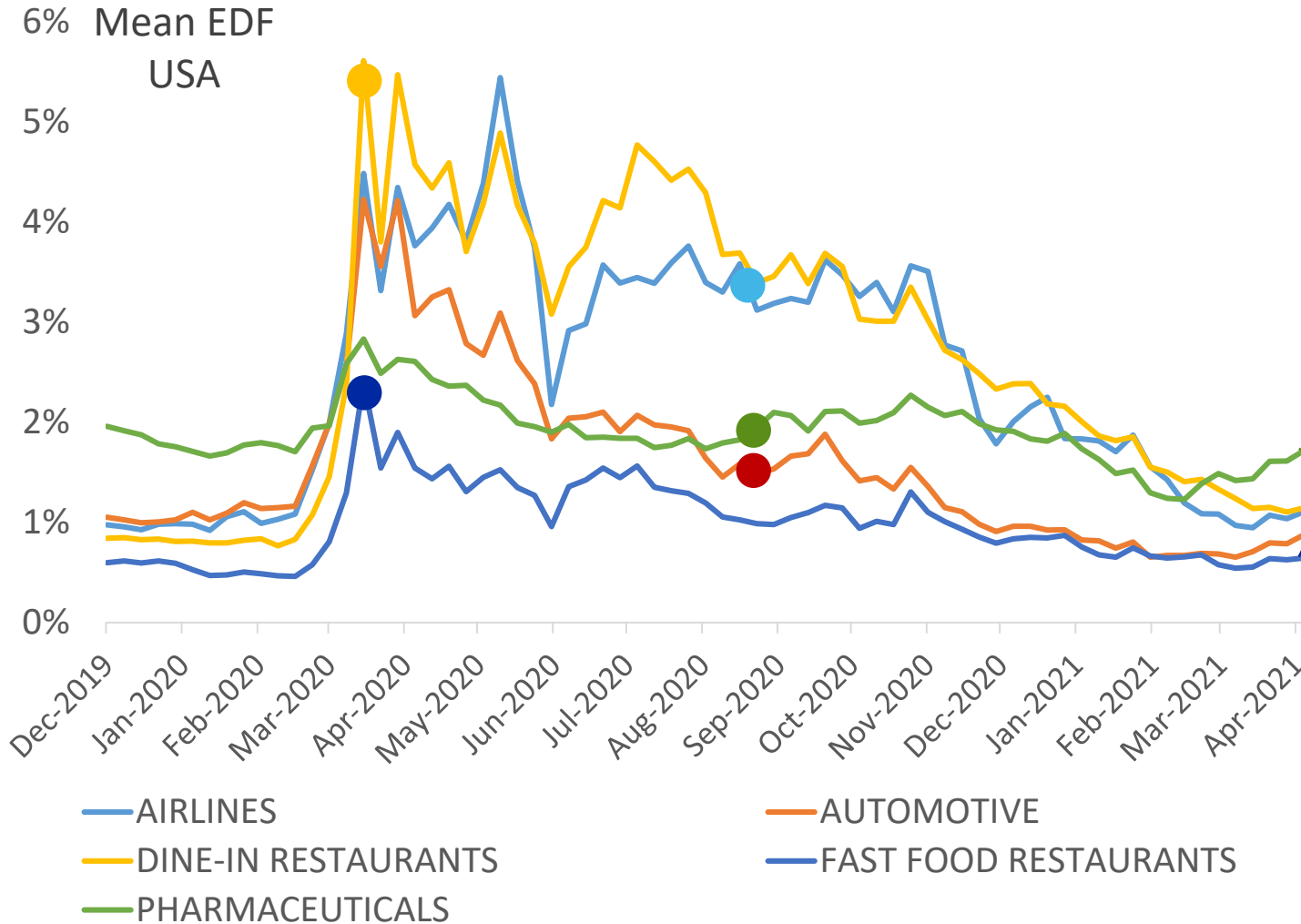


FAST FOOD RESTAURANTS and **DINE-IN RESTAURANTS** are often combined in a single broader sector.
To model the Pandemic properly, they must be separated

Granularity of 121 Industry Segments

The Pandemic's Cross-Industry Impact

Empirical patterns lead to new thinking about granularity & data



FAST FOOD RESTAURANTS and **DINE-IN RESTAURANTS** are often combined in a single broader sector.

To model the Pandemic properly, they must be separated

Granularity of 121 Industry Segments

While in the beginning, the **AUTOMOTIVE** and **AIRLINES** experienced a similar shock, **AIRLINES** suffered longer thanks to continued **social distancing and travel restrictions**.

AUTOMOTIVE segment recovered much faster, thanks to **improving consumer sentiment**.

Naturally, the Pandemic did not have a substantially adverse impact on **PHARMACEUTICALS**

Cross-Sectional Impact Is Unique to The Pandemic

Use of Alternative Data to Describe the Pandemic

Cross-Industry and –Country patterns do not follow traditional models

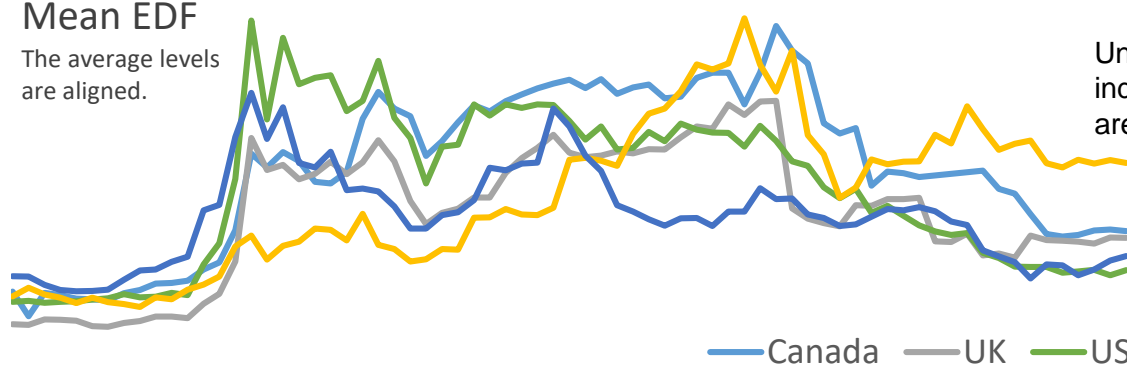
Average of Travel Industries

DINE-IN REST., AIRLINES, HOTELS

Mean EDF

The average levels are aligned.

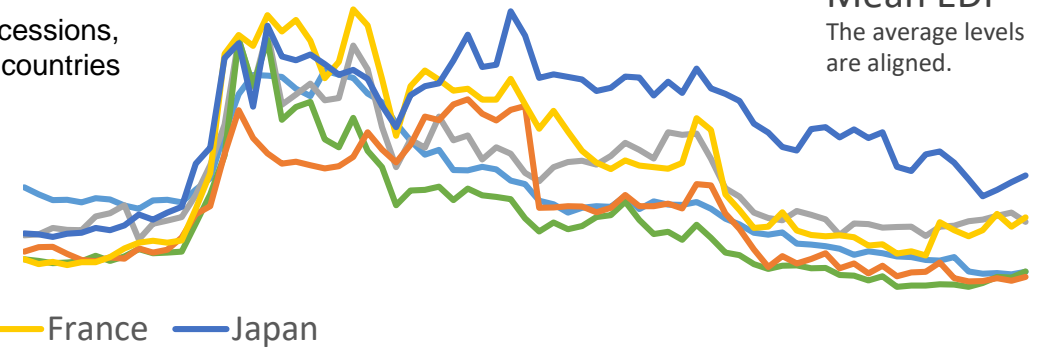
Unlike in the previous recessions, industry patterns across countries are comparable



AUTOMOTIVE Industry Segment

Mean EDF

The average levels are aligned.



Use of Alternative Data

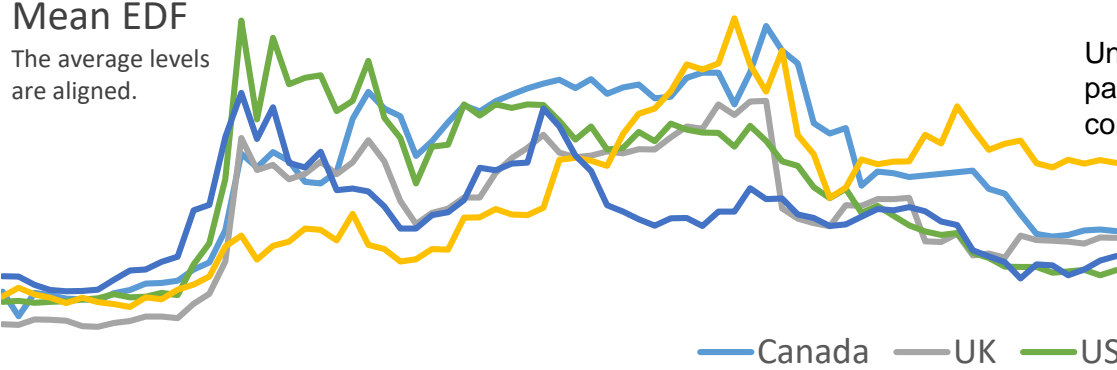
Traditional models cannot capture cross-sectional patterns

Average of Travel Industries

DINE-IN REST., AIRLINES, HOTELS

Mean EDF

The average levels are aligned.

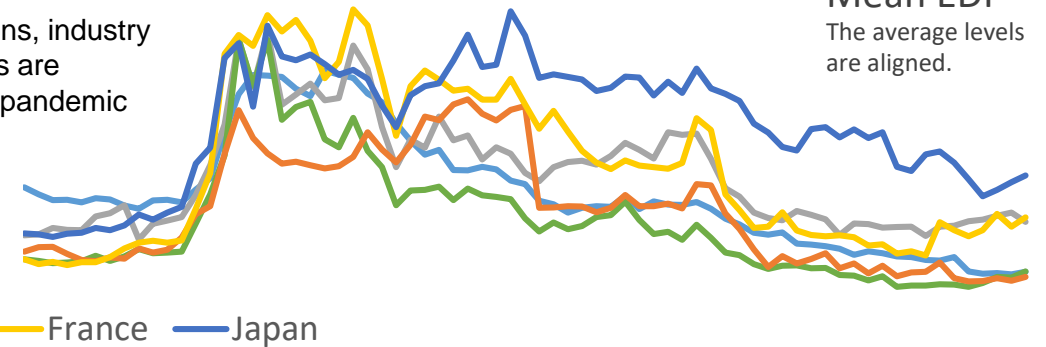


Unlike previous recessions, industry patterns across countries are comparable through the pandemic

AUTOMOTIVE Industry Segment

Mean EDF

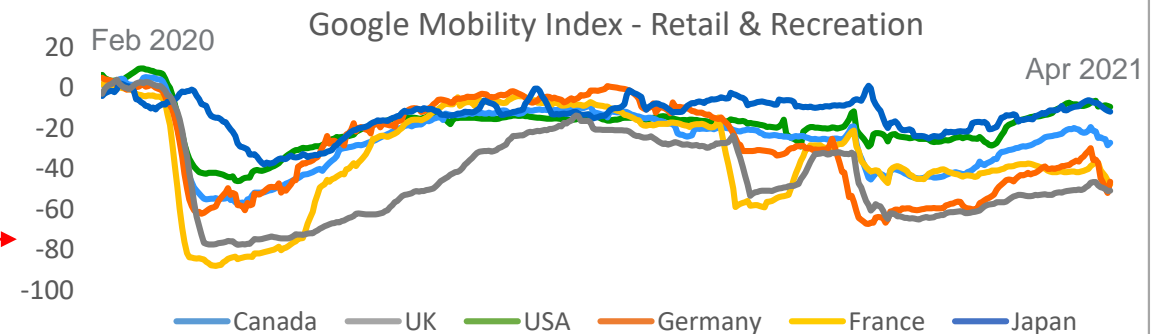
The average levels are aligned.



How to differentiate dynamics across industry segments?

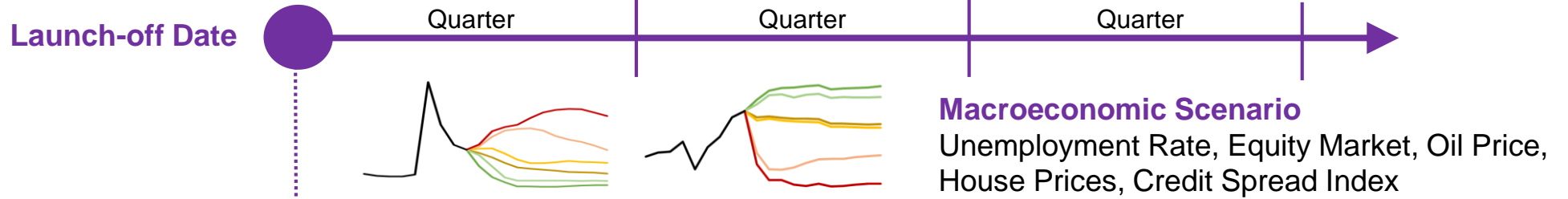
Calibrate sensitivities of industry segments to measures of

- **Social distancing** & the reaction of the population to the Pandemic... **MOBILITY INDEX**
- **Consumer Sentiment**... Proxied by **EQUITY INDEX**



Analytics: Cross-Sectional Overlay

Incorporating observed patterns into credit risk modeling



Initial credit quality Rating or PD

Google Mobility Index for a country – state of the pandemic and the sociological reaction

Event: Pandemic
Calibrated segment-level parameters using the 2020 data

- Sensitivity to mobility
- Sensitivity to consumer sentiment

Baseline Anchoring →
Macroeconomic shocks to be anchored to a Baseline Scenario

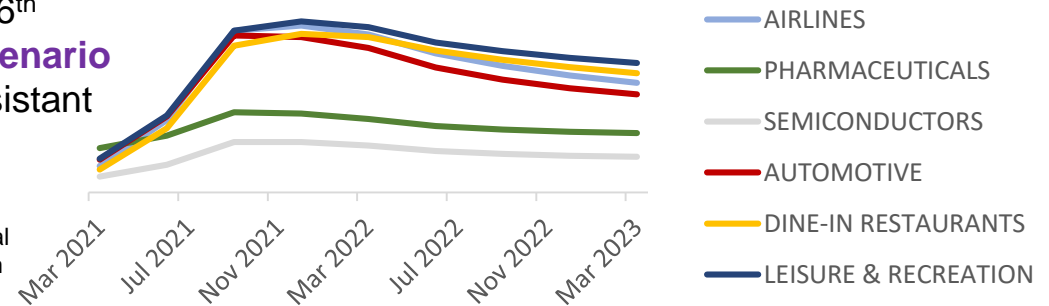
Traditional credit risk model →
Overall impact of the macroeconomic shock on credit risk

Cross-Sectional COVID-19 Overlay →
Varying impact on countries & granular industry segments

Economic recovery →
Are the vaccines effective? When will infections abate?

PD Projection Under a 96th Percentile **Downturn Scenario**
→ Spread of vaccine-resistant variants

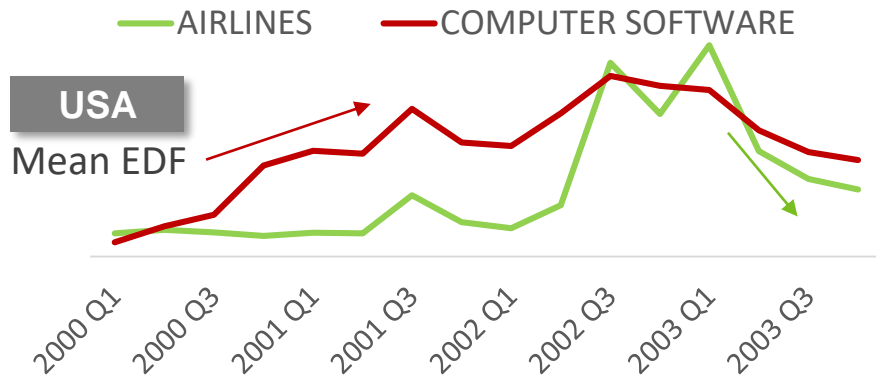
Pospisil, L., T. Daly, et al., "Incorporating Emerging Risks within Credit Models: Lessons from Sociological Reactions to COVID-19" Moody's Analytics Research Paper, December 2020.



Cross-Sectional Overlays for Past Crises

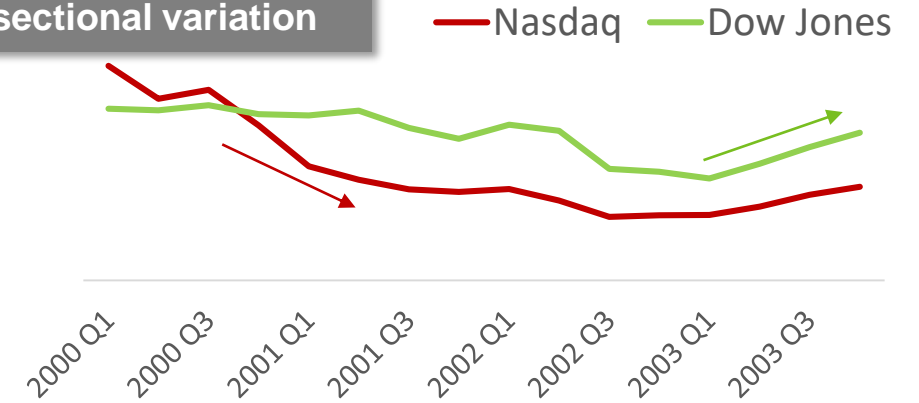
This style of analysis can be applied well beyond the Pandemic

Dot Com Bust

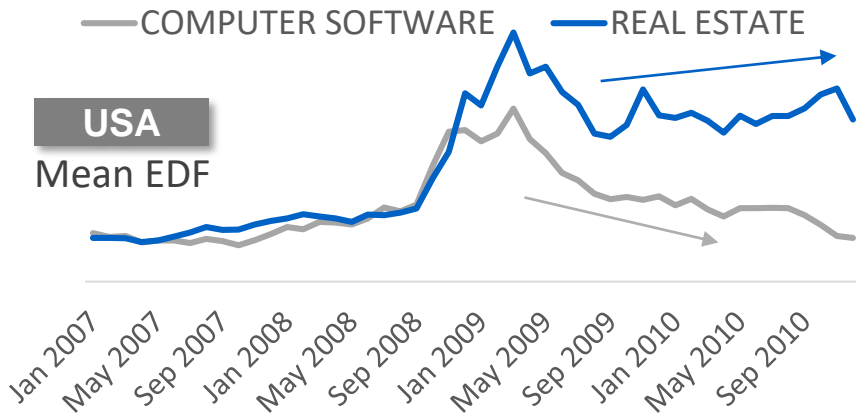


COMPUTER SOFTWARE experienced an adverse initial shock, in line with the fall in **Nasdaq**.
Credit risk of **AIRLINES** increased later and recovered faster, in line with **Dow Jones Index**.

Drivers of cross-sectional variation



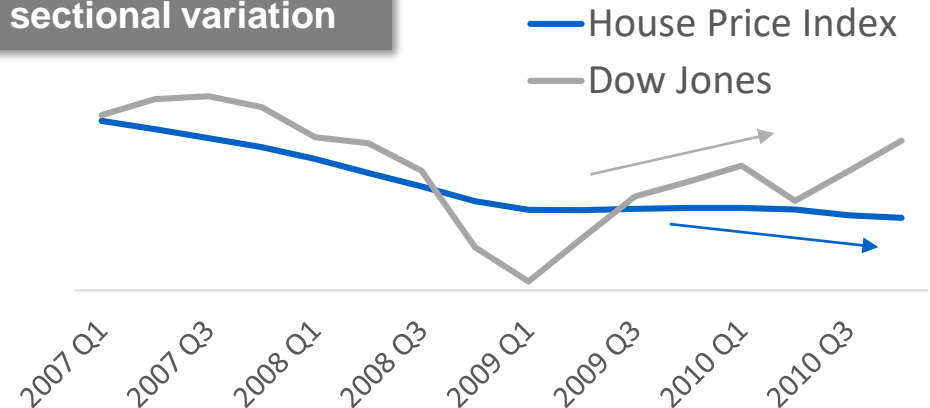
Financial Crisis



REAL ESTATE increased in credit risk that remained elevated for a prolonged period, in line with continued low level of **House Price Index**

Segments, such as **COMPUTER SOFTWARE** experienced an increase and then a quicker recovery, in line with **Dow Jones Index**.

Drivers of cross-sectional variation



Lessons from Previous Crises

Overcoming challenges with modeling emerging risks

Traditional Quantitative Credit Models

Models used for loss projections, IFRS9/CECL, stress testing.

Based on longer time series of data, at lower frequencies, such as quarterly.

Broad-brush economic variables, unable to differentiate industry impact.

Quantitative Emerging Risks Framework

Credit Risk Data

Higher frequency, name-level data captures cross-sectional patterns by allowing for empirical analysis with segment granularity descriptive of the emerging risk

Alternative Data

Mobility Indexes
Consumer Sentiment
Supply chain
Vulnerability to cyber events
Geo-location of climate hazards

Fundamental Analysis

Emerging risks, by their very nature, are new threats, for which **sufficient historical data does NOT exist**

In many cases, a qualitative assessment can be applied consistently across asset classes and is an indispensable part of risk analysis

The Global Risks Report 2021

Emerging Threats

WORLD ECONOMIC FORUM

Technological

Cyber Events

Geopolitical

Supply-Chain Disruption

Societal

Trade Disputes

Environmental

Infectious Diseases

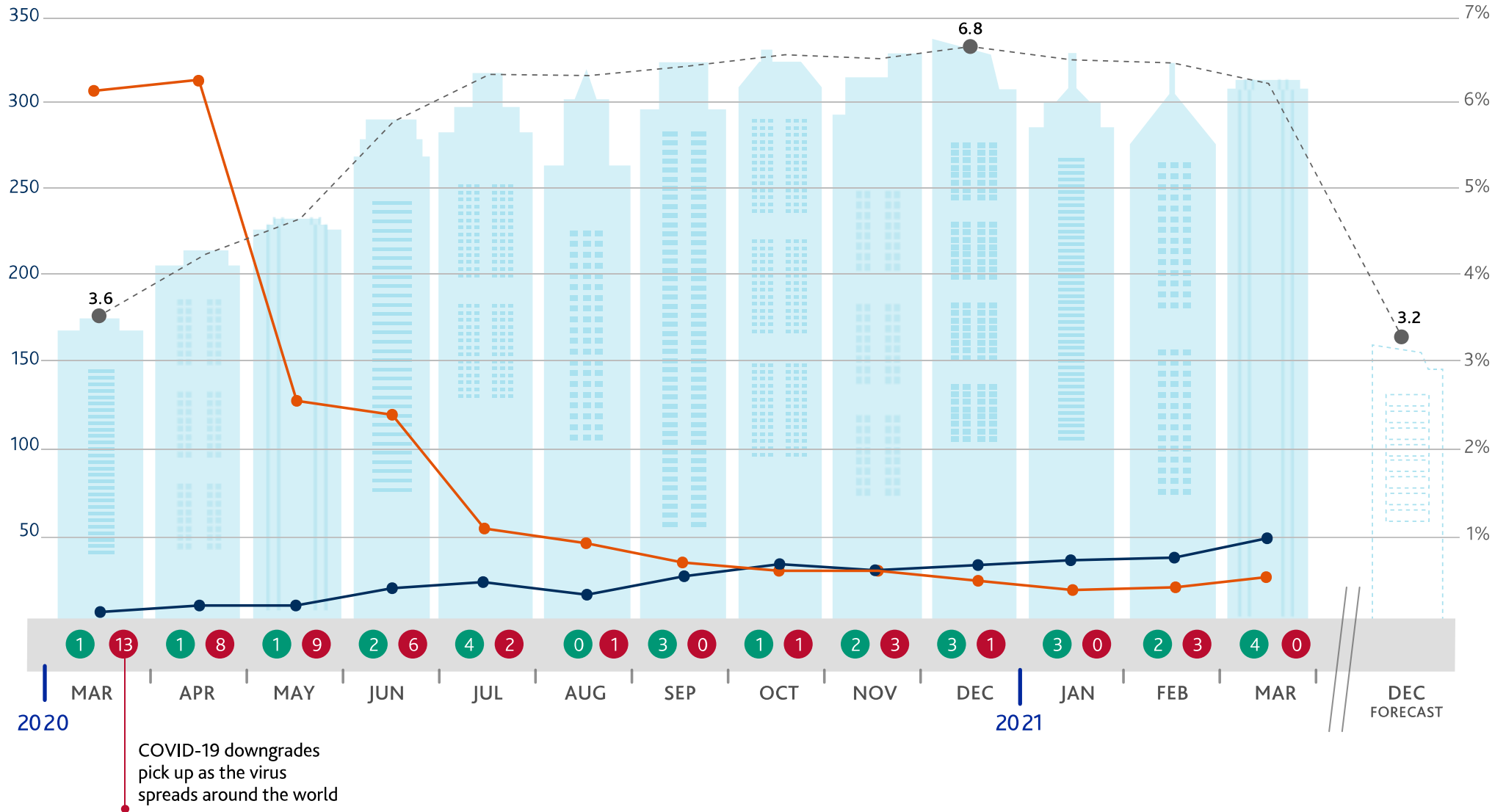
Natural Disasters



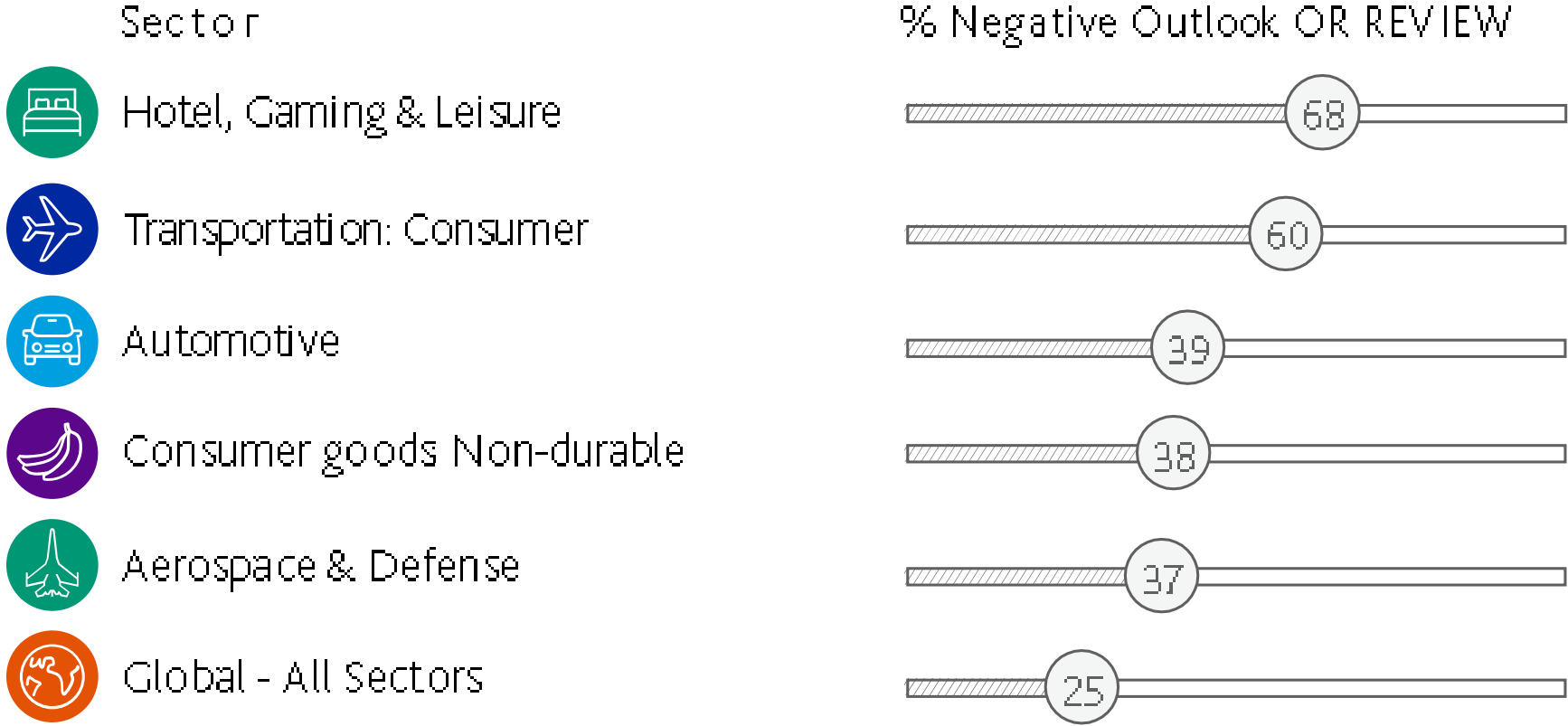
Fundamental Analysis: Understand Emerging Threats

Upgrades overtaking downgrades; speculative grade default rate to fall

● Rising stars ● Fallen angels —●— Upgrades —●— Downgrades -●- Represent default rate
■ Building heights represent the global speculative grade default rate on a trailing twelve months basis



Some highly exposed sectors still under pressure



Represents the percentage of issuers within each sector with a negative outlook or under review for downgrade at 30 March 2021.

Four Components to MIS Integration of ESG

New ESG scores will assist in transparently and systematically demonstrating the impact of ESG on credit ratings



Credit Ratings & Research

How is ESG integrated into credit ratings?

ESG factors taken into consideration for all credit ratings. Greater transparency in PRs, as well as Credit opinions. Credit Impact Score (CIS) is an output of the rating process that indicates the extent, if any, to which ESG factors impact the rating of an issuer or transaction.



ESG Scores

How is a specific issuer exposed to ESG risks/benefits?

Issuer Profile Scores (IPS) are issuer-specific scores that assess an entity's exposure to the categories of risks in the ESG classification from a credit perspective. IPSs, where available, are inputs to credit ratings.



ESG Classification

What is ESG?



Our classification reports describe how we define and categorize E, S and G considerations that are material to credit quality. New environmental classification sharpens focus on physical climate risks.

Heat Maps

Is ESG material to credit quality?



Heat maps provide relative ranking of various sectors along the E and S classification of risks.

Attacks on global energy infrastructure

....becoming more frequent and disruptive

October 2019 –
Attack on India's largest
nuclear facility breaches IT
network.

March 2020 –
Attack on Europe's Electric
Network Transmission
Operator breaches IT
network.

April 2020 –
Ransomware attack against
Energias de Portugal
impacts global IT network.

February 2021 –
Eletrobras ransomware
attack on IT systems of
nuclear power subsidiary.

Feb 2020 –
Ransomware attack on US
natural gas compression
facility.

April 2020 –
Attack on Israeli water utility
seek to disrupt water supply
during COVID epidemic.

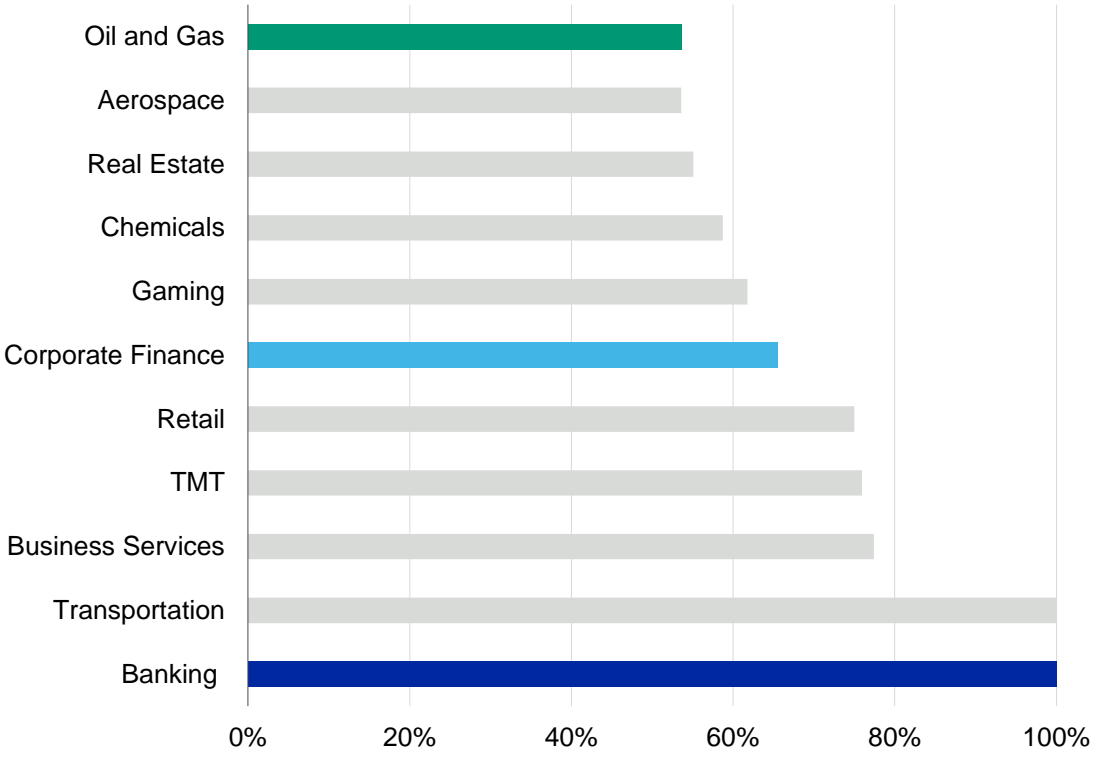
June 2020 –
ICS-capable SNAKE
ransomware attack
launched against Enel
disrupt corporate networks

May 2021 –
Colonial pipeline halts
operations after
ransomware attack on IT
systems.

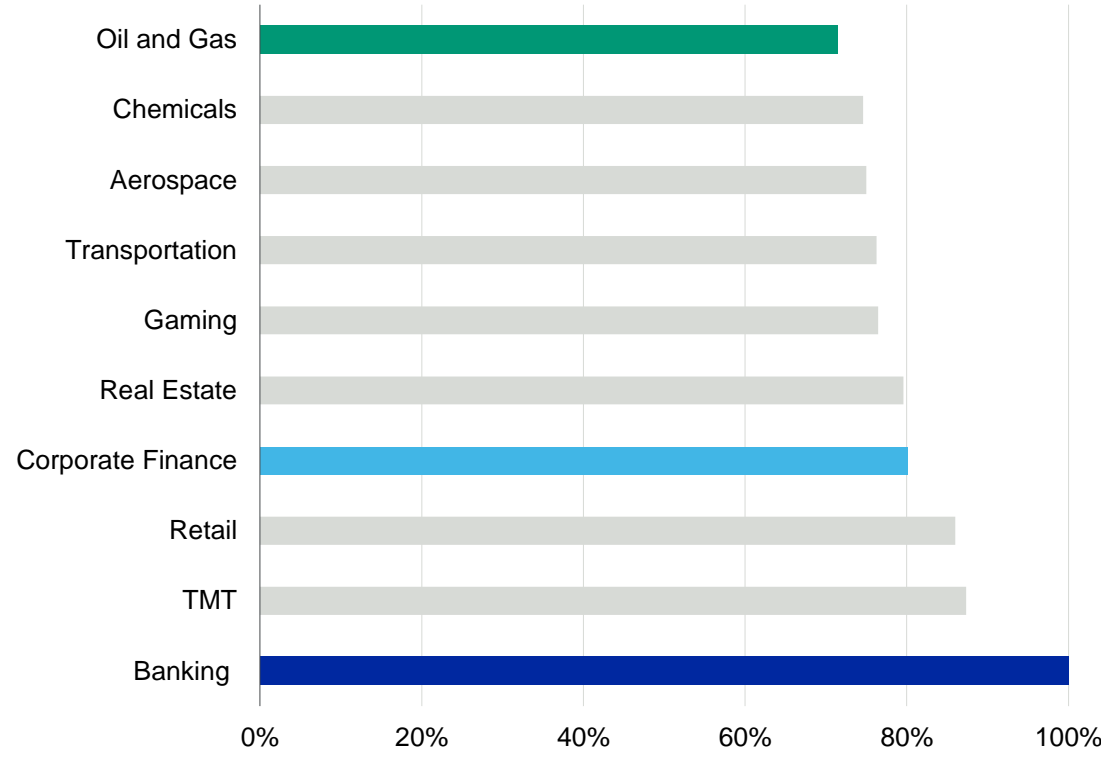
Cyber Risk

Oil and gas companies less likely to have completed tabletop simulation exercises than corporate and banking peers, and less likely to perform cyber assessment on third-party vendors

Percent of respondents by sector that have completed tabletop simulation exercises since May 2020



Percent of respondents by sector requiring cyber assessment of third-party vendors

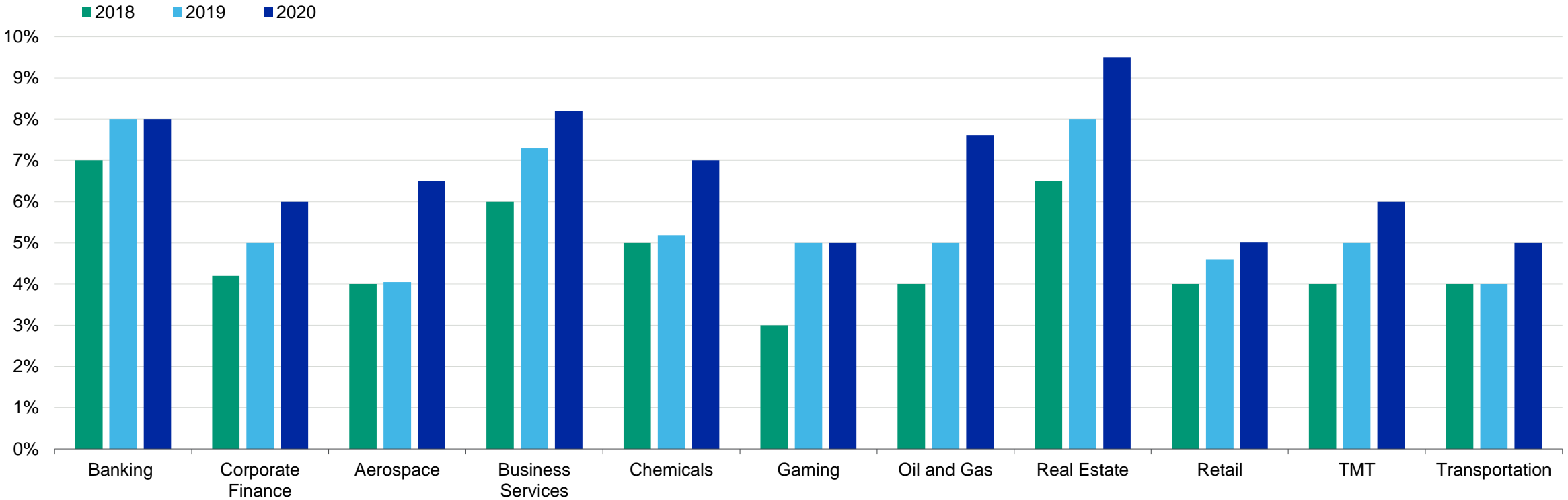


Moody's Investors Service, self-reported issuer survey results

Cyber Risk

Oil and gas industry's cybersecurity investment approaching levels of more advanced banking sector

Cybersecurity spend as percentage of IT/OT budget



Source: Moody's Investors Service, self-reported issuer survey results

Global cyber risk Issuer survey – series

INFRASTRUCTURE AND PROJECT FINANCE

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SECTOR IN-DEPTH
4 November 2020

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Electric Utilities – Global Cybersecurity readiness depends on scale, business model and generation ownership

To see how well electric utilities are prepared to defend themselves from cyberattacks, we conducted a survey of global electric utilities and power companies from March through September of this year. The results reflect key differences across what is otherwise a largely homogeneous sector. All observations in this report are based on our survey results and do not represent a definitive assessment of cybersecurity readiness.

- Amid growing cyberattacks, survey results reveal disparities in levels of preparedness. Cybersecurity readiness tends to be stronger among large, regulated utilities than among small utilities and those operating in competitive markets. There appears to be little difference among issuers based on geographic location or rating level.
- Greater financial resources give very large utilities an edge over smaller counterparts. Very large utilities exhibit better cyber governance, and risk management practices than midsize and small utilities.
- Regulated utilities appear better positioned than unregulated and not-for-profit utilities. Regulated utilities operate critical infrastructure assets and are often judged by their reliability in addition to their profits. As a result, regulators provide cost recovery mechanisms designed to maintain well-rounded cybersecurity practices.
- Among midsize and small utilities, cyber insurance helps mitigate weaker resiliency practices of not-for-profit utilities. Not-for-profit utilities with total assets of less than \$10 billion are more likely to have stand-alone cyber insurance and derive greater coverage value from their policy than similarly sized, regulated peers.
- Cybersecurity readiness is stronger among vertically integrated utilities than transmission networks. Vertically integrated utilities display stronger cybersecurity readiness, with closer links between cyber managers and the corporate executive team, a more diverse and sophisticated arsenal of cyber defense practices and more prevalent adoption of cyber insurance.
- Use of advanced cyber practices are more common at privately owned than state-owned utilities. But utility types rely on similar cyber risk governance practices and are investing in cybersecurity at about the same rate.
- Rating levels and regional differences are not major distinguishing factors. Cybersecurity readiness does not differ significantly by rating or region, but there are some differences in terms of cyber employee headcounts and cyber insurance coverage.

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Japan	81-3-5408-4100
EMEA	44-20-7772-3454

Banks – North America Cybersecurity strength rests on governance and prevention

To assess North American banks' cyber risk preparedness, we surveyed 29 banks in the region. The results show strong cyber risk practices but with some differences across what is otherwise a largely homogeneous sector. Cyberattacks pose financial, reputational and regulatory risks for banks. Evidence of weak governance, lax risk prevention or poor response and recovery readiness would be credit negative, with the implications of a successful attack reflecting its nature, severity and duration. All observations in this report are based on our survey results and do not represent a definitive assessment of cybersecurity readiness.

- Cyber governance is typically more robust at larger banks, Canadian banks and US government-related issuers (GRIs). Large banks and Canadian banks also report greater use of advanced cyber practices. Resource allocation is more substantial at banks where the chief information security officer (CISO) reports directly to the C-suite.
- Most bank cybersecurity managers report directly to the C-suite, which raises awareness and understanding of cyber risk. Most banks report at least one board member with cyber credentials, but large banks have more board-level expertise than mid-size and small banks. Canadian banks and US GRIs report to boards on cyber more frequently than US regional banks.
- Head count and budget allocated to cybersecurity continue to grow. Growth in head count has coincided with material investment to [help ensure that banks' digitalization efforts are secure](#). There is higher growth in full-time cyber employees and cyber budgets at banks where the CISO reports directly to the C-suite.
- Advanced cyber defense practices are in wide use. These include sophisticated exercises like red team testing, with formal processes to remediate findings. Sophisticated practices are more common among large banks and Canadian banks.
- Cyber risk assessments for external suppliers are also widely adopted. These include periodic review and timely notification of cybersecurity incidents, vulnerabilities, patches and malware affecting suppliers, highly relevant in light of the [Sunburst](#) attack.
- Cyber risk transfer is extensive and mitigates financial harm. About 90% of respondents have standalone cyber insurance with extensive coverage, including business interruption, legal settlements, regulatory fines and ransom payments.
- Cloud adoption will grow. Cloud technology, which can be more secure, is used the most by Canadian banks and small banks.

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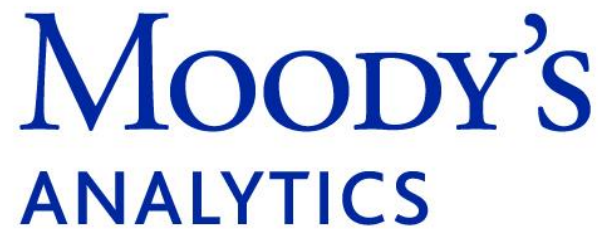
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Insurers, Insurance Brokers and Asset Managers – Global Survey signals cybersecurity strength, with some differences across sectors, regions

To assess insurers', insurance brokers' and asset managers' cyber risk preparedness, we surveyed 100 companies across North America and internationally, primarily in Europe. The results indicate cybersecurity strength, as was the case for North American banks, but with some differences across sectors and regions. Cyberattacks pose financial, reputational and regulatory risks for insurers, insurance brokers and asset managers. Evidence of weak governance, lax risk prevention or poor response and recovery readiness would be credit negative, with the implications of an attack depending on its nature, severity and duration. All observations in this report are based on our survey results and do not represent a definitive assessment of cybersecurity readiness.

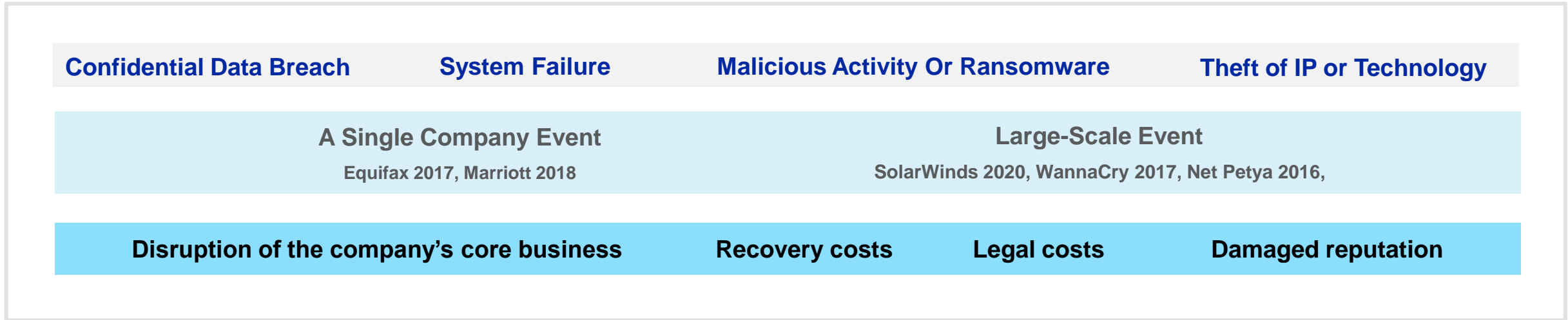
- Cyber governance is generally stronger at larger insurers, which report greater use of advanced cyber governance practices. North American insurers also reported higher use of advanced practices than did international insurers.
- Smaller to medium-sized asset managers' cyber preparedness has matured but lags that of insurers. Respondents reported cybersecurity governance, management and overall cyber preparedness that is more in line with smaller insurers.
- Most cybersecurity managers report directly to the C-suite, increasing companies' awareness and understanding of cyber risk. Larger insurers and higher-rated companies have more board-level expertise than smaller and lower-rated companies.
- Hiring and budget allocated to cybersecurity are growing. Growth in head count has coincided with material investment in cybersecurity.
- Advanced cyber defense practices are widespread. These include sophisticated exercises like red team testing, and are most common among larger companies.
- Cyber risk assessments for external supply chain providers are nearly universally adopted, and important given the recent [Sunburst](#) and Microsoft attacks. North American insurers were more likely to require third parties to carry cyber insurance than were international insurers.
- Cyber risk transfer and coverage is widespread and mitigates financial harm. Most North American respondents have standalone cyber insurance, but it is less prevalent outside North America.
- Cloud adoption will grow. Cloud technology can be more secure than on-premise data storage, and migration to the cloud will continue, reducing reliance on site infrastructure.



Quantitative Methods for Describing Emerging Threats

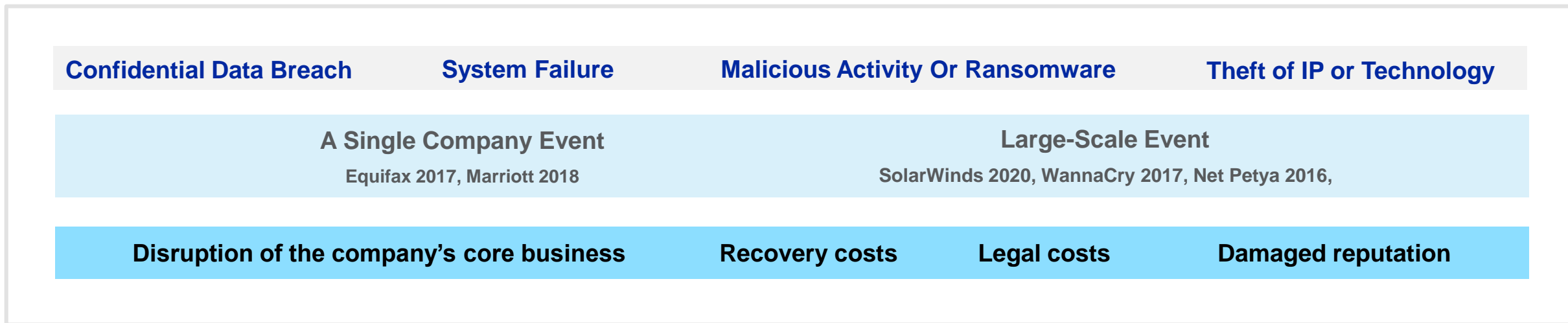
Cyber Events and Their Impact on Credit Risk

Select types of cyber events and sources of the resulting loss



Cyber Events and Their Impact on Credit Risk

Select types of cyber events and sources of the resulting loss



How can cyber events change the creditworthiness of affected companies?

- Impact EDFs
- Contribute to rating reviews
- Lead to corporate bankruptcies

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Rating Action: Moody's places SolarWinds' ratings on review for downgrade following announcement of cyberattack

https://www.moody's.com/research/Moodys-places-SolarWinds-ratings-on-review-for-downgrade-following-announcement--PR_437591



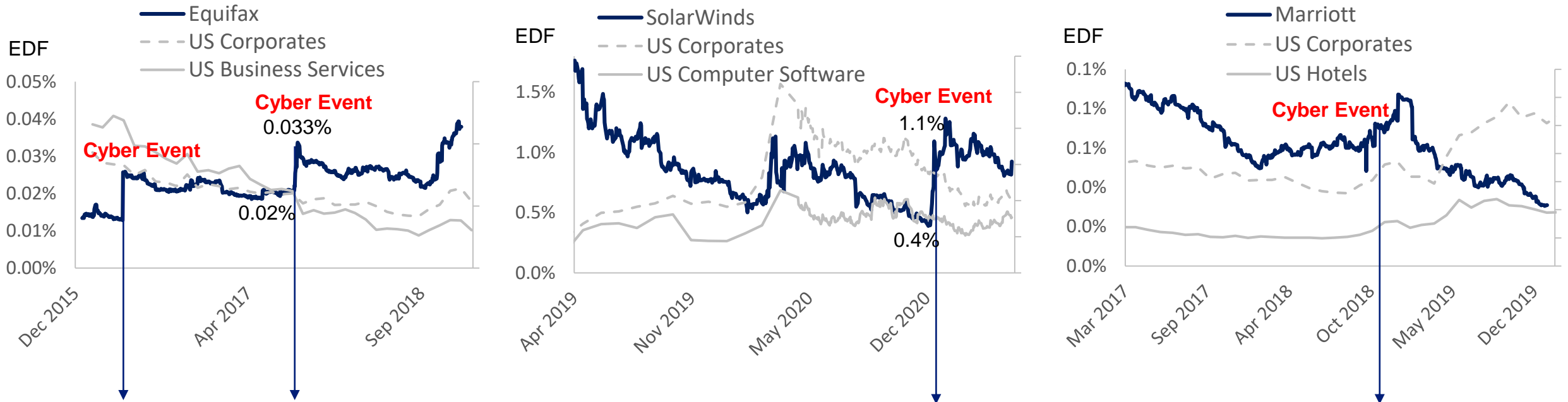
<https://www.forbes.com/sites/taylorarmerding/2019/06/14/more-medical-mega-breaches-thanks-to-third-party-insecurity/?sh=7ce624216111>

June 2019: Medical testing giants Quest Diagnostics and LabCorp announced...that personal and medical information of about 19.4 million patients had been compromised due to a breach of American Medical Collection Agency (AMCA), their billing collections vendor.

Retrieval-Masters Creditors Bureau Inc., which does business as AMCA, filed for Chapter 11 bankruptcy protection

When do Markets React to Cyber Events?

Using EDFs to quantify the real-time market reaction



What differentiates the magnitudes of impact?

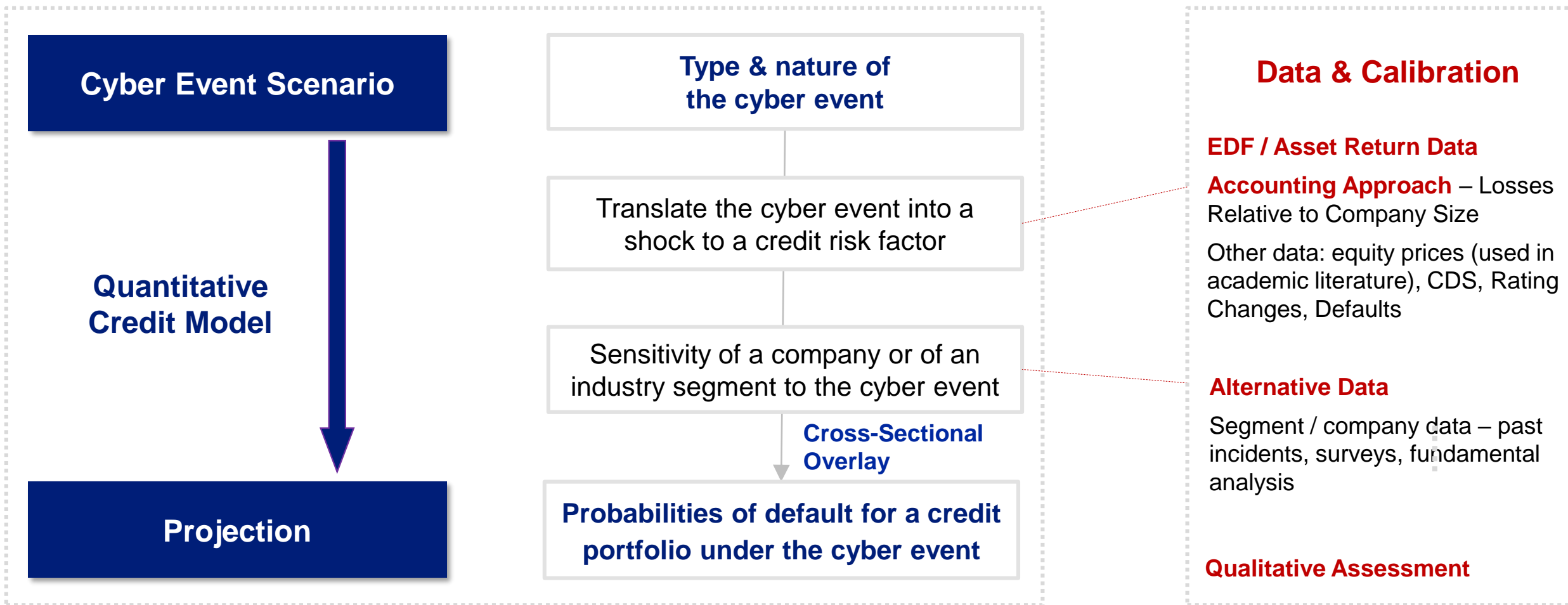
Confidential data breach (retail customers) in a company's core business

Malicious activity: hackers used a SolarWinds software update, and its core business, to access the IT systems of hundreds of customers, ranging from corporations to government agencies

Confidential data breach (retail customers) in a hotel chain

Quantitative Modeling of a Cyber Event Impact

Challenges: Data sparsity & heterogeneous nature of cyber events



Alternative Data for Cyber Risk

Searching for measures of segments' sensitivity to cyber events

Verizon Dataset of Cyber Incidents
32,000 Incidents Over 2020, Global Dataset.

Ponemon Survey (2017)
Annualized Cost of Cyber Crime, Global
Sample, 254 organizations

MIS – Cyber Risk Heatmap (2019)
Qualitative Assessment

Industry Segment <small>For challenges of cross-industry comparisons, see the report</small>	Number of Past Cyber Events		
	Web Application Compromised	Internal Errors	Crimeware Ransomware
Accommodation	18	15	34
Administrative	10	2	5
Construction	10	0	10
Education	65	62	179
Entertainment	30	22	35
Finance	152	128	63
Healthcare	140	163	192
Information	162	115	403
Manufacturing	107	47	393
Mining+Utilities	16	6	21
Other Services	39	20	15
Professional	139	63	135
Public	149	112	800
Real Estate	14	6	1
Retail	66	21	55
Transportation	22	15	24

Industry Segment <small>For challenges of cross-industry comparisons, see the report</small>	Cost per firm-year Million USD
Financial services	18
Utilities and energy	17
Aerospace and defense	14
Technology and software	13
Healthcare	12
Services	11
Industrial/manufacturing	10
Retail	9
Public sector	8
Transportation	7
Consumer products	7
Communications	7
Life science	6
Education	5
Hospitality	5

Sector	Vulnerability	Impact
Hospitals	HIGH	HIGH
Medical Devices	HIGH	MEDIUM
Banks	HIGH	HIGH
Basic Commodities	LOW	LOW
Consumer Products	MEDIUM	LOW
Lodging, Gaming	HIGH	MEDIUM
Manufacturing	HIGH	MEDIUM
Oil & Gas	LOW	MEDIUM

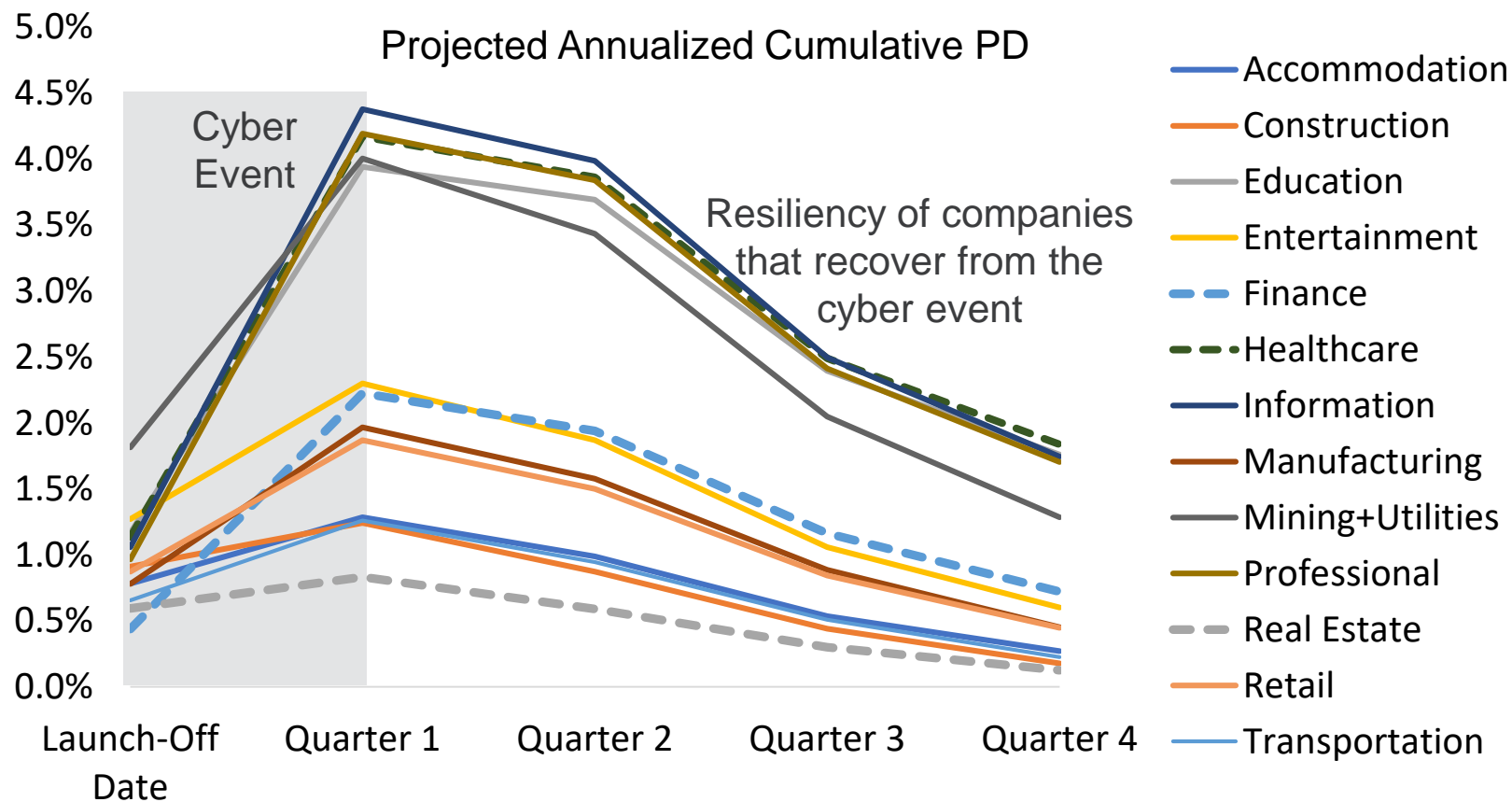
Constructing a segment-level score of sensitivity to cyber events

Quantifying a Cyber Scenario

Cross-sectional impact of a large-scale attack on credit

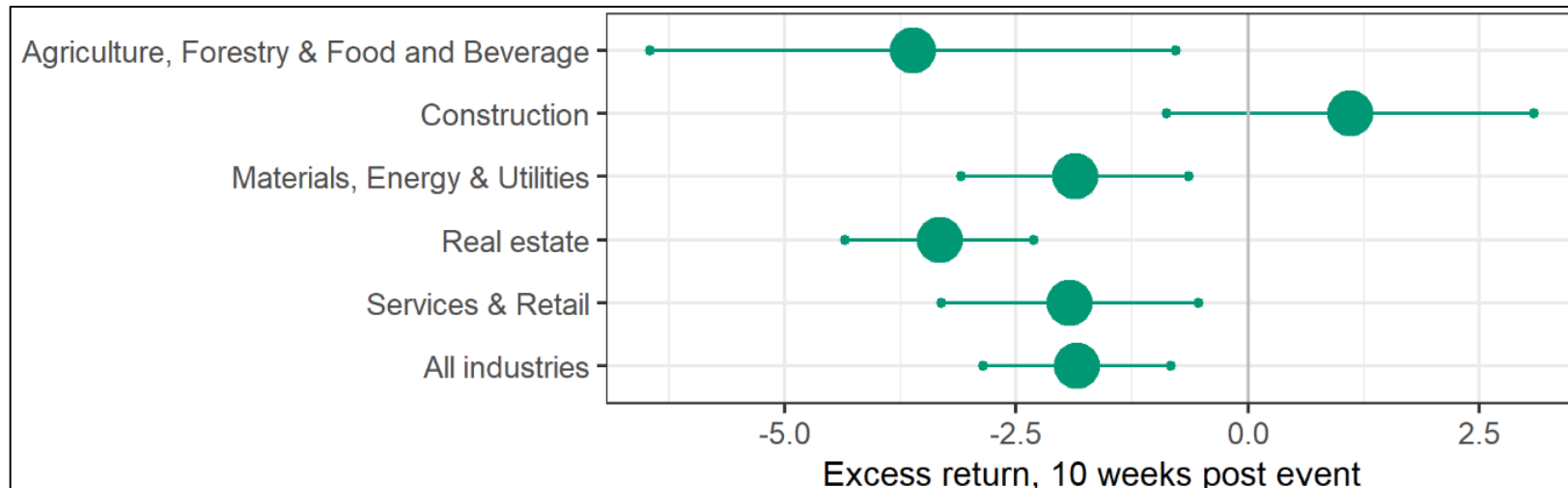
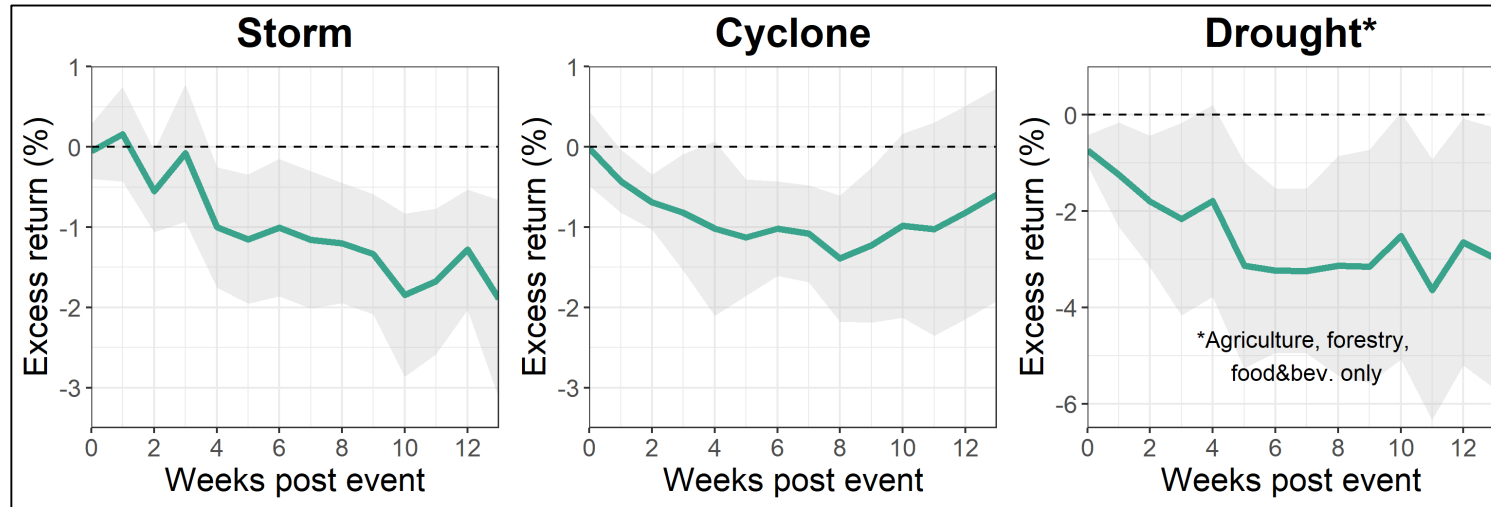
Cyber scenario calibrated to three times WannaCry or Not Petya ransomware attacks

- The segments with the most pronounced PD shocks include **HEALTHCARE** and **FINANCE**
- On the other hand, segments such as **REAL ESTATE** see little impact



Quantifying Emerging Threats: Climate Hazards

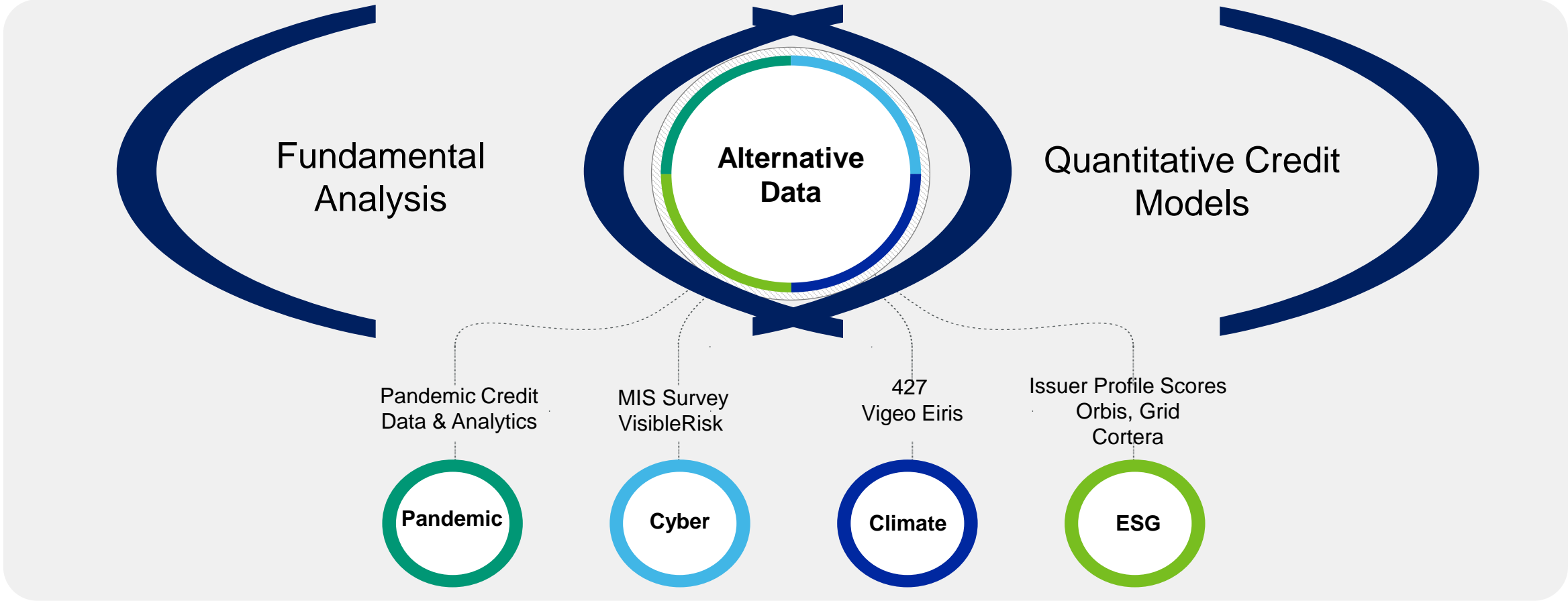
Natural disasters and affected firms post-event excess asset returns



Ozkanoglu, O., Milonas, K., Zhao, S., Brizhatyuk, D., "An Empirical Assessment of the Financial Impacts of Climate-related Hazard Events" Moody's Analytics Research Paper, December 2020.

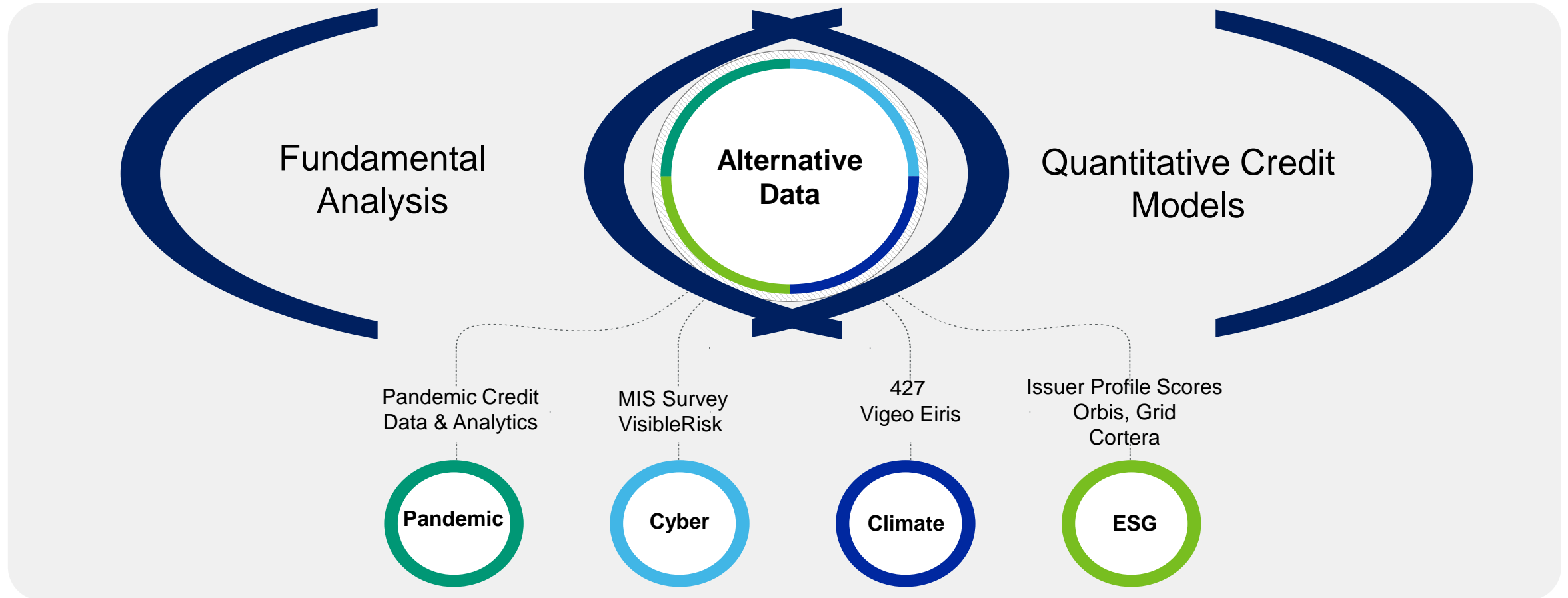
Credit Assessments and Emerging Threats

By their nature require articulation using alternative data



Credit Assessments and Emerging Threats

By their nature require articulation using alternative data



“if you’ve seen one pandemic, you’ve seen ... one pandemic.” Adam Kucharski

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