Transmission of Economic and Financial Shocks:
Getting Prepared for the Next Downturn or Crisis

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Preamble

"Would I say there will never, ever be another financial crisis? ... Probably that would be going too far. But I do think we're much safer, and I hope that it will not be in our lifetimes, and I don't believe it will be…"

- *Janet Yellen, Former U.S. Federal Reserve Chair*

Agenda

1. Where Are We in the Credit Cycle?
2. Assessing Risk and Vulnerabilities
3. Transmission of Shocks
4. Getting Prepared for Next Downturn

1

Where Are We in the Credit Cycle?

Where Are We in the Credit Cycle?

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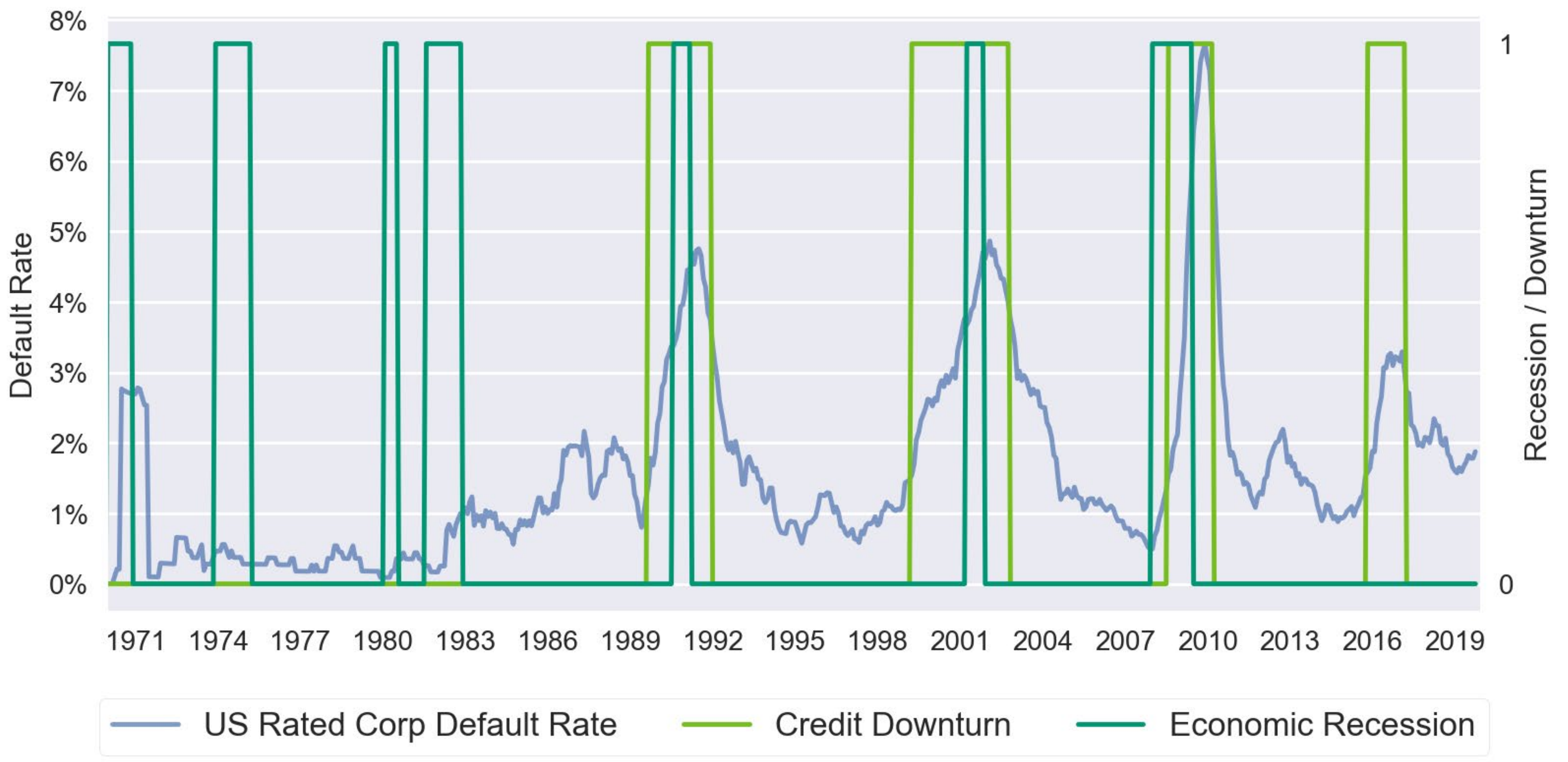
The $1.3 trillion loan market that's spooking everyone right now

Subprime Auto Loans Blow Up, 60-Day Delinquencies Shoot Past Financial Crisis Peak

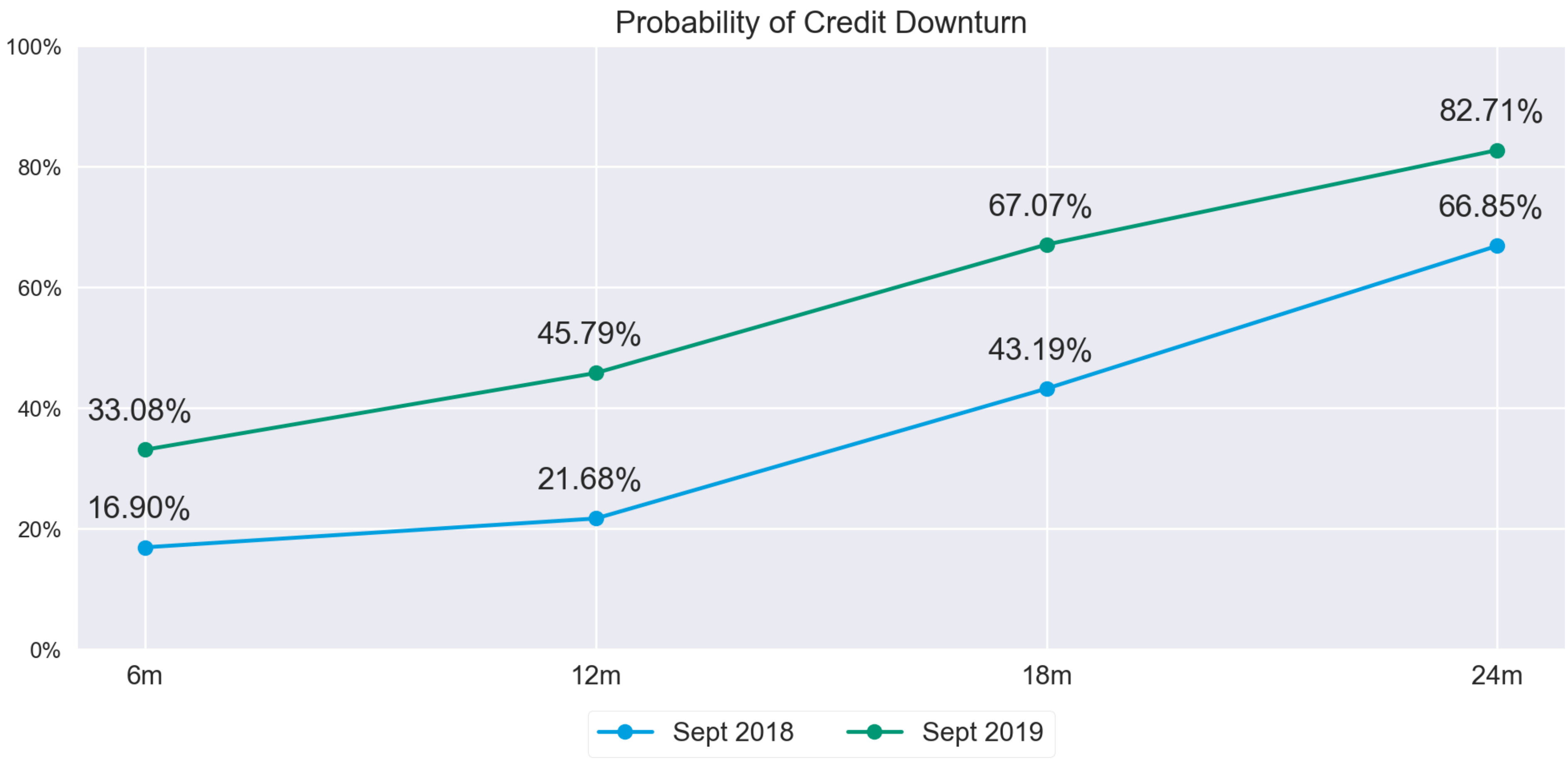
WTO cuts forecast for global trade growth amid U.S.-China dispute, broader economic slowdown

Increasing Portfolio Similarities of Investment Funds Raise the Potential to Transmit Shocks

Economic Recessions & Credit Downturns



Probability of Credit Downturn Elevated



2

Assessing Risk and Vulnerabilities

Assessing Risk and Vulnerabilities

Widely Cited Vulnerabilities: Corporate Credit

Significant rise in non-financial corporate credit

Prolonged decline in overall borrower quality

Decrease in covenant protection

Record level of repayment and debt rollover ahead

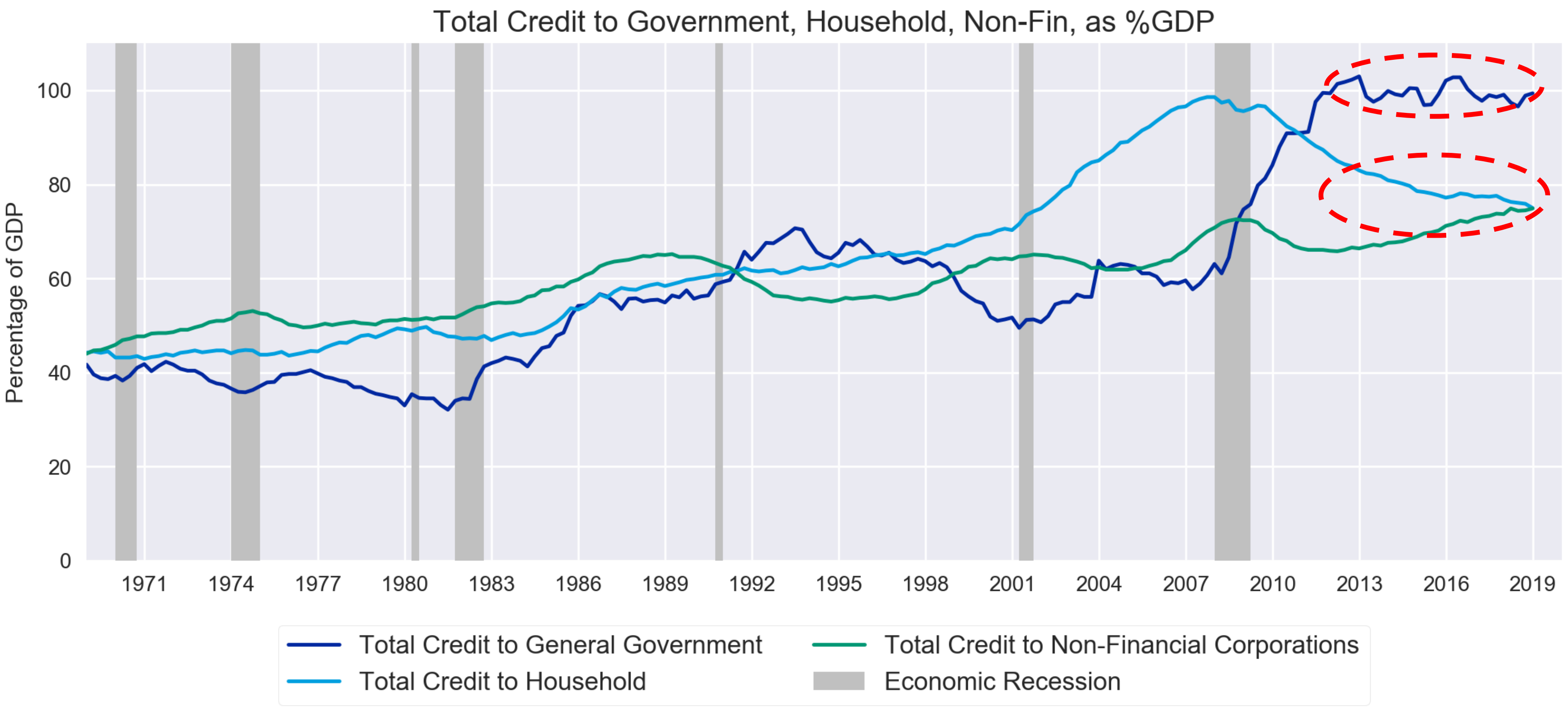
Abilities of our financial markets, central banks, regulators and governments to absorb and deal with a large shock and crisis

Increasing holdings of riskier and more illiquid assets by institutional investors

Sources: Fed, OECD, IIF, OFR, BIS, IMF, Moody's Analytics, etc.

Assessing Risk and Vulnerabilities

Rising Debt Levels



Source: Fed

Assessing Risk and Vulnerabilities

Questions to ponder

What drives the significant expansion of corporate credit?

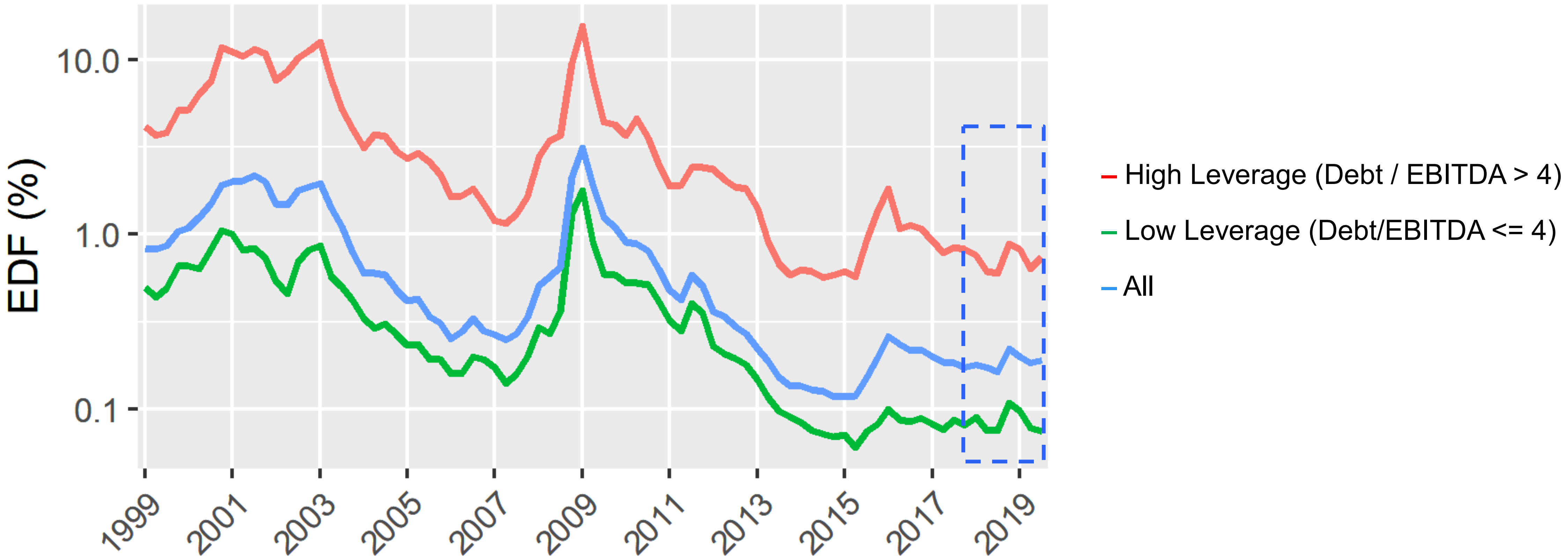
Have the borrowers been putting debt into productive use?

Can the borrowers service and repay the debt, both under current and stressed economic conditions?

What do realized default rates and forward looking measure say about the level of credit risk now?

Assessing Risk and Vulnerabilities

Low EDF

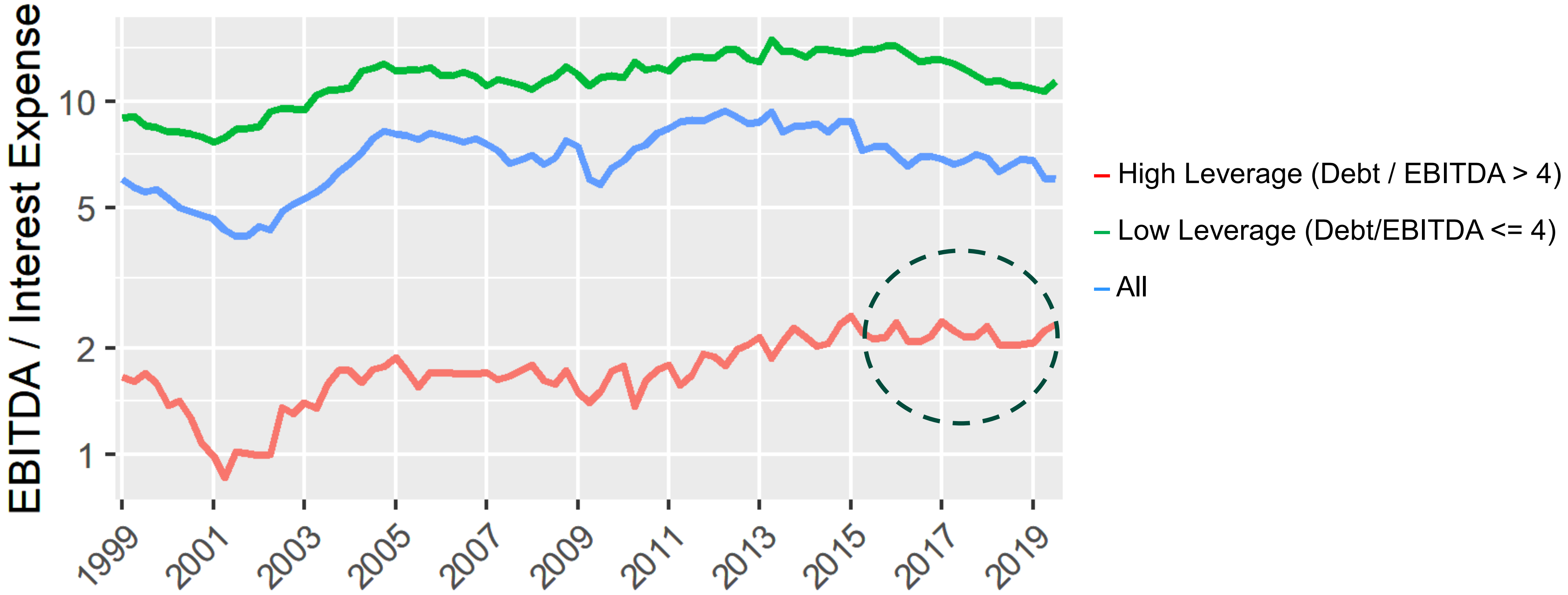


US corporates with sales larger than $100 MM

Source: Moody's Analytics

Assessing Risk and Vulnerabilities

Good Repayment Capacity

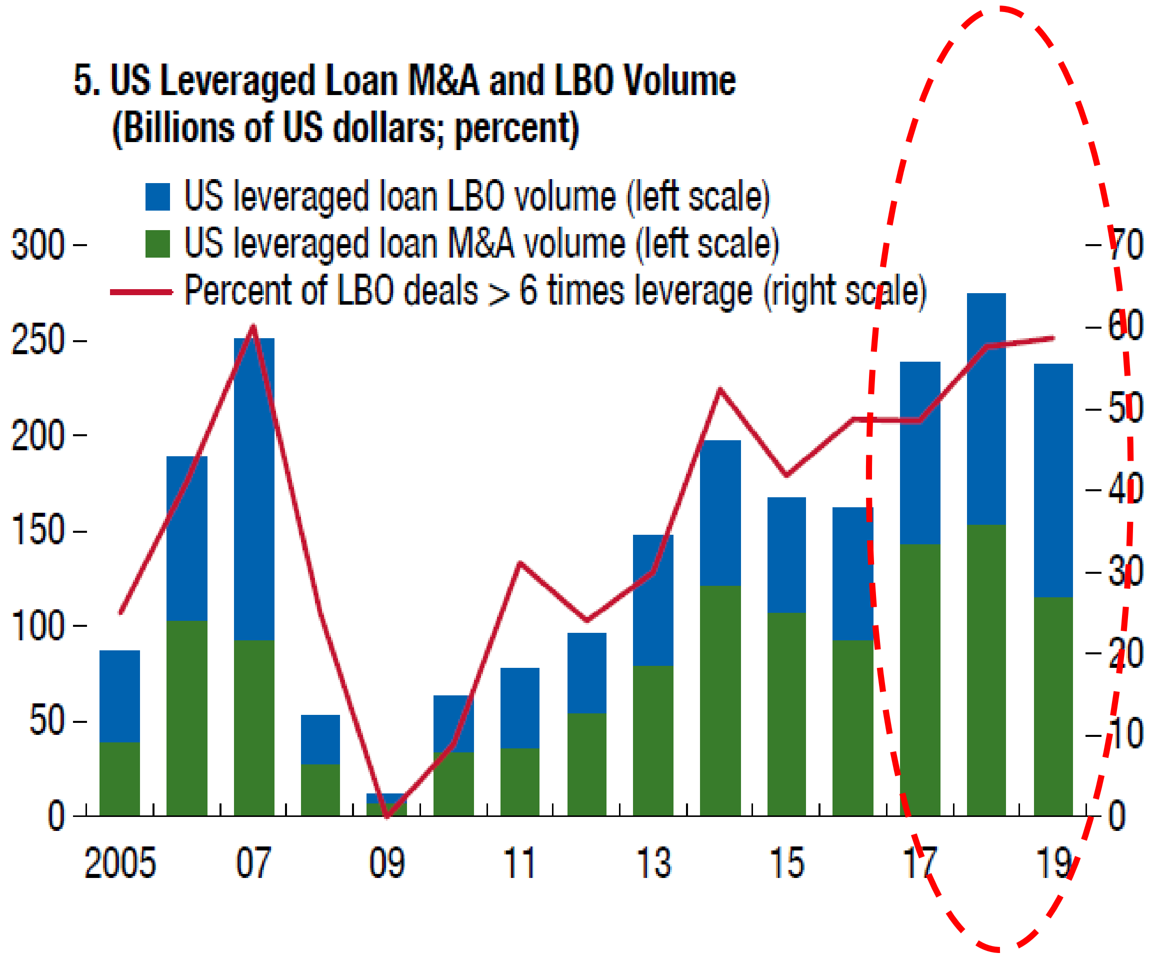


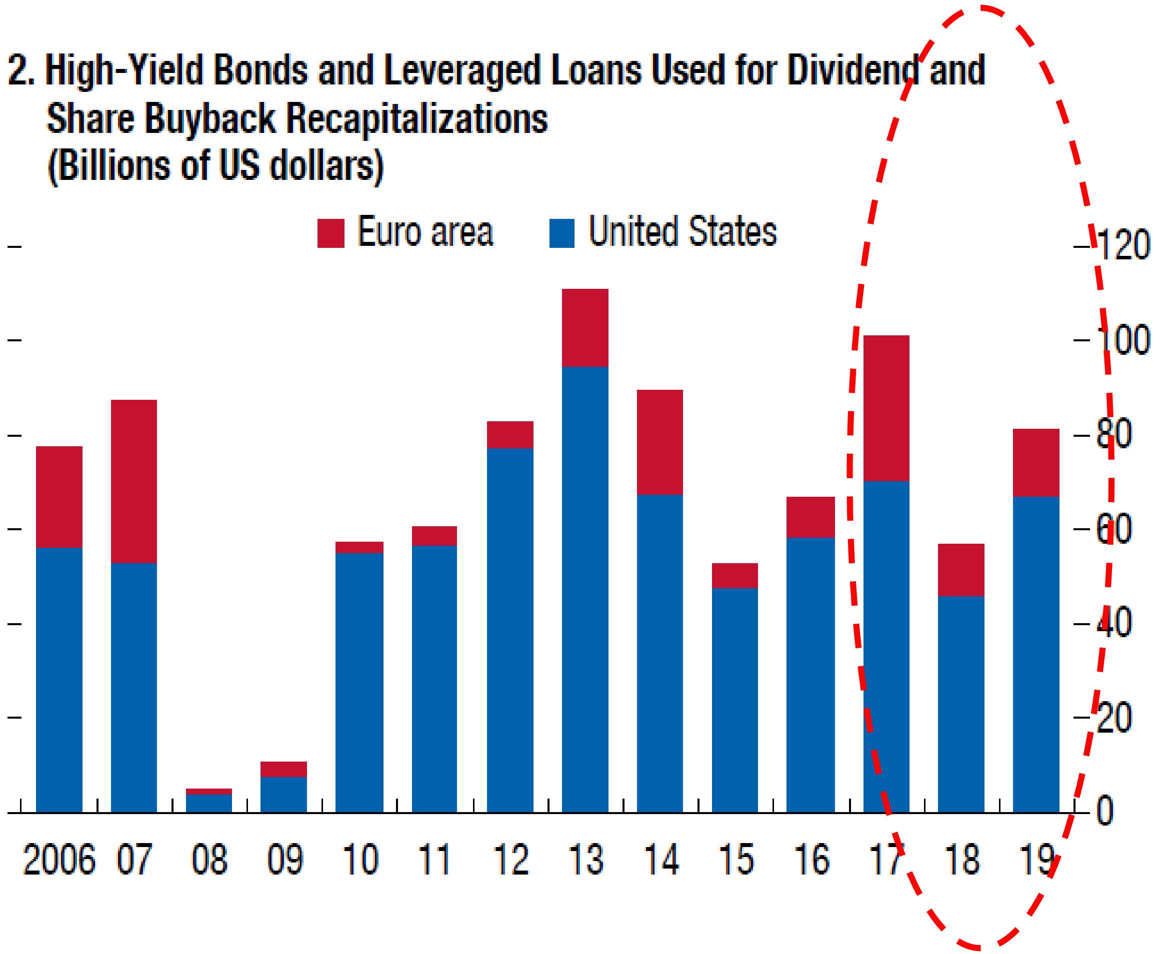
US corporates with sales larger than $100 MM

Source: Moody's Analytics

Assessing Risk and Vulnerabilities

Increased payouts, M&As, LBOs Financed with Debt

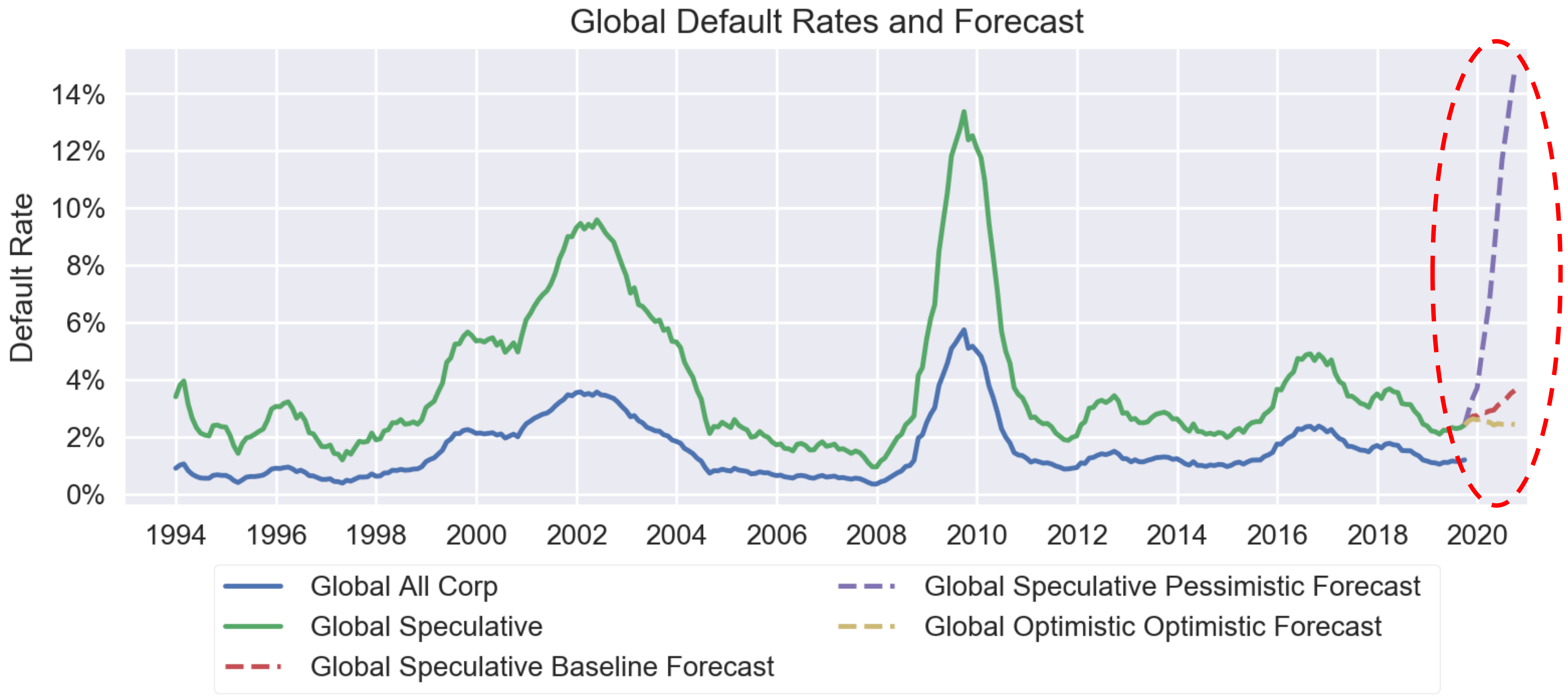




Source: IMF

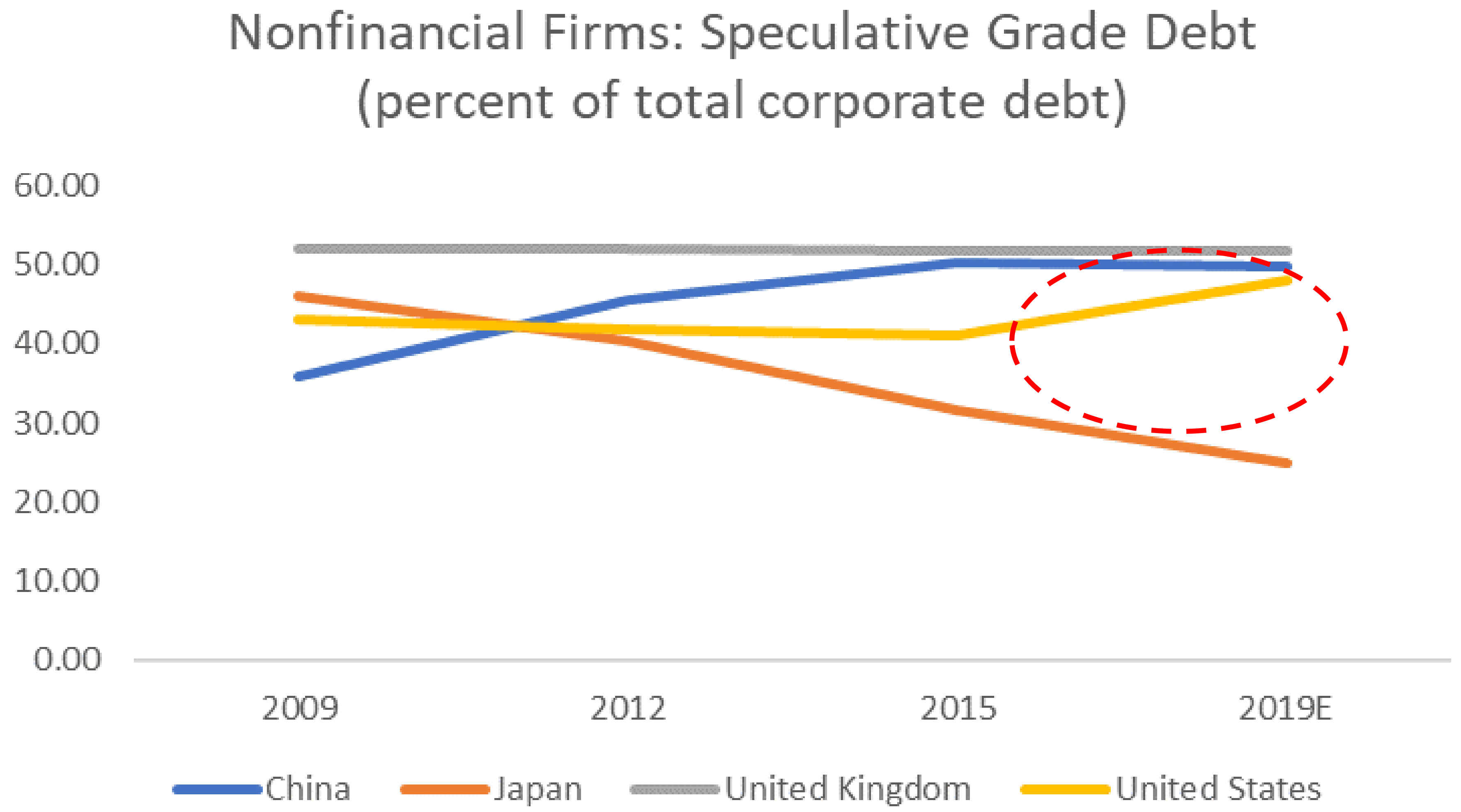
Assessing Risk and Vulnerabilities

High Yield Default Rates Are Still Low



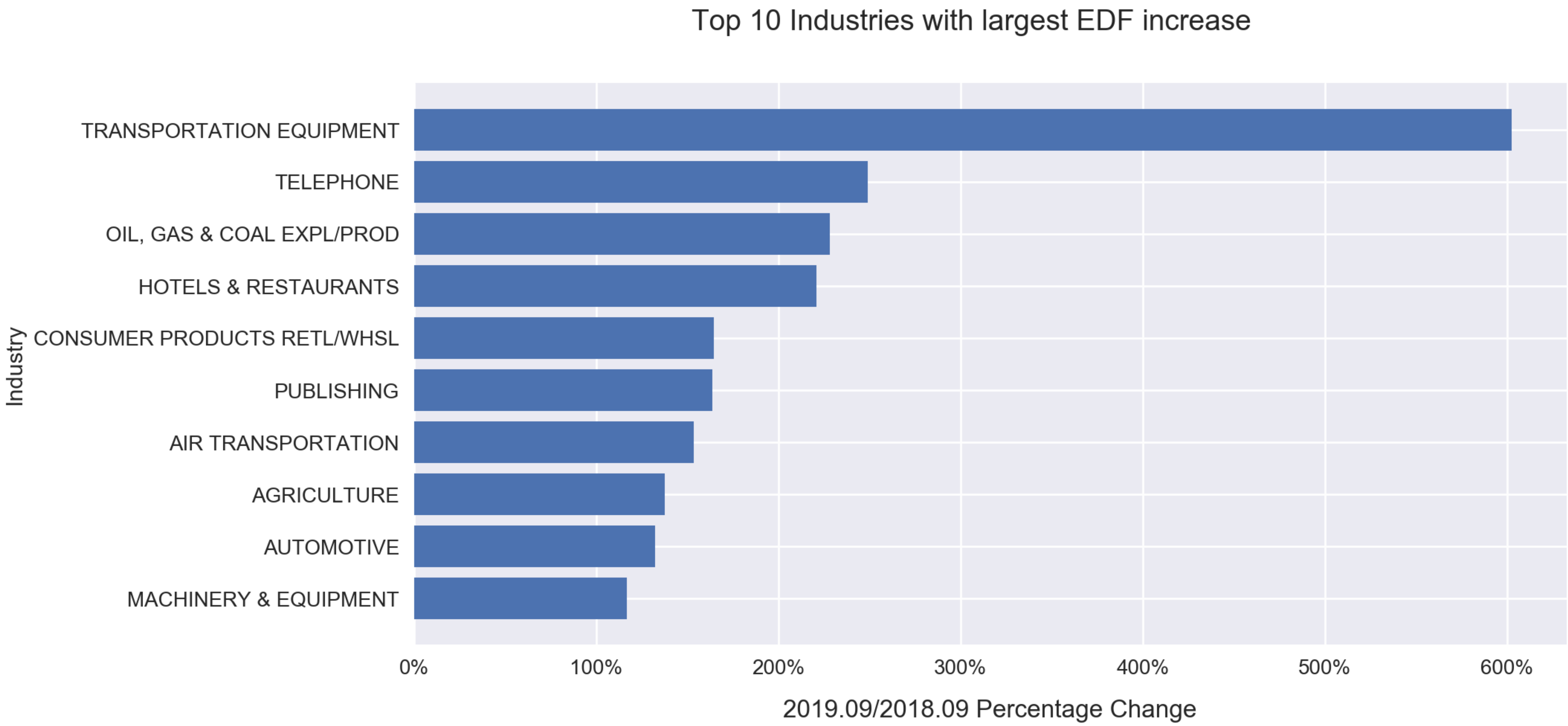
Source: Moody's Investor Service

Debt Credit Quality Deteriorating

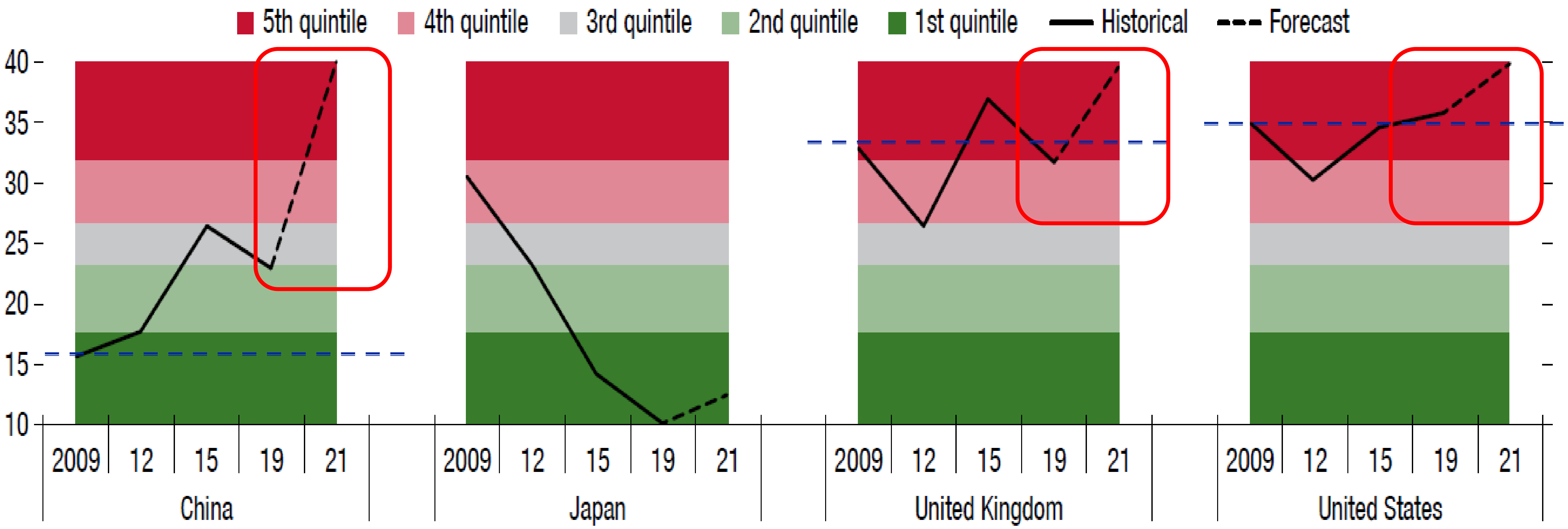


Source: International Monetary Fund

Cyclical Industries seen Increase in EDF



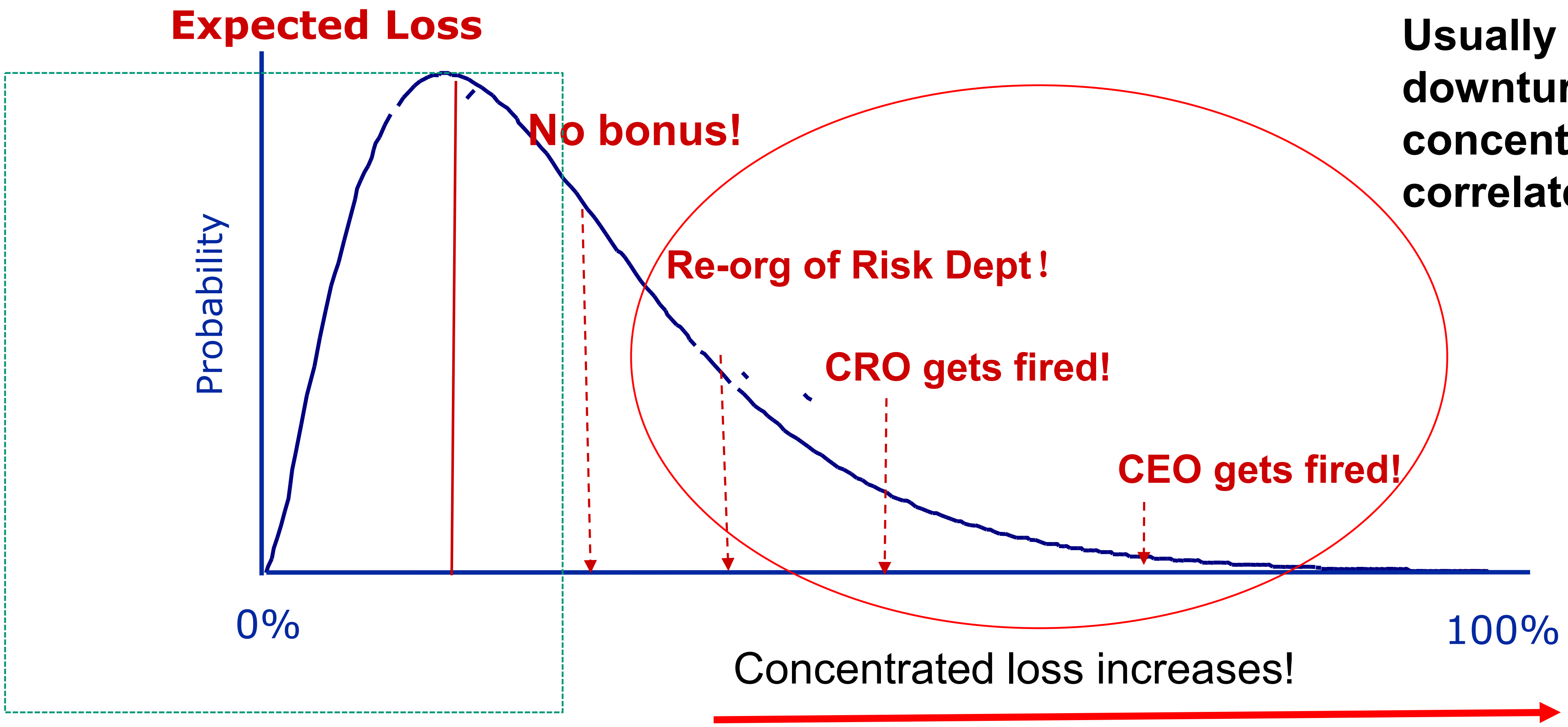
Debt-at-Risk Under Stressed Scenarios



Sources: IMF

3 Transmission of Shocks

Credit Loss and Consequence



Usually happens during downturn or crisis, with concentrated or correlated loss

Which May Tip the Balance?

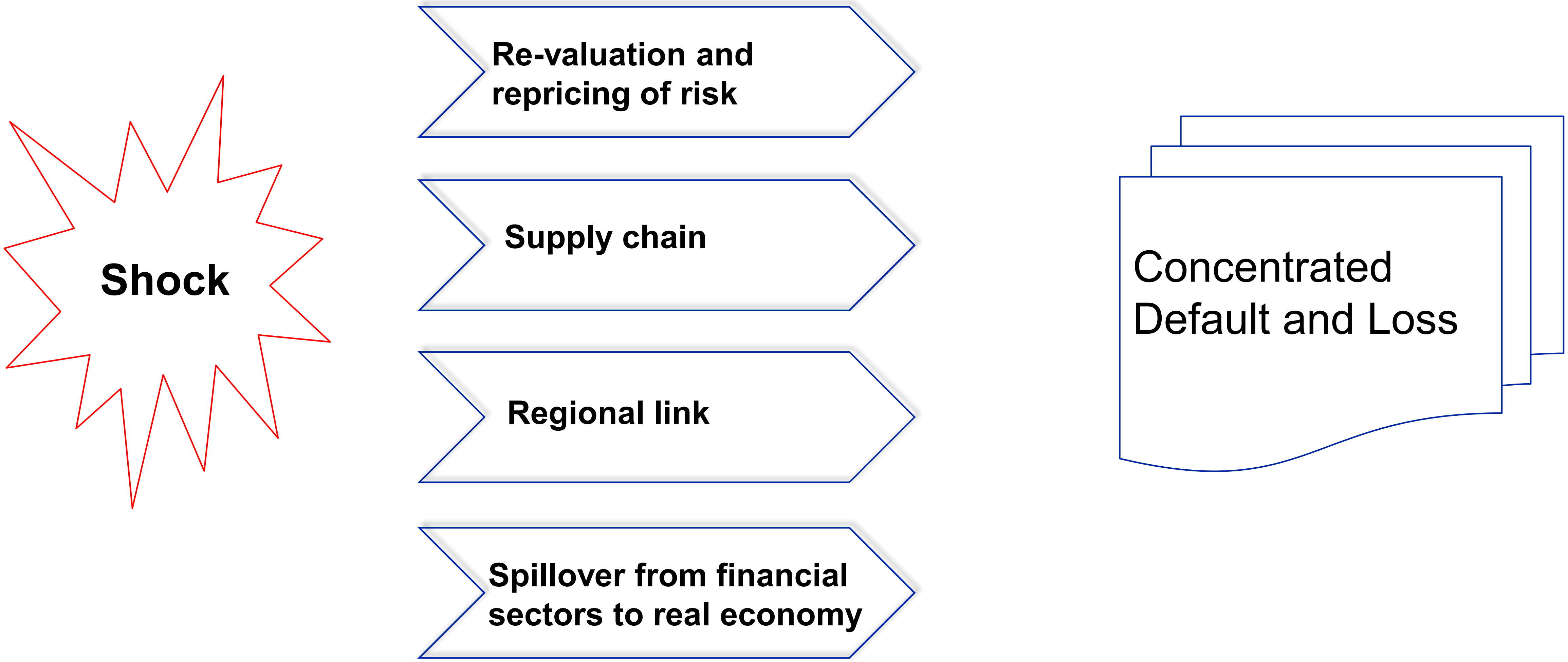
» Burst of Valuation Bubbles?

» Trade Wars?
  – U.S. vs. China, U.S. vs. Europe, etc.

» Geopolitical?
  – Sino-American new cold war
  – Brexit
  – Oil price shock, conflict with Iran

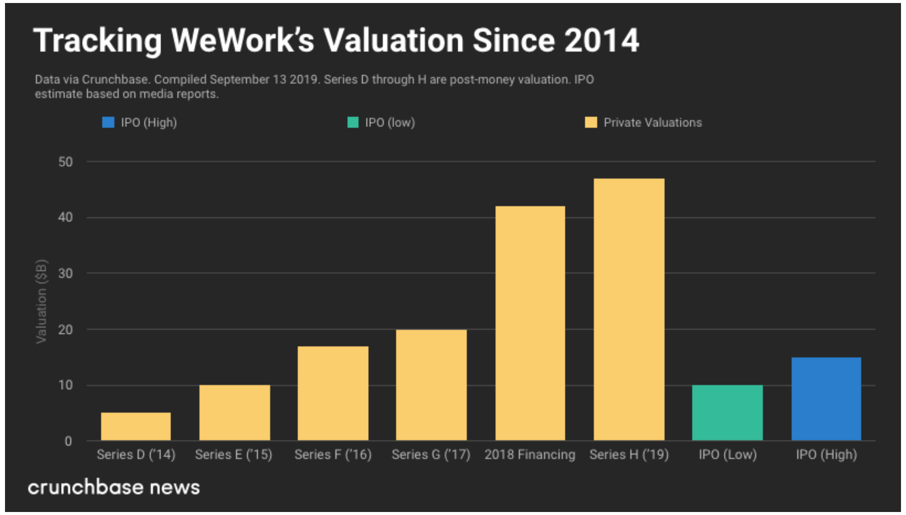
» Monetary or fiscal policy mistake?

Shock Propagation Channels to Watch



Transmission of Re-Valuation and Repricing of Risk

SoftBank Gets Downgraded After WeWork's $9.5 Billion Rescue



It all sounds familiar:

- High valuation
- Eager investors
- Overlooking earnings and profitability
- High cash burn rate
- Potential unsustainability

Propagation Through Supply Chain: Evidence from the CDS Market

» How many supply chain layers does a laptop manufacturer have?

» Credit risk propagates through multiple tiers of supply chains:

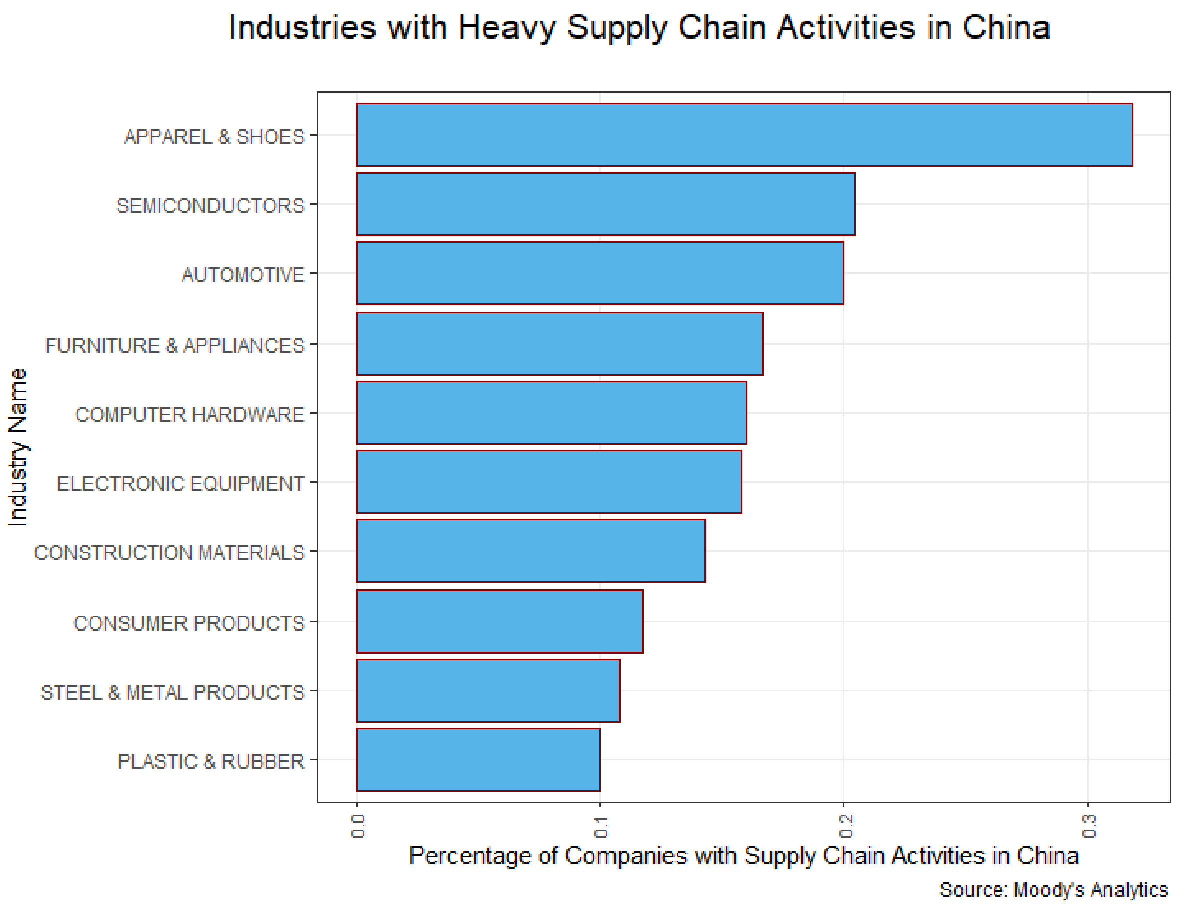
– Sizeable CDS spread changes in the same direction as shocks, both for customers and suppliers in a network.

– Considerable effects continue to hold for the 2nd- and 3rd-tier supply chain partners for bad credit shocks.

– Contagion is magnified with longer-term supply-chain relations and trade credit, percentage of sales from a supplier to the customer, with differentiated products, and customer leverage.

Source: Agca et al., 2017. Credit Risk Propagation along Supply Chains: Evidence from the CDS Market, SSRN Working Paper

Transmission of Shocks Through Trade Route



Transmission of Shocks Through Regional Economic Clusters

Shocks from the Financial Sector to Real Economy

- Is the recent repo turmoil a sign of a longer-term problem?
- It remains to be seen how the post-crisis financial system and market infrastructure will respond and absorb a major shock, and how central banks, regulators, and governments will respond to a major shock or crisis.
- Is the fiscal policy risk looming?

4

Preparing for the Next Downturn

Implications of Previous Analyses

- We are at the tail-end of the credit cycle, observing significant increases in credit risk recently.
- There are pronounced vulnerabilities in corporate credit.
- It is critically important to understand how economic shocks are transmitted and how credit risk propagates.

Managing Risk at the Tail-End of the Cycle

- Having a cycle-sensitive, risk-appetite framework
  - Socializing the concept of credit cycle with a long-term view
  - Dynamic and cycle-sensitive limiting setting
- Conducting stress testing and scenario analysis
  - CCAR type of framework is inadequate
  - Measuring correlation and contagion is critical
  - Incorporating scenarios
- Building and leveraging early warning system and indicators
- Maintaining proper trade-off between risk and return, avoiding excess at both ends

Perhaps the most sensible, time-tested, and realistic approach is to ensure your portfolio is well-diversified, with appropriate trade-off of risk and return.

Appendix

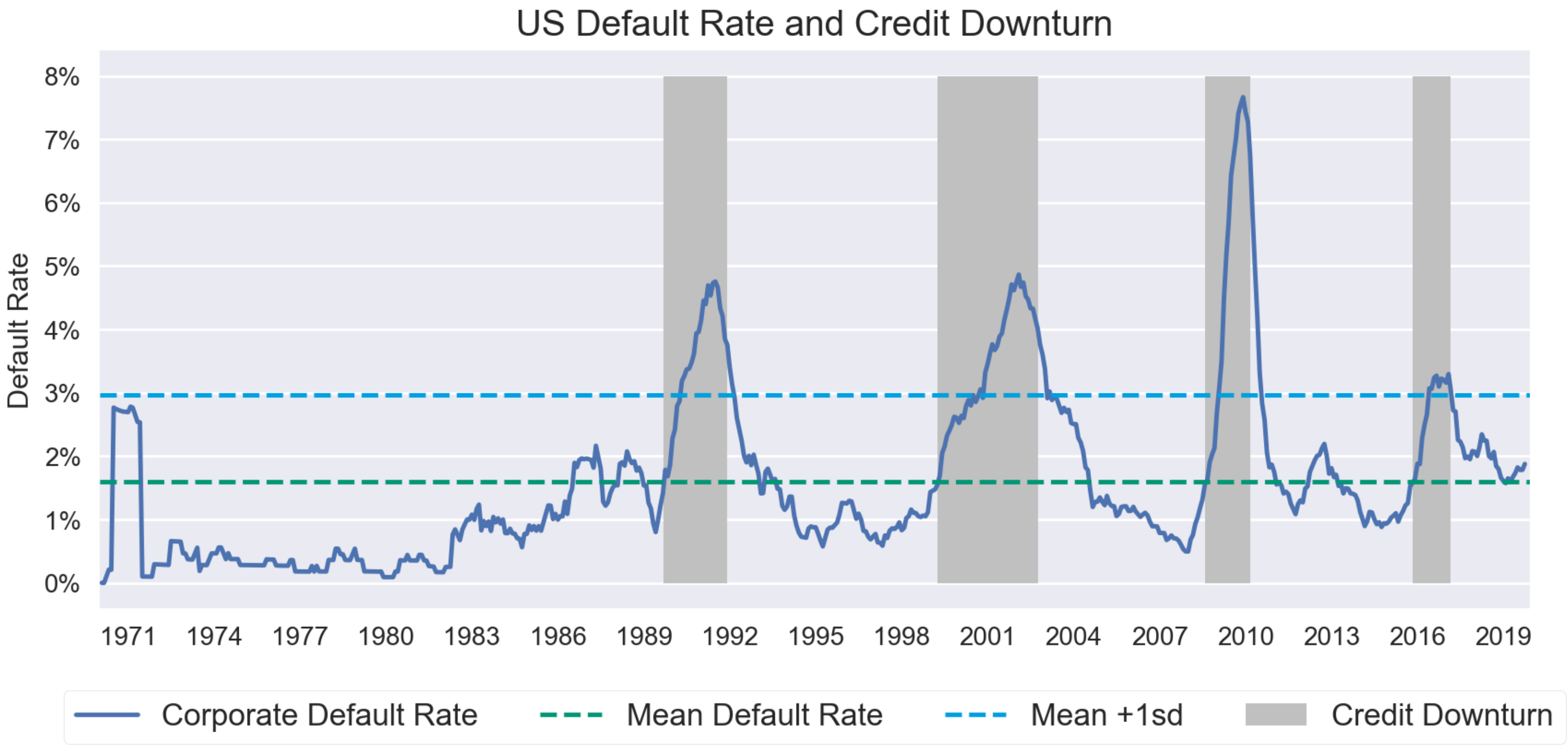
Supporting Material

Appendix 1.1

Supporting Material for Section 1

Where Are We in the Credit Cycle?

What is a Downturn?



» Downturns: $Default\ Rate > mean + 1Stdev$

- Beginning: $Default\ rate\ >\ mean$
- End: $Default\ rate\ <\ 1/3 * (peak - mean)$

Where Are We in the Credit Cycle?

Models

Traditional: $P(Y_t = 1|X_t) = \Phi(X_t^T \beta)$

» Pros

- Natural: Binary definition of stage of cycle; output of probabilities
- Popular in the literature

» Cons

- Fewer explanatory variables
- Restrictive model framework

Machine Learning

» Pros

- Complex and flexible: Comprehensive feature space; Non-linearity
- Ensemble Modeling

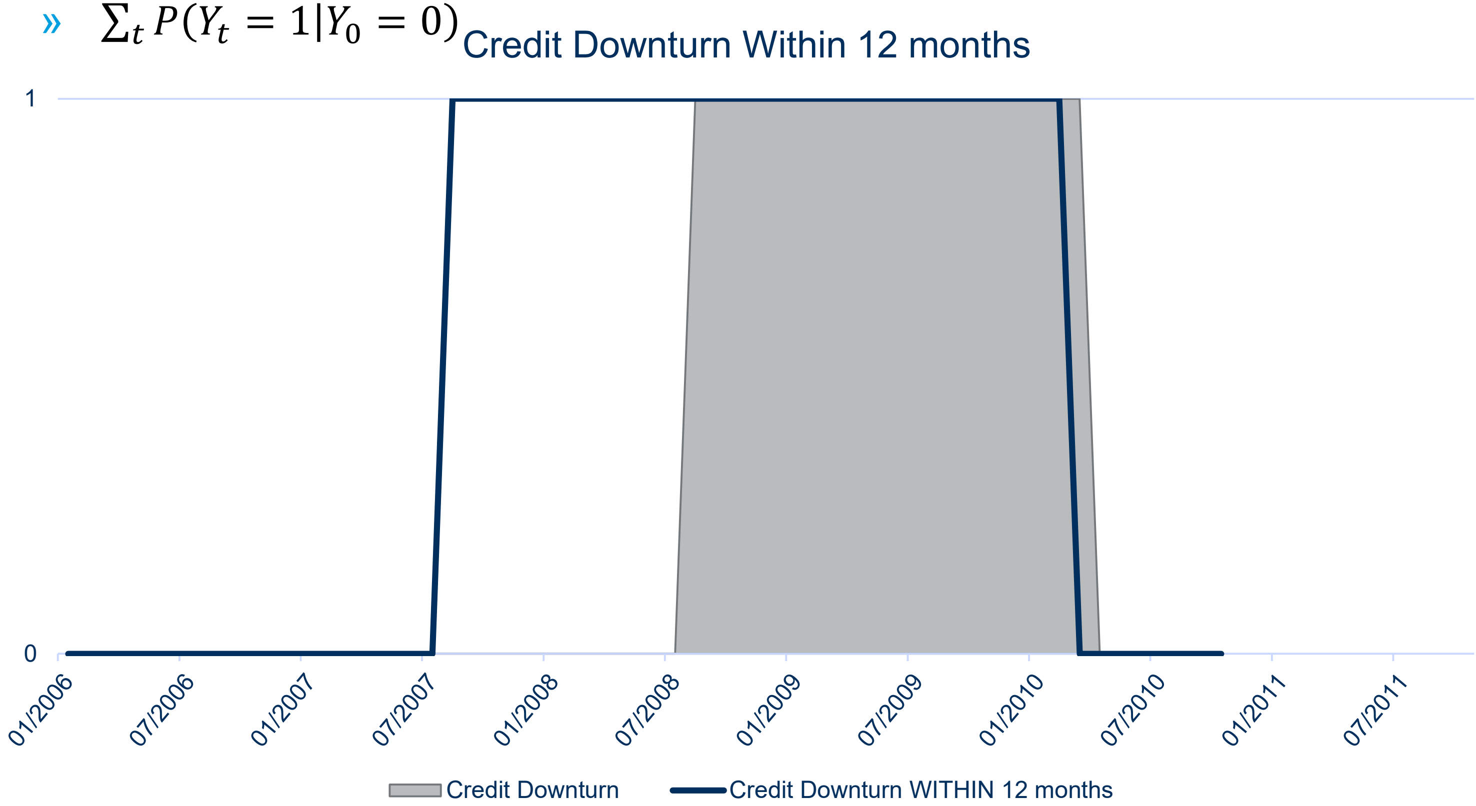
» Cons

- Interpretability and Explainability
- Overfitting concerns

Where Are We in the Credit Cycle?

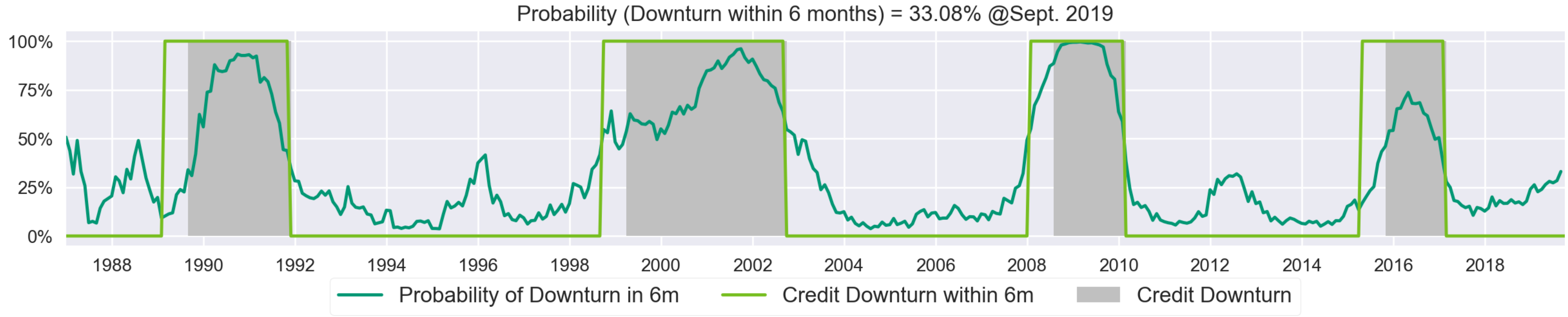
Probabilities of being in Downturns?

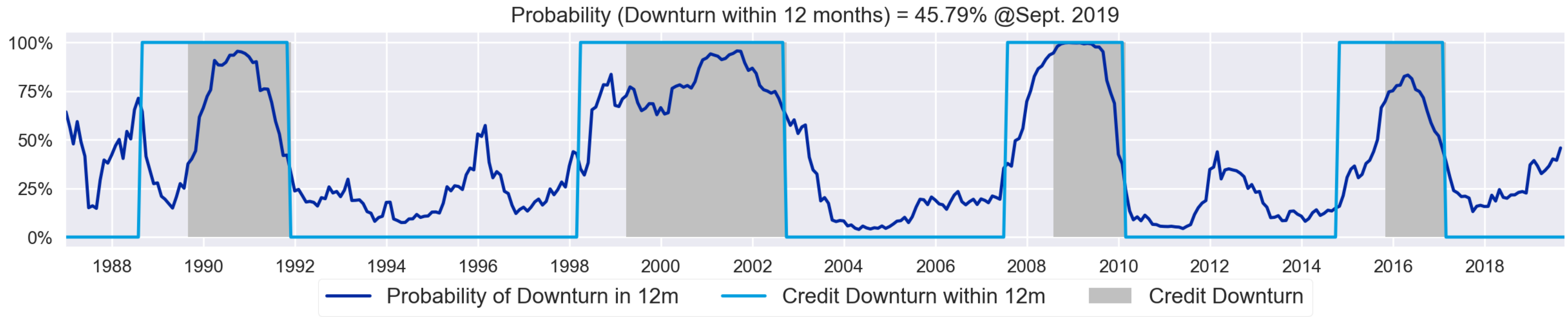
» $\sum_t P(Y_t = 1 | Y_0 = 0)$



Where Are We in the Credit Cycle?

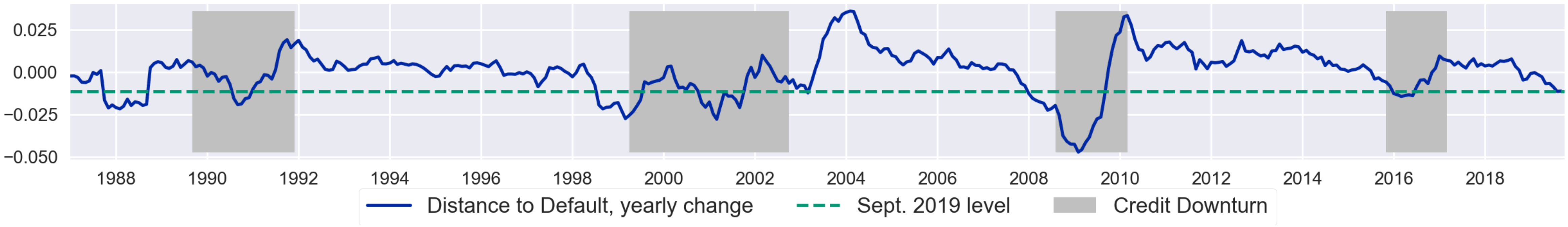
Downturn in 6 & 12 months: Historical Predictions

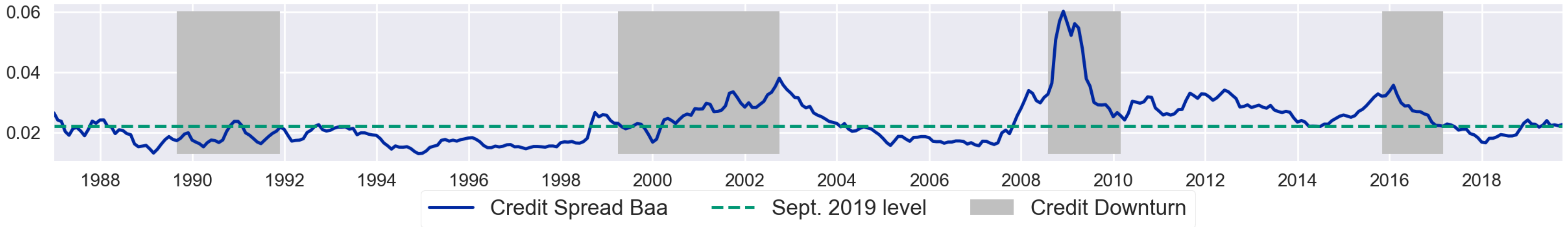


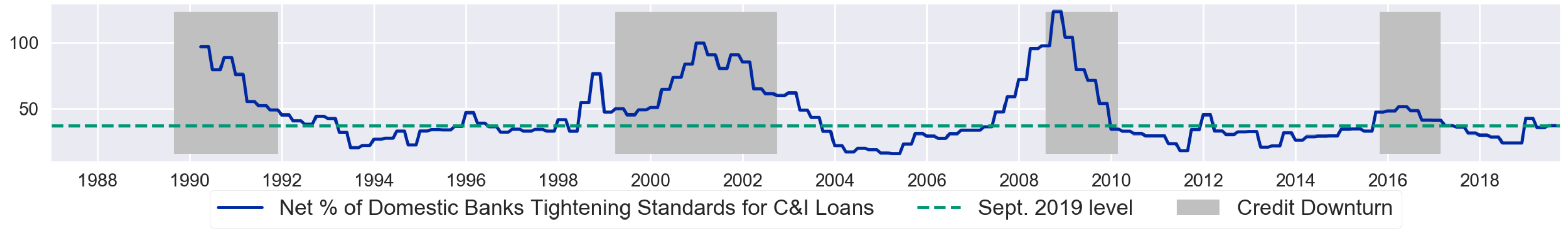


Where Are We in the Credit Cycle?

Downturn Indicator Examples







Appendix 1.2

Supporting Material for Section 2

Assessing Risk and Vulnerabilities

Low Spreads and EDF

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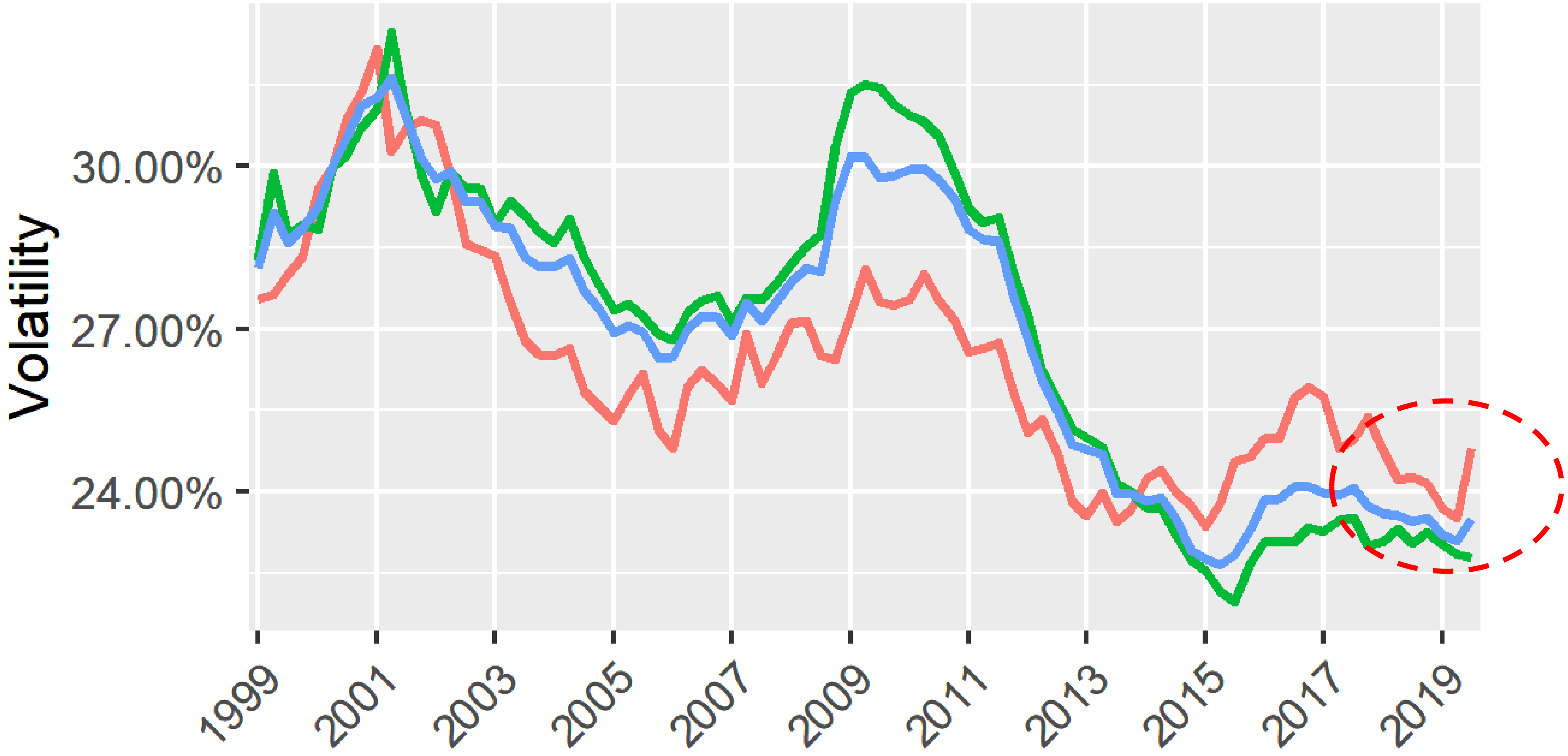


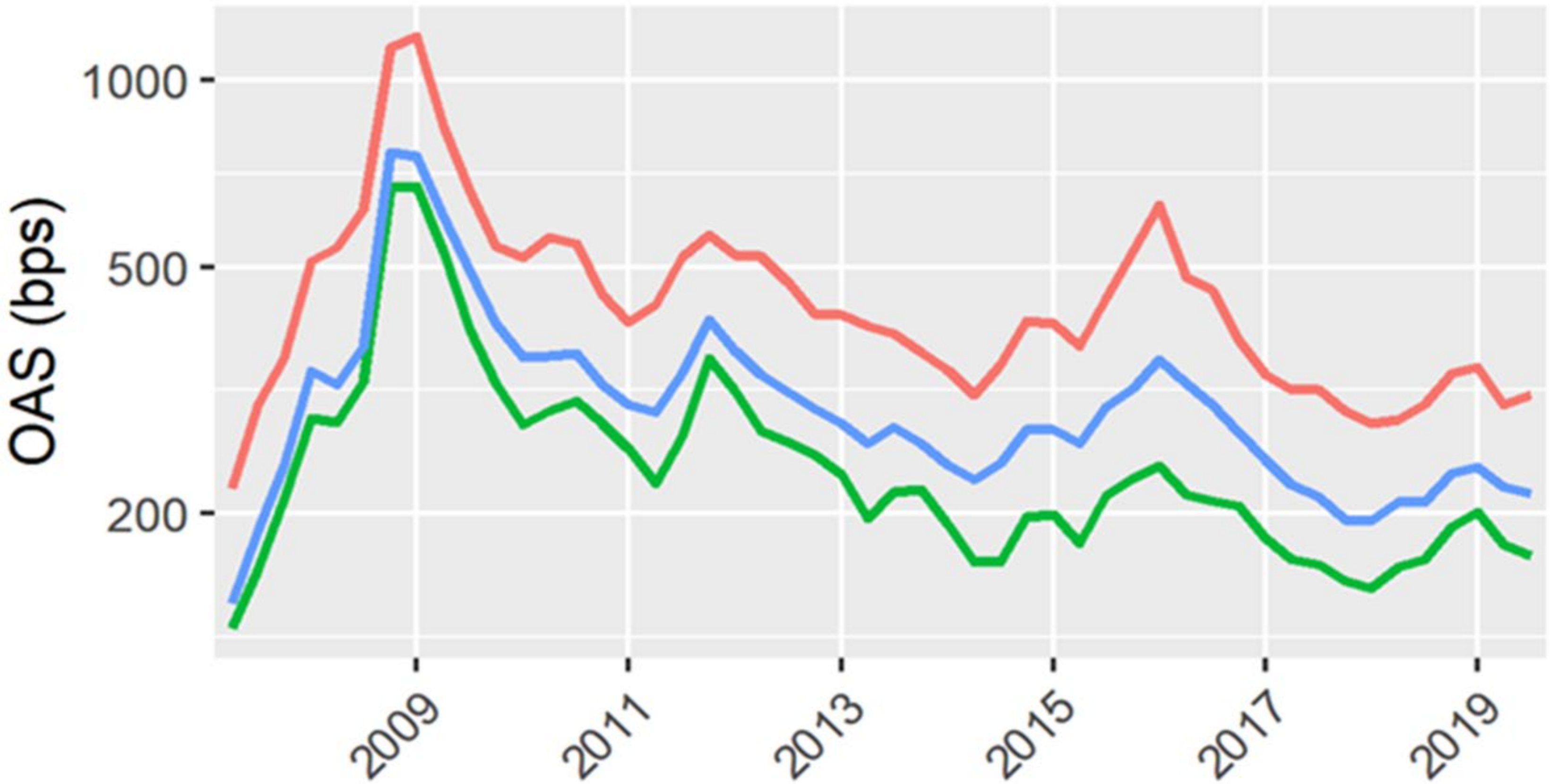
US corporates with sales larger than $100 MM

Median – High Leverage (Debt / EBITDA > 4) – Low Leverage (Debt/EBITDA <= 4) – All

Source: Moody's Analytics

Assessing Risk and Vulnerabilities

Low Spreads and EDF



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Assessing Risk and Vulnerabilities

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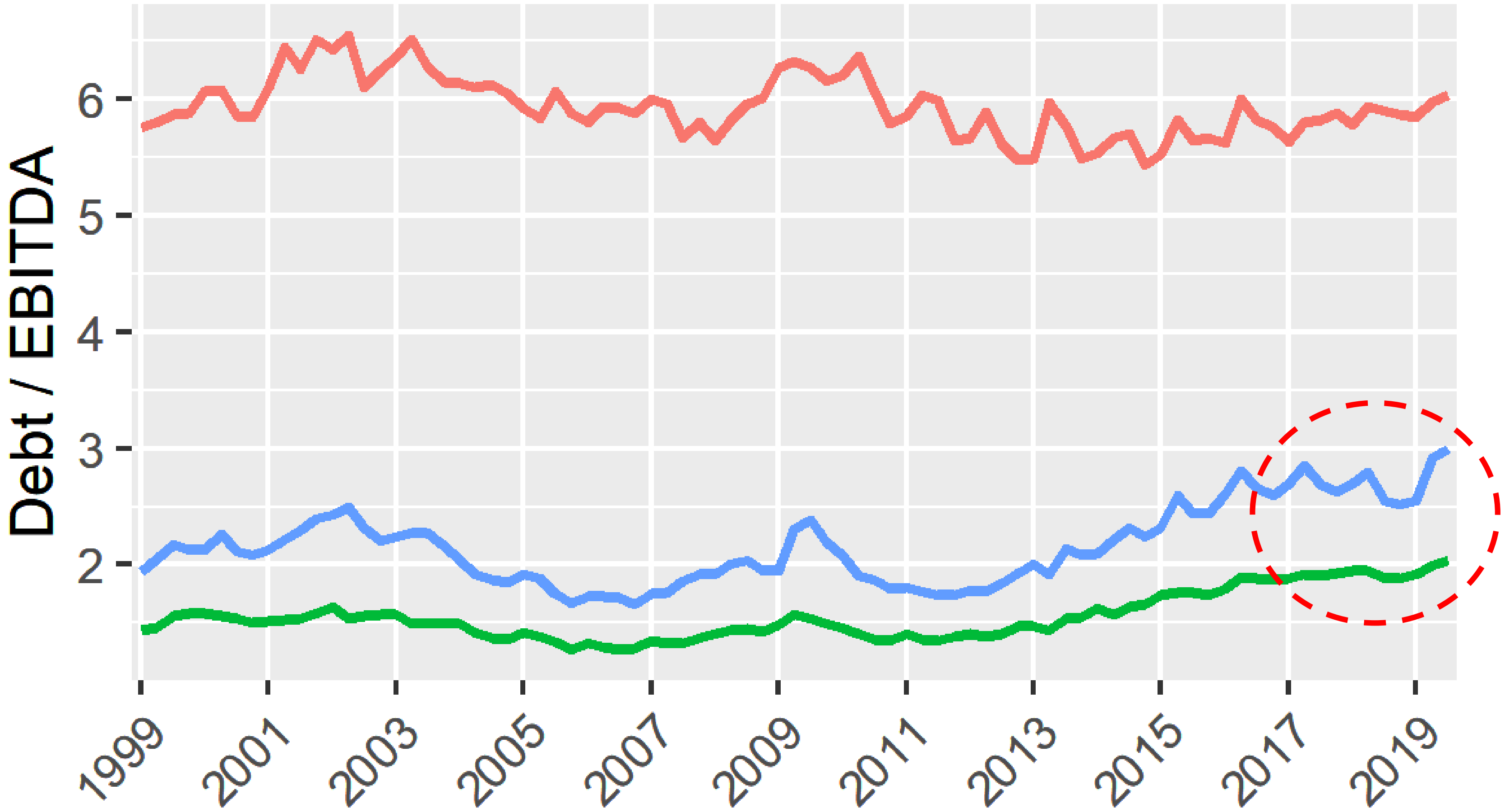

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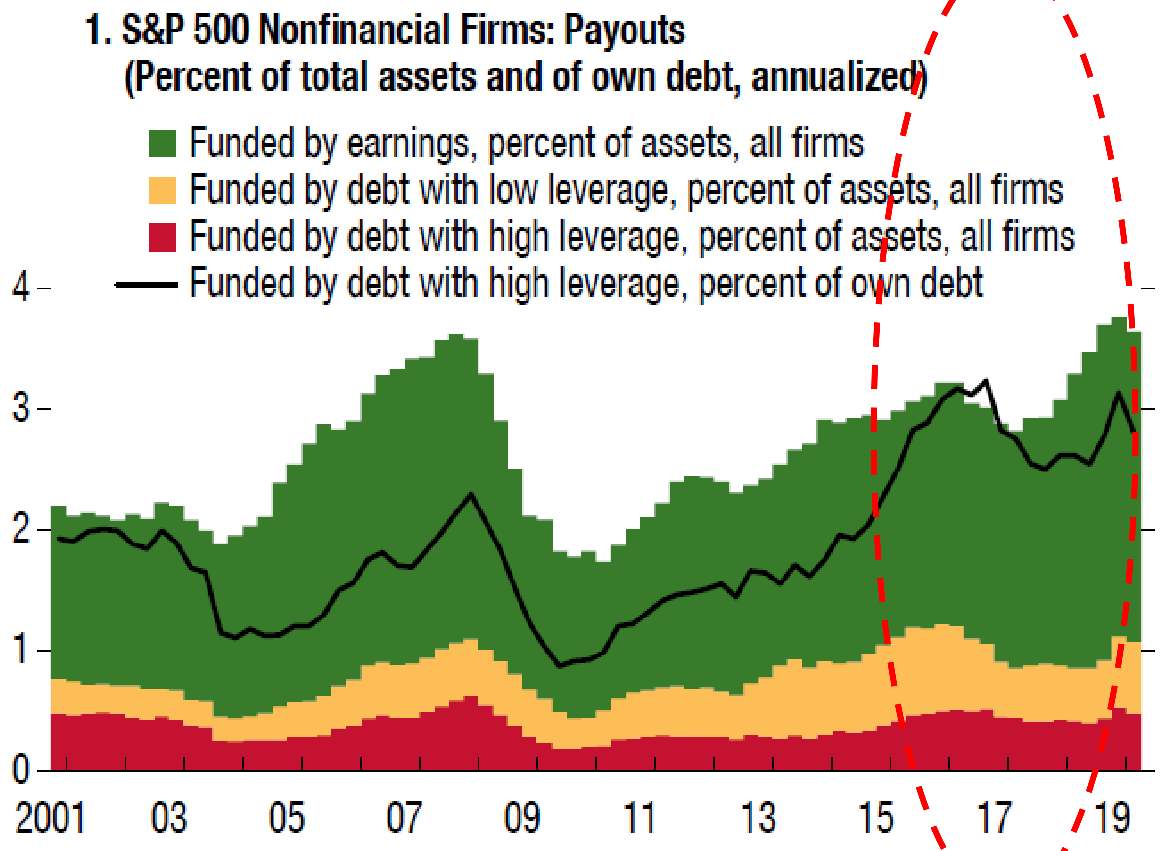
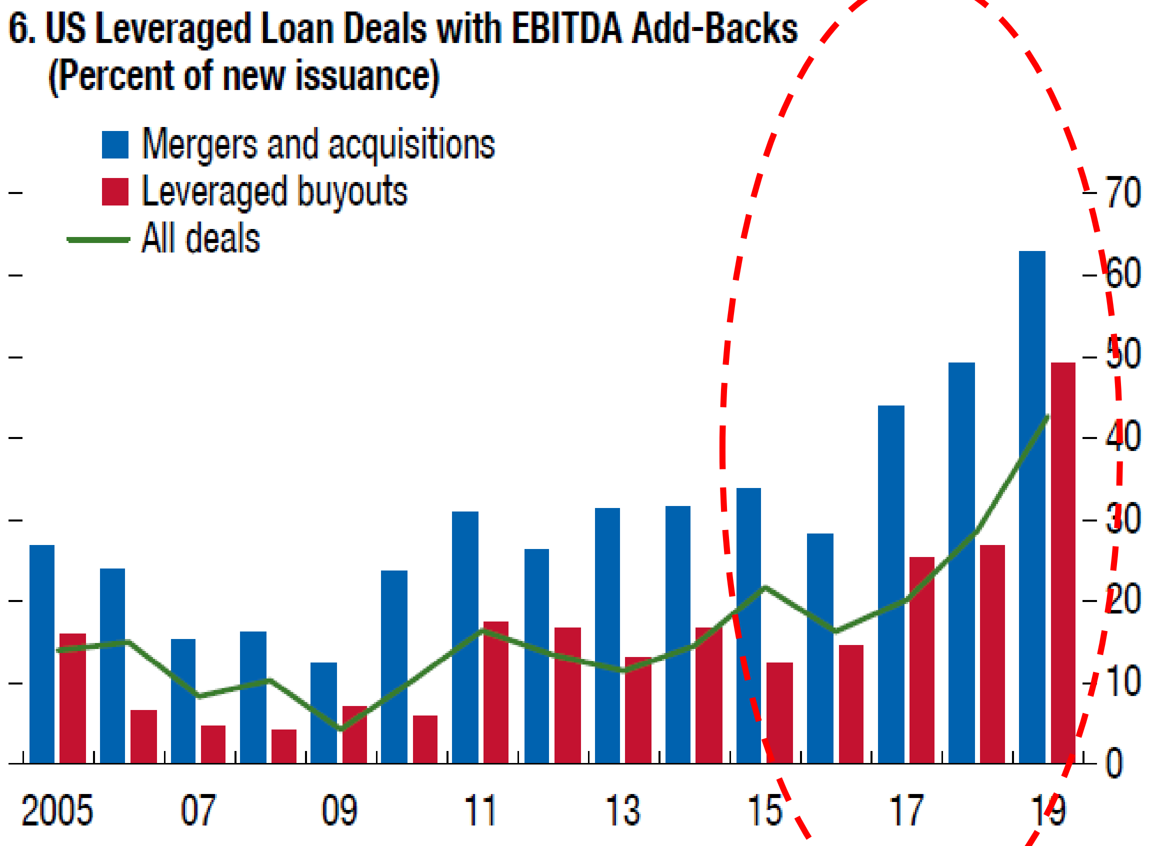
Assessing Risk and Vulnerabilities

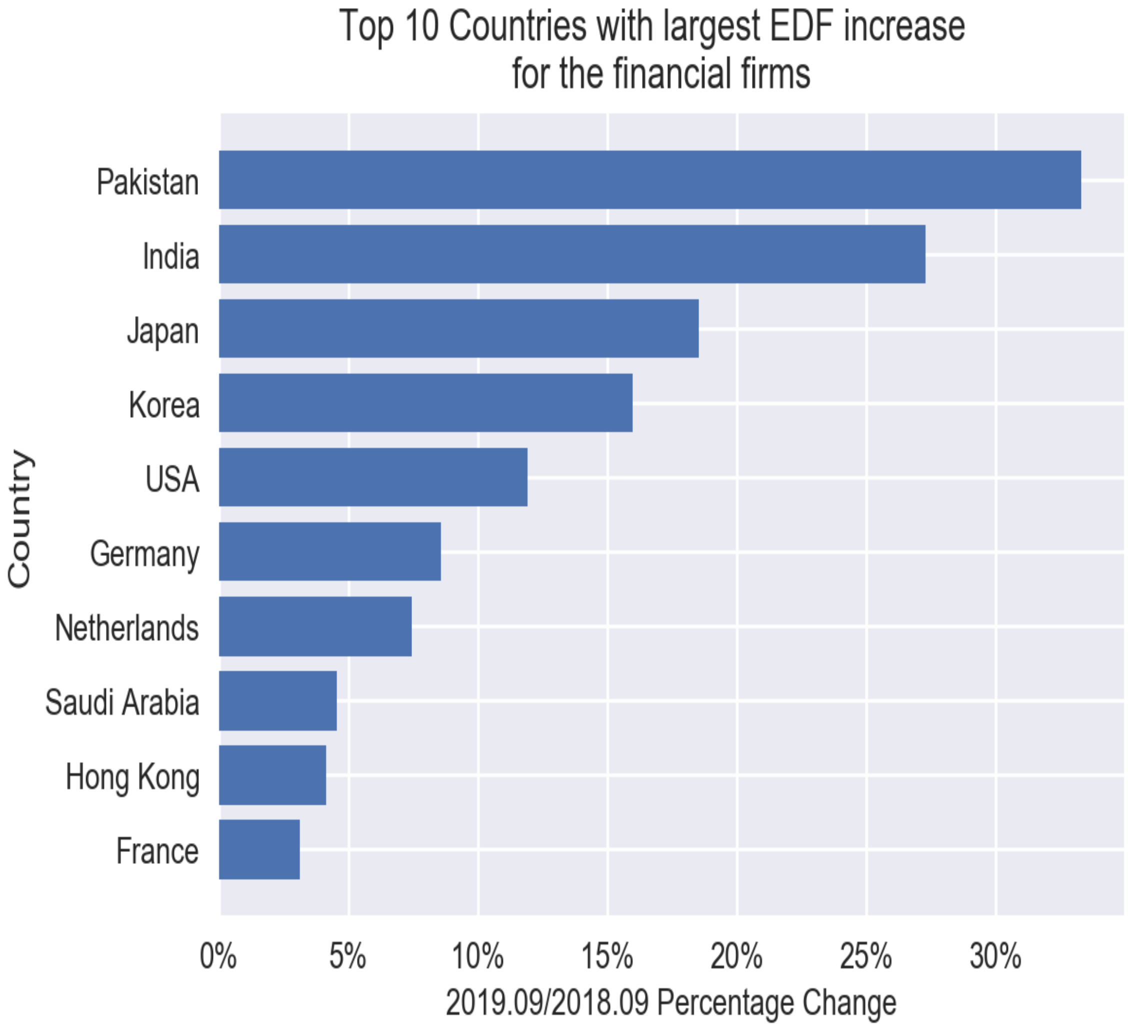
Increased payouts, M&As, LBOs Financed with Debt

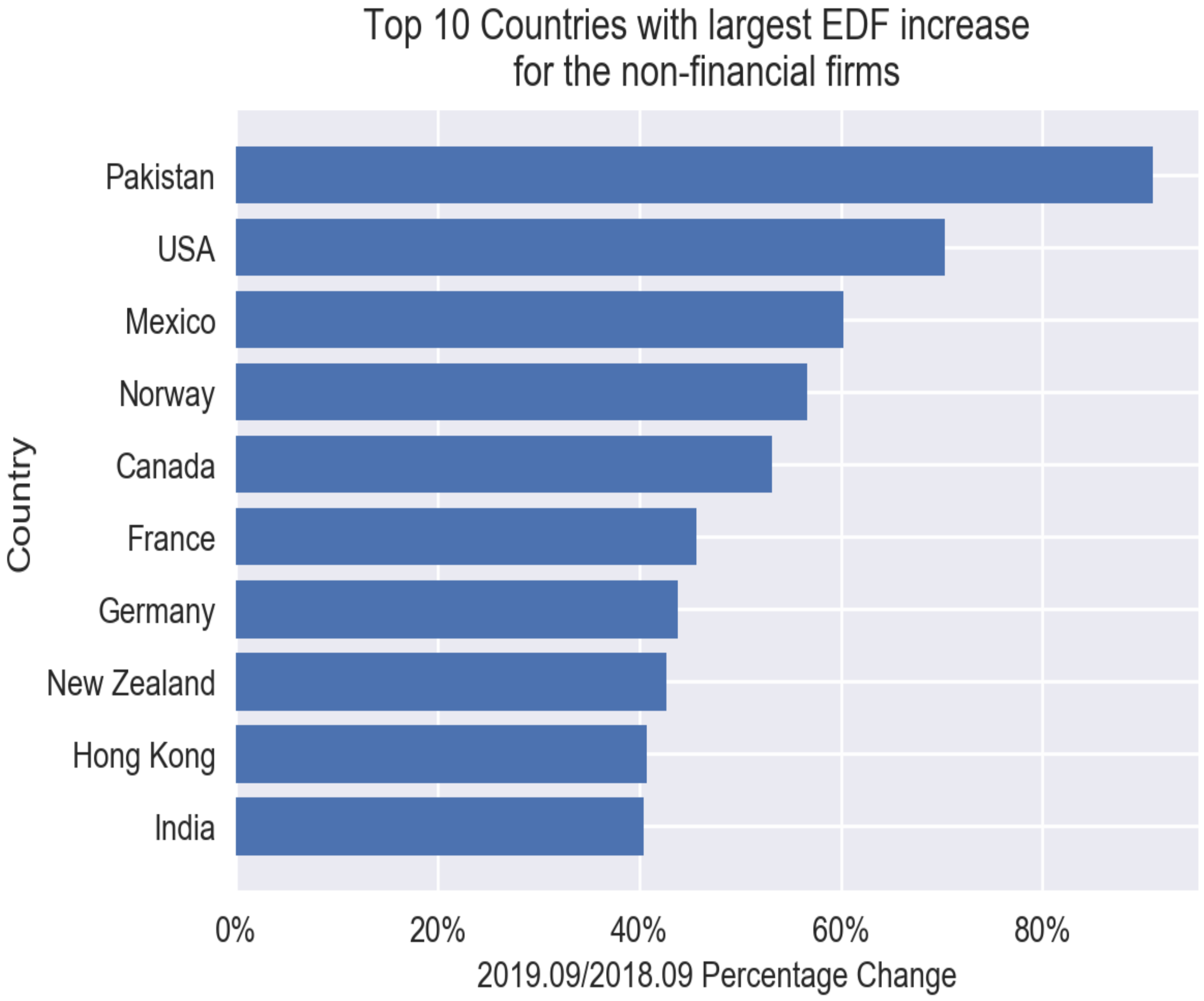




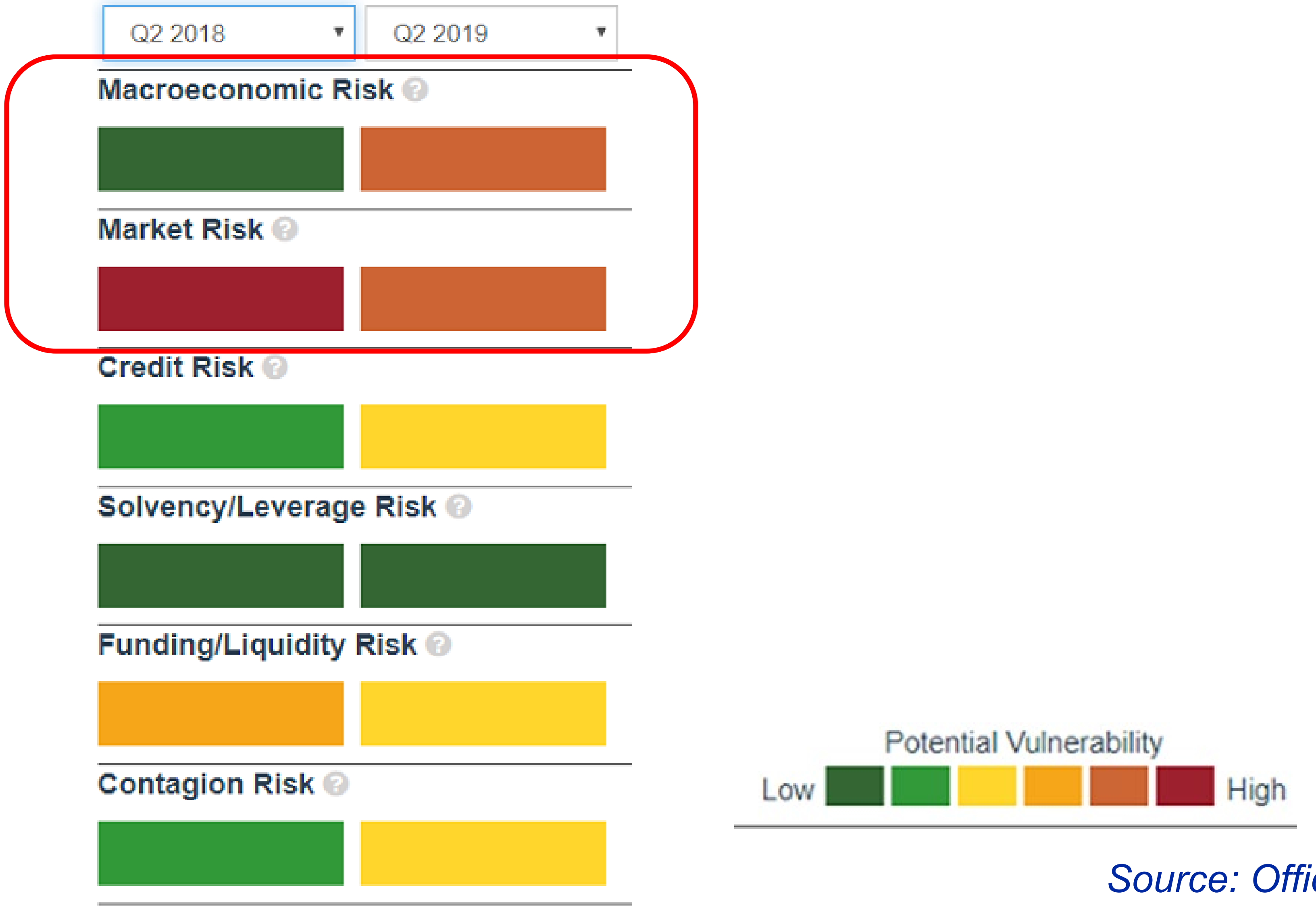
Source: IMF

Countries with EDF Increase





Financial System Vulnerabilities



Source: Office of Financial Research

Appendix 1.3

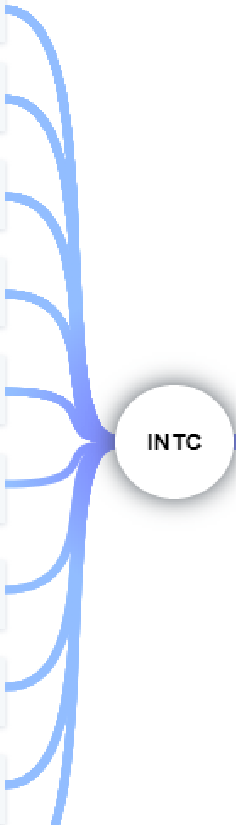
Supporting Material for Section 3

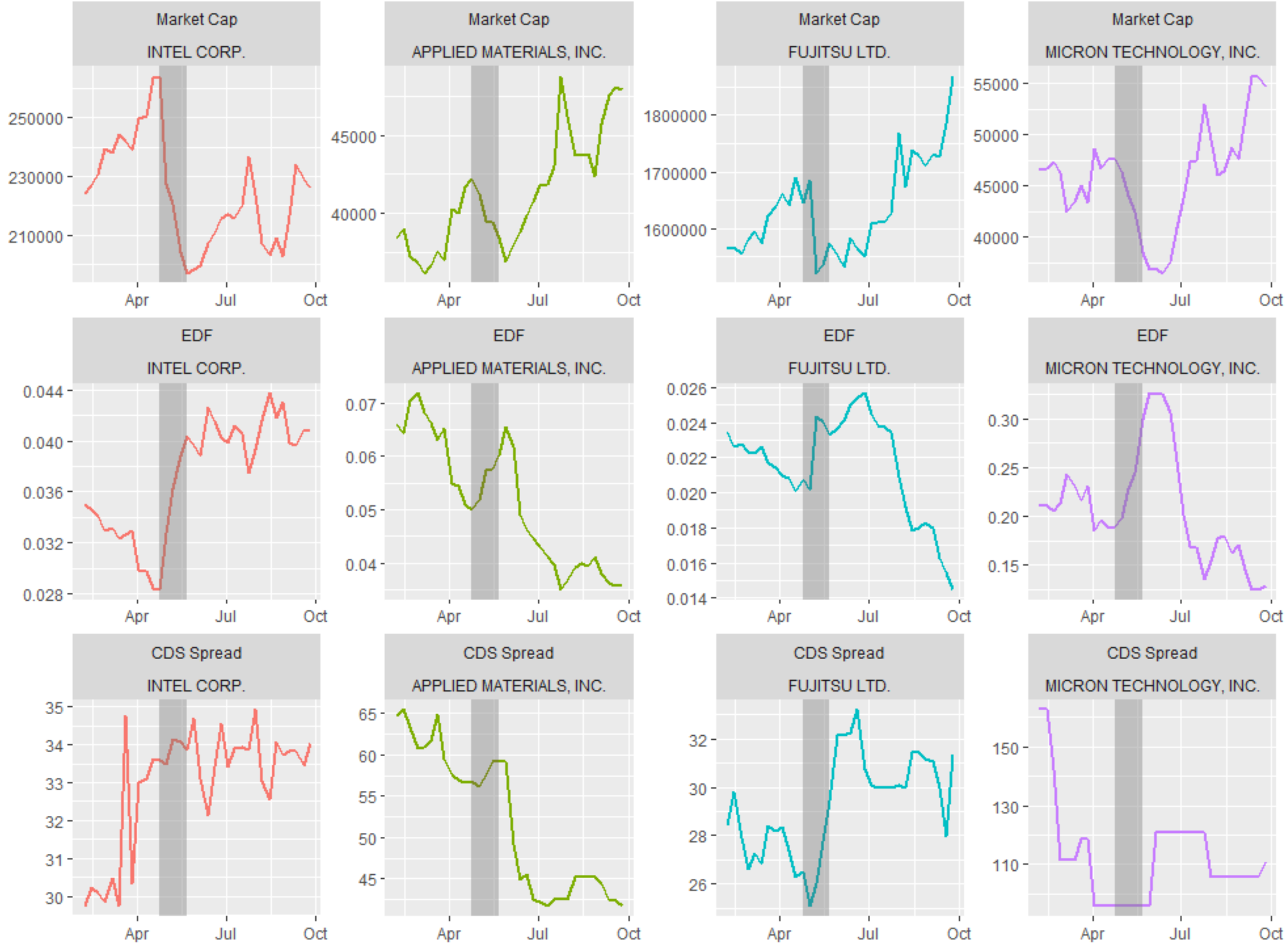
Transmission of Shocks

An Example of Propagation through Supply Chain

Top Suppliers

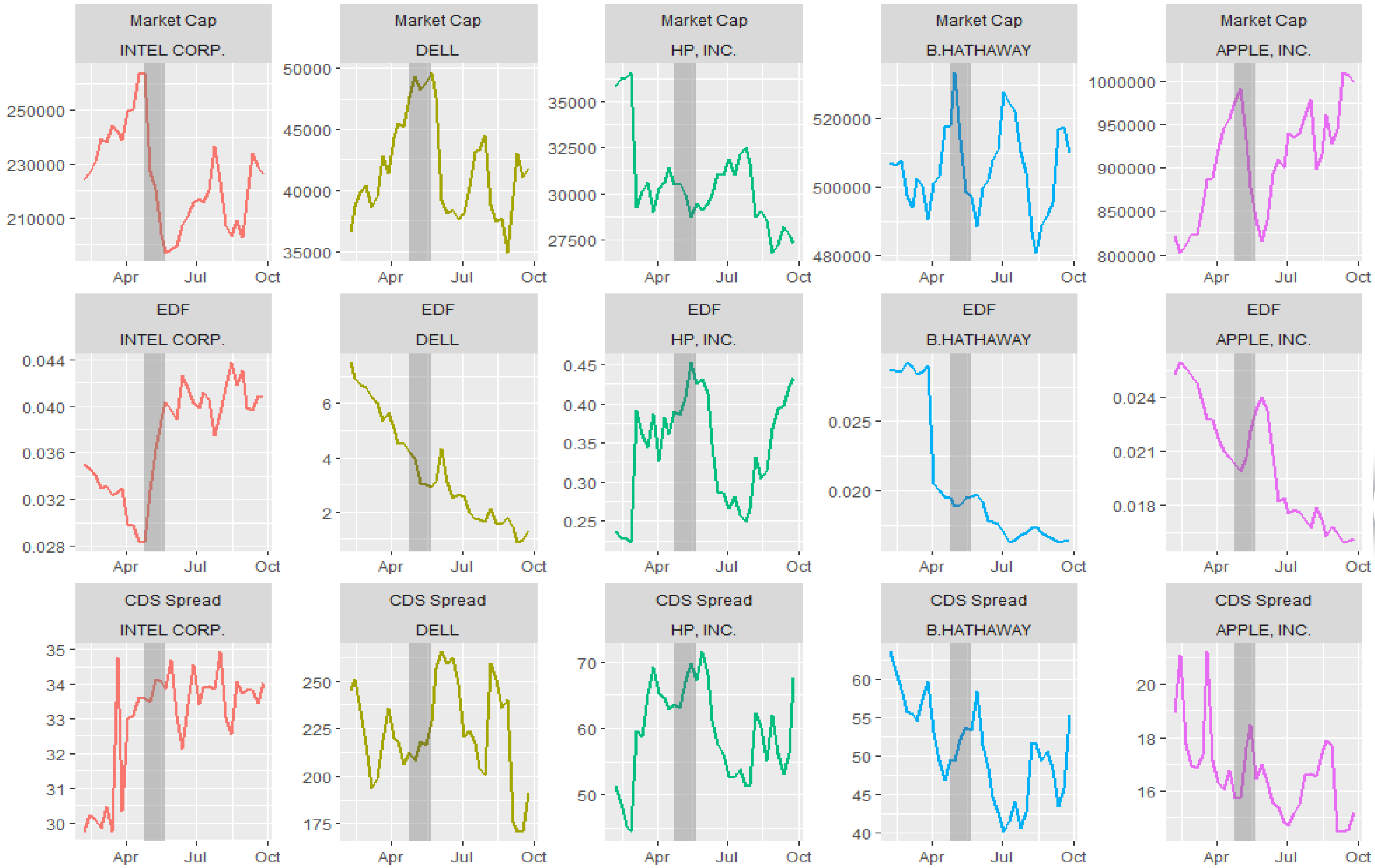
Company	Economic Value	Total Exposure
Tokyo Electron Limited	1.7B	3.71%
Financial 0.03%	Media 0.76%	Economic 10.36%
Applied Materials, Inc.	1.6B	7.27%
Financial 7.80%	Media 4.29%	Economic 9.72%
Fujitsu Limited	1.5B	3.42%
Financial —	Media 1.52%	Economic 8.76%
Veolia Environnement S.A.	1.1B	2.44%
Financial 0.38%	Media 0.25%	Economic 6.68%
Lam Research Corporation	964M	4.59%
Financial 1.73%	Media 6.31%	Economic 5.73%
Micron Technology, Inc.	900M	14.19%
Financial 7.92%	Media 29.29%	Economic 5.35%
NEC Corporation	826M	1.97%
Financial —	Media 1.01%	Economic 4.91%
Rolls-Royce Holdings plc	583M	1.26%
Financial 0.06%	Media 0.25%	Economic 3.46%
Ibiden Co., Ltd.	582M	1.32%
Financial —	Media 0.51%	Economic 3.46%

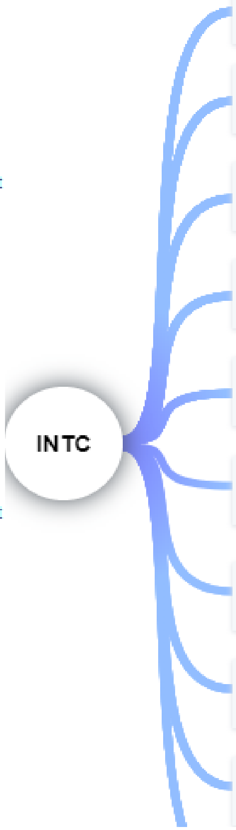




Transmission of Shocks

An Example of Propagation through Supply Chain



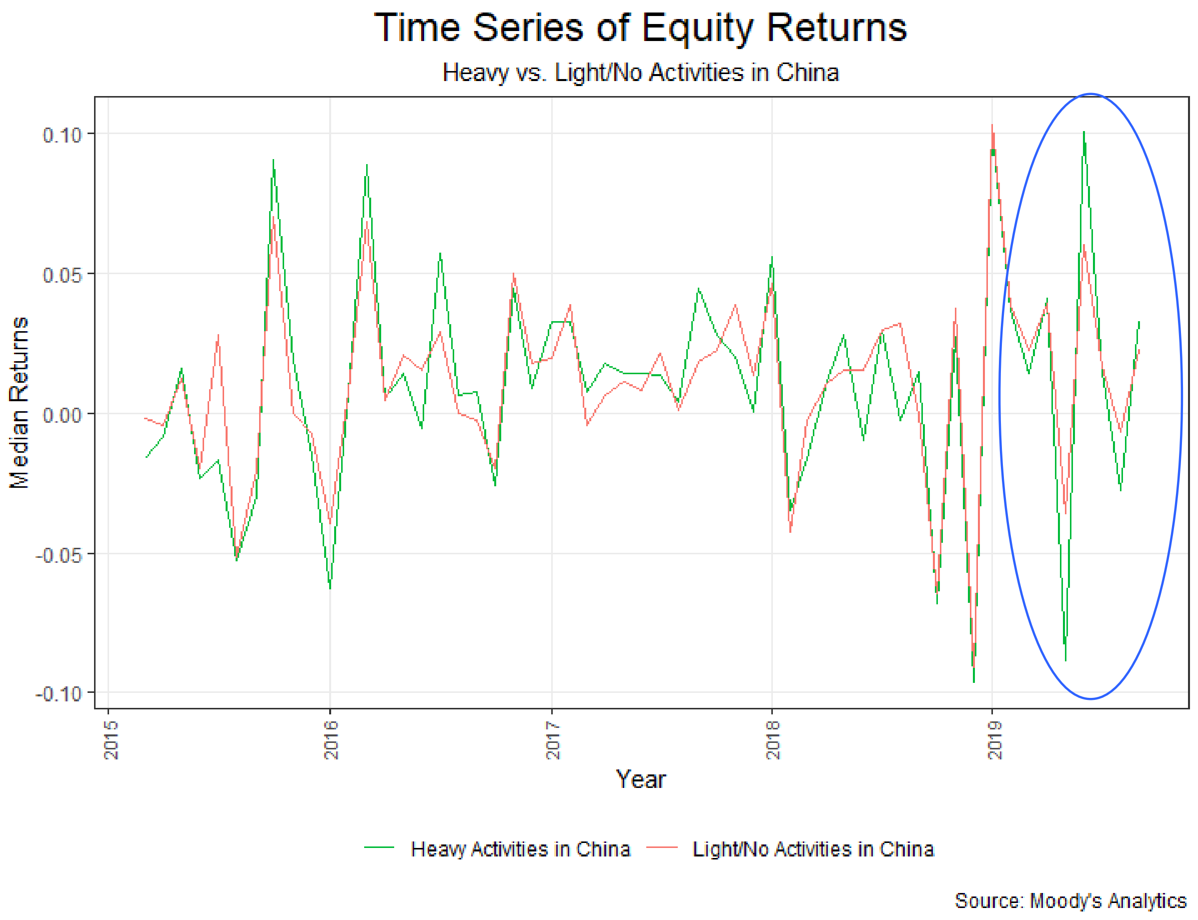


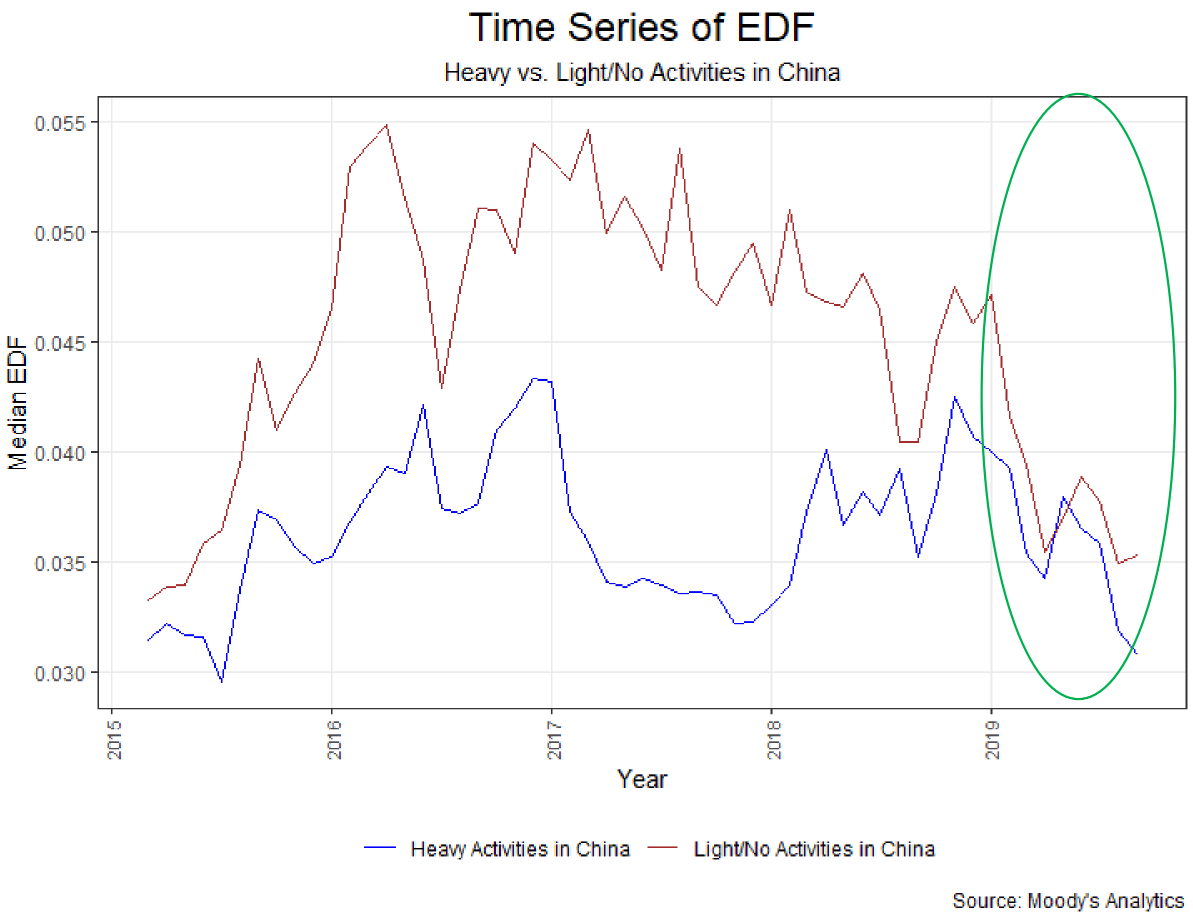
Top Customers

Company	Economic Value	Total Exposure
Dell Technologies Inc.	11B	7.75%
Financial 1.30% Media 3.61%		Economic 18.34%
Lenovo Group Limited	8.4B	5.44%
Financial 0.08% Media 2.49%		Economic 13.75%
HP Inc.	7.7B	6.68%
Financial 6.64% Media 0.79%		Economic 12.61%
Quanta Computer Inc.	5.6B	3.05%
Financial 0.00% Media 0.04%		Economic 9.10%
AB Volvo (publ)	3.5B	1.94%
Financial 0.09% Media 0.11%		Economic 5.63%
Berkshire Hathaway Inc.	3.4B	2.07%
Financial 0.65% Media 0.04%		Economic 5.54%
Apple Inc.	1.9B	21.19%
Financial 7.84% Media 52.60%		Economic 3.13%
Costco Wholesale Corpora...	1.8B	1.07%
Financial 0.21% Media 0.11%		Economic 2.89%
Foxconn Industrial Internet...	1.6B	0.88%
Financial 0.01% Media 0.04%		Economic 2.60%

Transmission of Shocks

Propagation through Supply Chain: Trade War





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