Systemic interconnectedness in the US financial system

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Motivation and Research Question

1. GFC highlighted role of bank interconnectedness for systemic risk
2. Which US banks are the most systemically connected (central)?
3. Existing analyses rely on regulatory data
    - Limited time-dimension and mostly confidential

Contribution

- First paper performing interconnectedness analysis with different data and methods
  - Data: Regulatory, market, textual
  - Methods: Technical details and transmission channels
- Are results consistent across data and methods?
  - Qualitatively similar results on bank interconnectedness and its persistence over time
  - Indication that market data and textual data can be used, in absence of (pubicly available) regulatory data

Main Findings

- JPM, Citi, BoA, GS, and MS are the most interconnected US banks
- Interconnectedness is a persistent feature of the US banking system
- JPM the most interconnected bank across all methods and data
  - Dominant net transmitter of volatility spillovers
  - Persistently highest eigenvector centrality in residual return network
  - Accounts for 20% of regulatory exposure index (IIR)

Literature Review

1. **Financial networks**
   - Allen & Gale (2000): network structure determines how shocks spread
   - Acemoglu et al. (2015): dense networks amplify large shocks
2. **Systemic risk measures**
   - Acharya et al. (2017): SRISK
   - Adrian & Brunnermeier (2016): CoVaR
3. **Volatility spillovers**
   - Diebold & Yilmaz (2012): who transmits risk to whom and how much
4. **Dynamic correlations**
   - Engle (2002): correlations rise sharply during crises

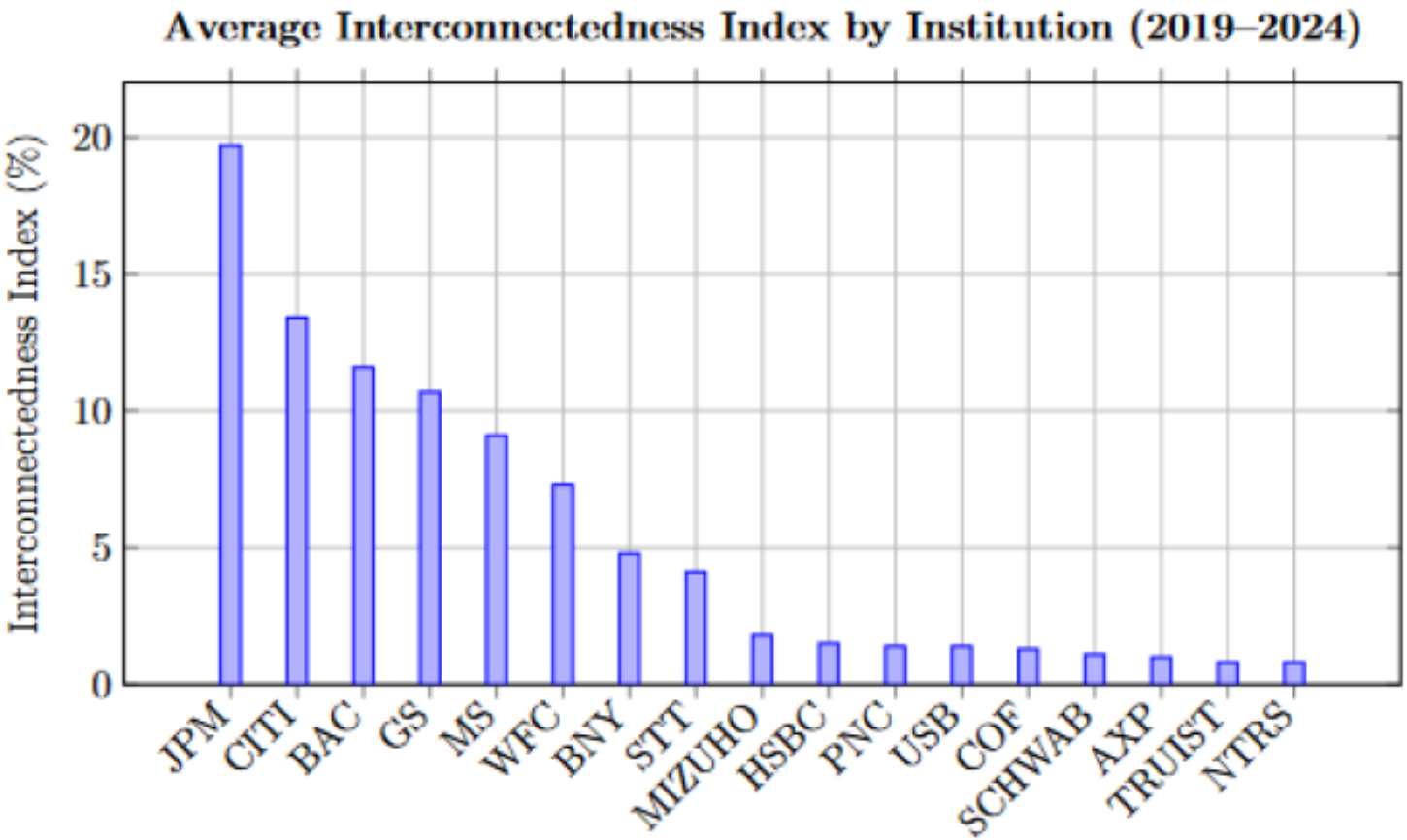
Data Description

1. FR Y-15 filings (regulatory Fed data)
   - 38 large US banks, annual, 2019–2024
   - Quantitative data on intra-financial assets & liabilities, securities outstanding, OTC derivatives
   - Each year, publicly available only for five previous years
2. 10-K filings (SEC filings)
   - Textual and quantitative data
   - JPM annual reports, 2002–2025
3. Stock prices (Yahoo Finance)
   - Daily adjusted closing prices, 2003–2025

1. Interconnectedness from FR Y-15 Regulatory Data

- Interconnectedness Index (IIR) using 2019-2025 data corresponding to four connectedness or exposure channels (as defined by regulators)
  - Intra-financial system assets
  - Intra-financial system liabilities
  - Securities outstanding
  - OTC derivatives
- For each channel, calculate the fraction of the total accounted for by each bank in each year
- Aggregate each bank's share across the four channels in each year into an annual IIR for each bank
- Aggregate across years

Aggregate IIR by Bank

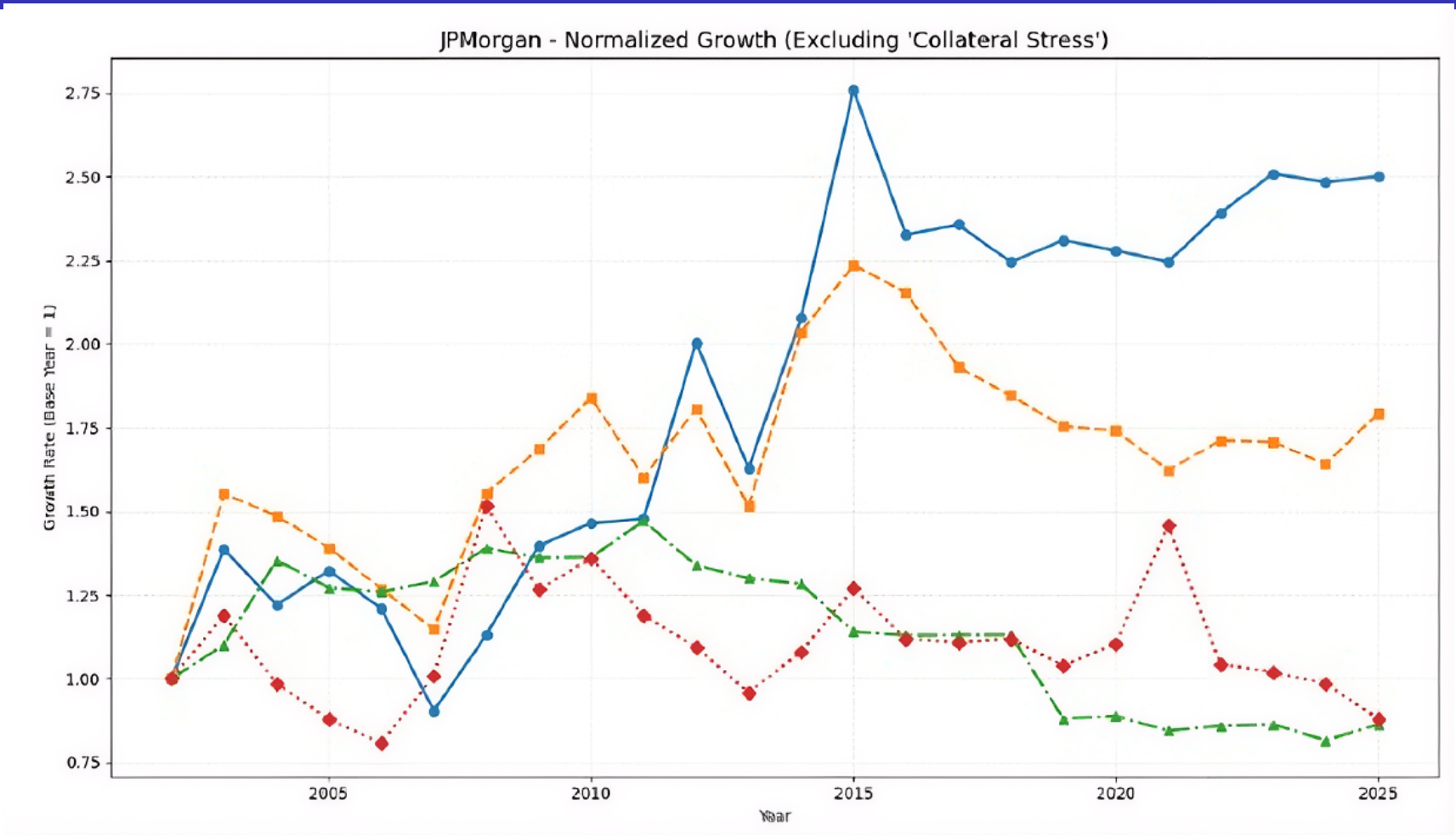


- JPM accounts for 20% of total exposure
- Five banks account for more than half of all exposure
- Suggests large concentration of (counterparty) risk

2. Interconnectedness from JPM 10-K Textual Data

- Interconnectedness Index (IIT) using textually-derived quantitative data, 2002-2025
- Data correspond to five interconnectedness channels (as highlighted in the literature) and associated lexicons and their frequencies
  - Direct counterparty risk: Losses from a single failed counterparty
  - Derivatives network: Losses propagating through derivatives contracts
  - Shadow linkages: Losses propagating through non-bank activities
  - Collateral stress: Losses propagating from collateral shortfalls
  - Systemic contagion: From any source
- Aggregate word frequencies in each lexicon annually, aggregate across lexicons to get annual textual interconnectedness index (IIT) for JPM

JPM IIT Decomposition: Component Growth



- Blue: direct counterpart; orange: derivatives; green: shadow; red: systemic; purple (missing) collateral
- Post-2010, collateral stress (not shown) the fastest-growing channel, followed by direct counterparty risk (blue) and derivatives risk (orange)

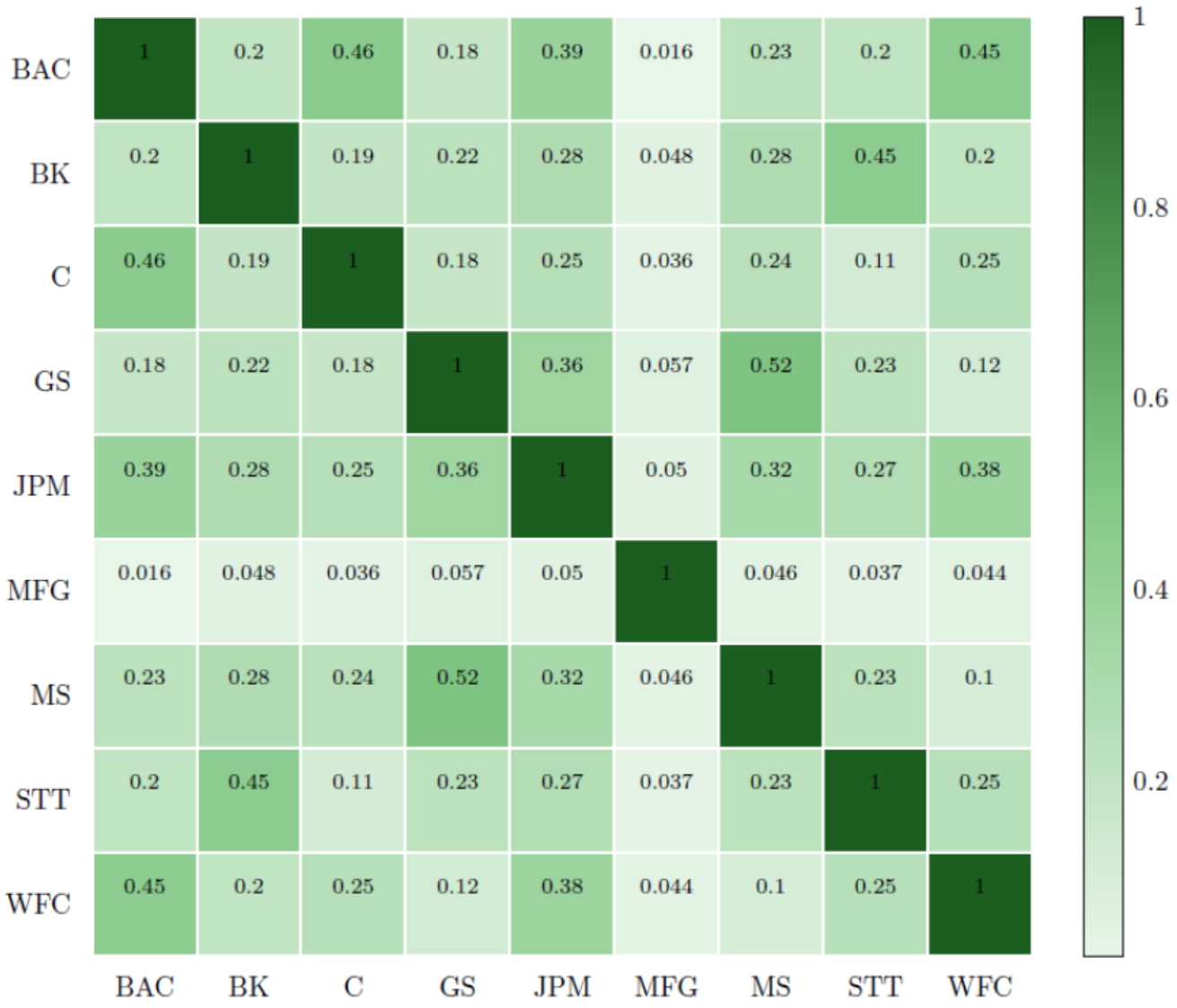
3. Interconnectedness from Fama-French Data

- Residuals from a Fama-French 5-factor model (FF5)
- For each bank, construct annual volatility of residuals as measure of idiosyncratic return-volatility (IVOL)
- Construct interconnectedness measures from IVOLs
  - Pearson correlation matrix
  - Eigenvector centrality

Pearson Correlation Matrix of IVOLs

- Pairwise correlations of IVOL time series across banks
- How similarly do IVOLs of different banks move over time
- High correlation between two banks' IVOLs suggests that what was intended to be idiosyncratic risk contains a common component
  - Commonality in residual risk beyond the five systematic factors of FF5

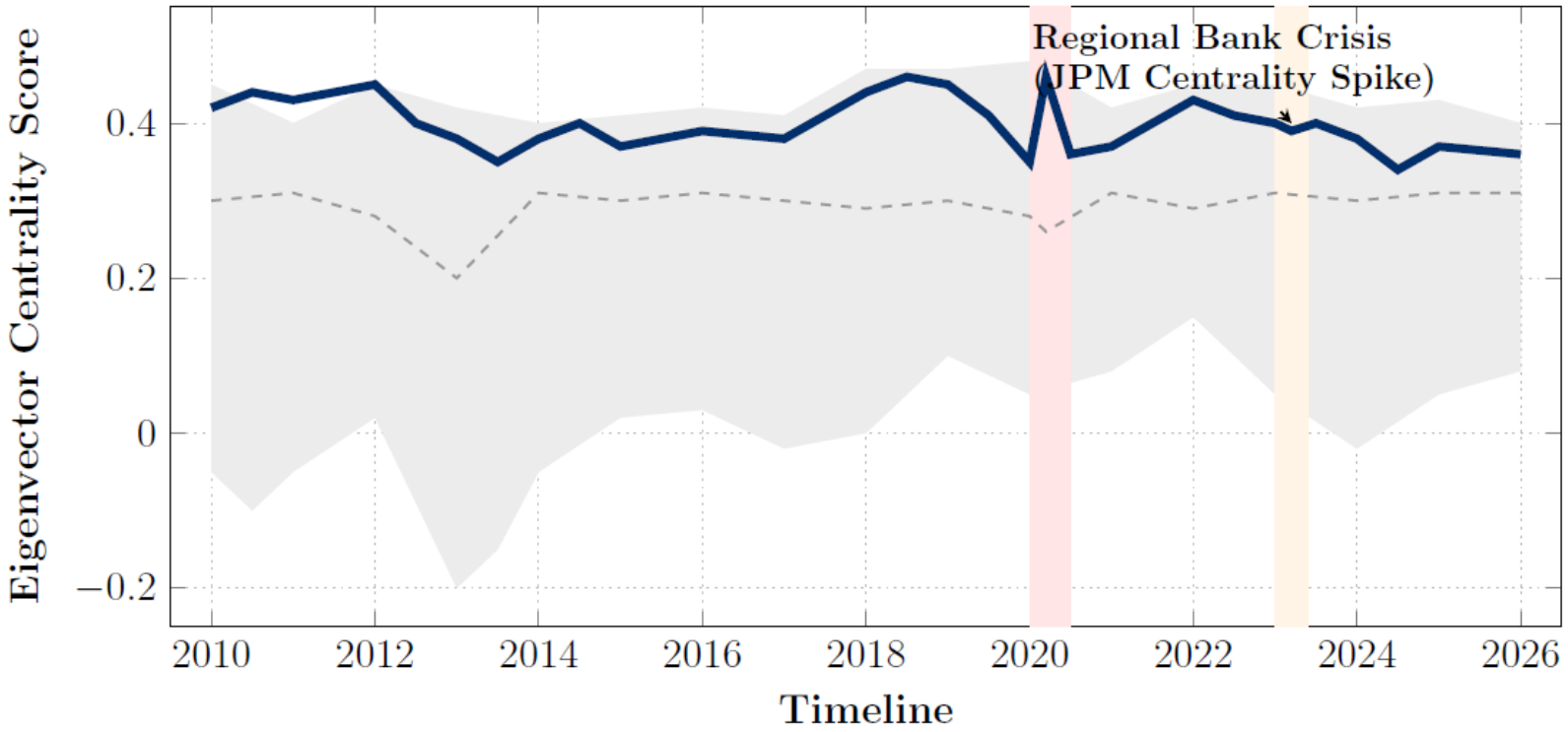
Pearson Correlation Results



Eigenvector Centrality of IVOLs

- Constructs interbank network, with banks as nodes and links between
- It is a network measure ranking the importance of each node (bank) based on number *and* importance of its connections
    - A node is more important if it has multiple connections and/or these connections are linked to other important nodes
- Identifies banks occupying the core of the IVOL network
- Banks with higher centrality exhibit idiosyncratic risk that co-moves with the risk of other highly connected banks, suggesting greater systemic importance within the network of residual risk

Eigenvector Centrality Over Time



- JPM centrality (blue) persistently above peer group
- Grey area shows peer centrality range
- Grey dotted line shows peer centrality average

4. Interconnectedness from Volatility Spillovers

- Diebold & Yilmaz (2012) method, applied to measuring shock transmission across banks
  - Construct daily volatility from stock-price data for each bank
- VAR forecast error variance decomposition
  - How much of the forecast error variance of bank i's volatility is attributable to shocks in bank j
  - Measure of connectedness and spillover effects within system
- Identifies measures of interconnectedness
  - Aggregate: Measures of system-wide interconnectedness
  - Directional: Identifies extent to which banks transmit or receive shocks
- Propagation of shocks and dynamic view of (systemic) risk, as opposed to simple correlations

Volatility Spillover Results, 2003-2024

	JPM	BAC	CITY	GS	MS	WFC	BK	STT	FROM (%)
JPM	21	13	14	11	11	14	9	7	79
BAC	13	24	16	8	9	16	8	7	76
CITY	13	16	24	9	10	14	7	7	76
GS	13	9	11	22	17	10	9	7	78
MS	12	9	10	16	26	9	10	8	74
WFC	14	16	13	9	9	22	9	8	78
BK	13	10	10	12	15	11	19	11	81
STT	11	10	10	11	15	11	13	19	81
TO (%)	89	83	83	75	87	85	66	55	
NET (%)	11	7	7	-3	13	8	-16	-26	

- On average, $\approx 3/4$ of a bank's volatility come from others (FROM col.)
- Biggest net senders of shocks (NET row, positives): MS and JPM
- Biggest net receivers (NET row, negatives): State Street, BNY Mellon
- In 5-year-rolling-window (time-varying) analysis (not shown) JPM the main volatility transmitter almost 50% of the time

Conclusions

- All four methods consistently identify JPM as the most systemically central US bank
- Interconnectedness is a persistent structural feature of the US banking system
- Market and textual data replicate regulatory data findings, offering a viable alternative when confidential data are unavailable

Future Research

- Better understanding of correspondence between channels of interconnectedness in each method
- Validation via EU: ECB publishes conclusions from confidential data $\rightarrow$ apply market data methods $\rightarrow$ do they also yield qualitatively similar results
- Validation via Jim's GNN

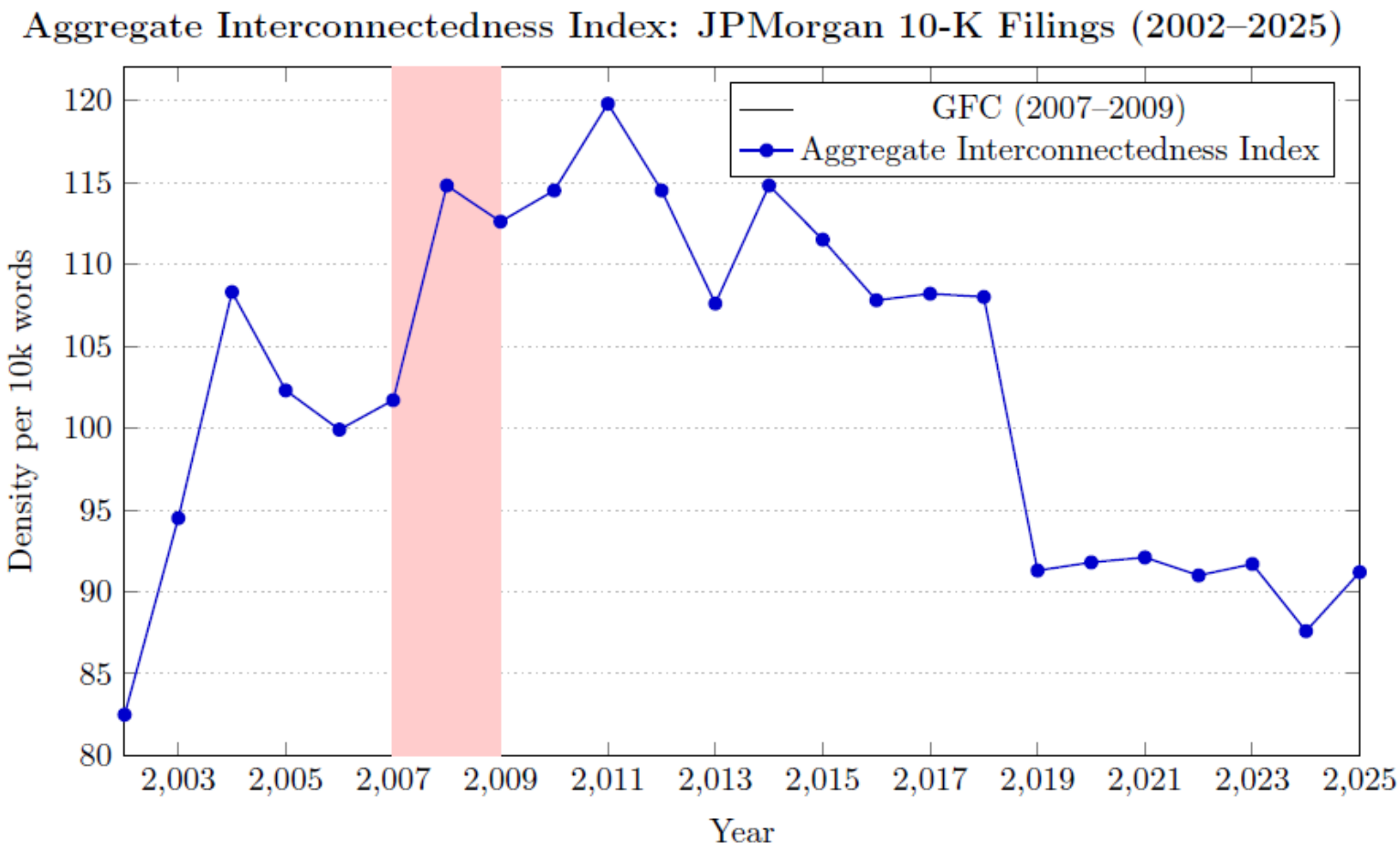
Thank you

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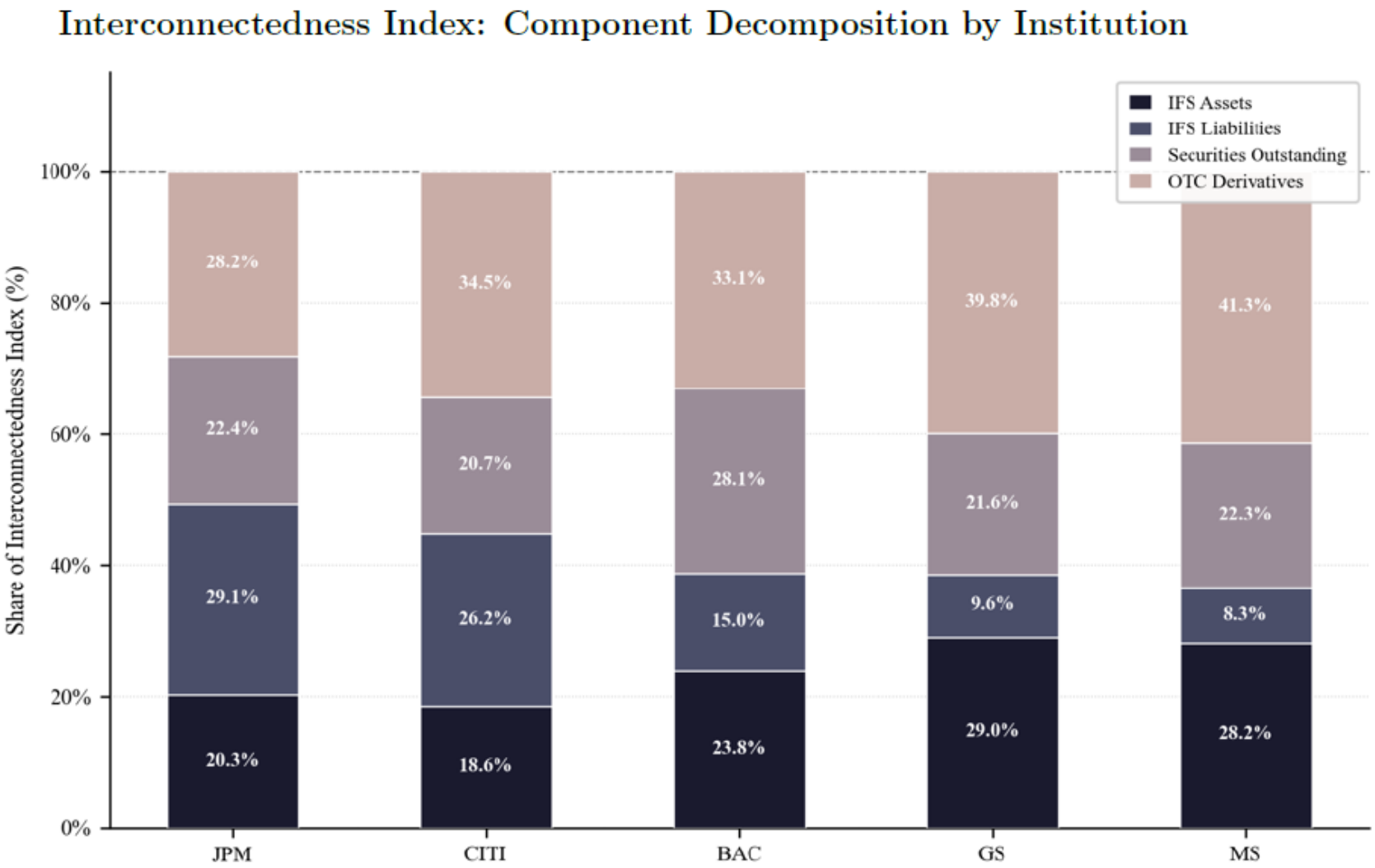
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Annual IIT for JPM



- JPM's IIT reaches a maximum during the GFC
- After 2019, decline in JPM's IIT

Annual IIR for JPM



Residual Shock Transmission Network

