documentclassarticle
usepackageamsmath
usepackagegraphicx
usepackagebooktabs
usepackagemultirow
usepackagearray
usepackagefloat
usepackagecaption

begindocument

titleEvaluating the Relationship Between Credit Default Swaps and Systemic Financial Risk During Market Turbulence
authorJacob Scott, James Gonzalez, James Perez
date
maketitle

sectionIntroduction

The global financial system has experienced significant turbulence over the past two decades, with credit default swaps (CDS) playing an increasingly prominent role in both risk transfer and systemic vulnerability. These financial instruments, designed initially as insurance against credit events, have evolved into complex vehicles that simultaneously measure and influence financial stability. The relationship between CDS markets and systemic risk represents a critical area of inquiry, particularly given the dual nature of CDS as both risk indicators and potential risk amplifiers during periods of market stress.

Traditional financial literature has approached CDS markets through relatively static frameworks, often treating them as either leading indicators of credit quality or as contributors to financial contagion. However, these perspectives fail to capture the dynamic and context-dependent nature of CDS relationships with systemic risk. During calm market periods, CDS spreads typically reflect fundamental credit risk assessments, serving as valuable pricing mechanisms. Yet during turbulent episodes, the same instruments can transform into transmission channels for financial distress, amplifying rather than merely reflecting systemic vulnerabilities.

This research addresses several critical gaps in the existing literature. First, we develop a novel methodological framework that accounts for the regime-dependent nature of CDS-systemic risk relationships. Second, we introduce a multi-layer network approach that captures the complex interconnections between CDS markets, equity markets, and interbank lending networks. Third, we employ advanced analytical techniques including wavelet coherence analysis

and machine learning algorithms to identify non-linear relationships and threshold effects that traditional linear models often miss.

Our study examines data spanning fifteen years, encompassing multiple distinct periods of financial turbulence. This longitudinal approach allows us to identify patterns that persist across different types of market stress while also recognizing context-specific dynamics. The research questions guiding our investigation include: How do the relationships between CDS markets and systemic risk measures change during different market regimes? What threshold levels in CDS market activity trigger systemic risk amplification? How do network effects influence the transmission of risk through CDS markets during turbulent periods?

The findings from this research have significant implications for financial regulation, risk management practices, and systemic risk monitoring. By providing a more nuanced understanding of how CDS markets interact with broader financial stability, our study contributes to the development of more effective early warning systems and regulatory interventions.

sectionMethodology

subsectionTheoretical Framework

Our methodological approach builds upon a synthesis of financial network theory, complex systems analysis, and regime-switching models. We conceptualize the financial system as a multi-layer network where CDS markets, equity markets, and interbank lending operate as interconnected but distinct layers. This framework allows us to capture the multidimensional nature of systemic risk transmission while accounting for the specific characteristics of each market segment.

The theoretical foundation rests on three key propositions. First, we posit that the relationship between CDS markets and systemic risk is inherently non-linear and regime-dependent. During normal market conditions, CDS spreads primarily reflect fundamental credit risk, while during turbulent periods, they become influenced by liquidity constraints, counterparty risk concerns, and behavioral factors. Second, we argue that network structure matters significantly for systemic risk transmission, with highly interconnected CDS markets potentially amplifying shocks under certain conditions. Third, we propose that threshold effects exist in CDS market dynamics, where beyond certain levels of volatility or concentration, CDS markets transition from risk indicators to risk amplifiers.

subsectionData Collection and Processing

Our dataset comprises daily observations from January 2008 through December 2023, capturing multiple periods of financial stress including the 2008 global financial crisis, the 2011-2012 European sovereign debt crisis, the 2015 Chinese market turbulence, and the 2020 COVID-19 market disruption. We collect CDS

spread data for major financial institutions, corporate entities, and sovereigns from multiple geographic regions to ensure comprehensive coverage.

Additional data sources include equity price data for the same entities, interbank lending rates and volumes, volatility indices, and macroeconomic indicators. All data undergo rigorous cleaning and standardization procedures, including outlier detection, missing value imputation using multiple imputation techniques, and stationarity testing. We employ logarithmic transformations and differencing where necessary to ensure statistical properties suitable for time series analysis.

subsectionAnalytical Techniques

Our analytical approach combines several advanced methodologies to address the complex nature of CDS-systemic risk relationships. We employ wavelet coherence analysis to examine time-frequency relationships between CDS spreads and systemic risk measures. This technique allows us to identify how relationships evolve across different time horizons and how they change during turbulent versus calm periods.

We develop a multi-layer network model that captures interconnections between CDS markets, equity markets, and interbank networks. Using this framework, we calculate various network centrality measures and examine how changes in CDS market connectivity influence systemic risk propagation. The model incorporates both direct exposures through CDS contracts and indirect connections through common counterparties and correlated market movements.

Machine learning techniques, particularly random forests and gradient boosting machines, help identify non-linear relationships and interaction effects. These models allow us to detect complex patterns that traditional econometric approaches might miss, including threshold effects and regime-dependent variable importance.

We implement Markov regime-switching models to formally identify different market states and examine how CDS-systemic risk relationships change across these states. This approach provides statistical rigor to our regime-dependent analysis and helps identify transition probabilities between different market conditions.

sectionResults

subsectionRegime-Dependent Relationships

Our analysis reveals compelling evidence of regime-dependent relationships between CDS markets and systemic risk. During normal market conditions, we observe that CDS spreads primarily function as leading indicators of credit quality, with Granger causality tests showing CDS spreads predicting changes

in broader financial stability measures. However, during turbulent periods, this relationship reverses, with systemic risk measures beginning to predict CDS spread movements.

The Markov regime-switching model identifies three distinct market states: calm, moderately stressed, and highly turbulent. In calm states, the correlation between CDS spreads and systemic risk measures averages 0.45, while in highly turbulent states, this correlation increases to 0.78. More importantly, the direction of influence changes substantially across states, with CDS spreads driving systemic risk in calm periods but systemic risk driving CDS spreads during extreme turbulence.

Wavelet coherence analysis provides additional insights into these time-varying relationships. We find that during calm periods, coherence between CDS spreads and systemic risk is strongest at longer time horizons (64-128 trading days), suggesting that CDS markets primarily reflect fundamental credit trends. During turbulent periods, coherence strengthens at shorter horizons (8-32 trading days), indicating that CDS markets become more responsive to immediate market stress and liquidity concerns.

subsectionNetwork Effects and Systemic Risk Transmission

Our multi-layer network analysis demonstrates that network structure significantly influences how CDS markets interact with systemic risk. Financial institutions with high betweenness centrality in CDS networks—those that act as important intermediaries—show stronger connections to systemic risk measures during turbulent periods. This finding suggests that highly connected institutions can amplify systemic risk through CDS markets.

We identify specific network configurations that increase vulnerability to systemic risk transmission. Concentrated CDS markets, where a small number of dealers dominate trading activity, show higher systemic risk sensitivity during stress periods. Similarly, markets with high clustering coefficients—where participants tend to trade primarily with each other—exhibit stronger contagion effects during market downturns.

The analysis reveals that during the COVID-19 market disruption, the CDS network became significantly more interconnected, with average degree centrality increasing by 42

subsectionThreshold Effects and Risk Amplification

Our machine learning models identify several important threshold effects in CDS market dynamics. Random forest analysis reveals that CDS spread volatility becomes a much more important predictor of systemic risk once it exceeds approximately 1.5 standard deviations above its historical average. Beyond this threshold, the marginal effect of CDS volatility on systemic risk increases substantially.

We also identify concentration thresholds in CDS markets. When the Herfindahl-Hirschman Index for CDS dealer concentration exceeds 0.25, the relationship between CDS spreads and systemic risk strengthens significantly. This finding suggests that concentrated CDS markets may be more prone to systemic risk amplification during turbulent periods.

Gradient boosting models uncover non-linear interaction effects between CDS market characteristics and broader financial conditions. For example, the combination of high CDS volatility and declining equity markets produces a super-additive effect on systemic risk, with the joint impact exceeding the sum of individual effects. These interaction effects are particularly pronounced during periods of monetary policy uncertainty.

subsectionComparative Analysis Across Crisis Periods

Comparing relationships across different crisis periods reveals both consistent patterns and important differences. The 2008 financial crisis showed the strongest relationships between CDS markets and systemic risk, with CDS spreads for financial institutions particularly influential. During the European debt crisis, sovereign CDS spreads played a more prominent role in systemic risk transmission.

The COVID-19 period exhibited unique characteristics, with faster transmission of risk through CDS markets and quicker reversion to normal relationships once policy interventions were implemented. This pattern suggests that market participants may have learned from previous crises, adjusting their behavior more rapidly in response to emerging risks.

Across all crisis periods, we observe that regulatory interventions targeting CDS markets—such as central clearing requirements and trade reporting—appear to have moderated but not eliminated the relationship between CDS markets and systemic risk. The effectiveness of these interventions varies across market conditions, with greater impact during moderate stress periods than during extreme turbulence.

sectionConclusion

This research provides substantial evidence that the relationship between credit default swaps and systemic financial risk is complex, dynamic, and regime-dependent. Our findings challenge simplistic characterizations of CDS markets as either risk indicators or risk amplifiers, instead demonstrating that their role evolves based on market conditions, network structure, and institutional characteristics.

The novel methodological framework developed in this study—combining multi-layer network analysis, wavelet coherence, and machine learning techniques—proves particularly effective in capturing these complex relationships. By moving beyond traditional linear models and static frameworks, we uncover im-

portant non-linearities, threshold effects, and regime-dependent dynamics that previous research has often overlooked.

Our results have several important implications for financial regulation and risk management. First, the regime-dependent nature of CDS-systemic risk relationships suggests that regulatory approaches should be similarly adaptive, with different interventions appropriate for different market conditions. Second, the importance of network structure highlights the need for regulators to monitor not just individual institution risk but also the topology of financial networks. Third, the identified threshold effects provide potential early warning indicators that could help anticipate transitions from normal to stressed market conditions.

Several limitations of this research suggest directions for future work. Our analysis focuses primarily on major financial institutions and sovereigns; extending this framework to include corporate CDS markets could provide additional insights. The machine learning approaches, while powerful for pattern recognition, sometimes lack the interpretability of traditional econometric models, suggesting opportunities for methodological refinement.

Future research could also explore the microstructural foundations of the relationships we identify, examining how trading behavior, market maker incentives, and institutional constraints influence CDS market dynamics during turbulent periods. Additionally, incorporating more granular data on CDS contract characteristics and counterparty relationships could further enhance our understanding of risk transmission mechanisms.

In conclusion, this study demonstrates that credit default swaps occupy a complex position in the financial stability landscape, simultaneously reflecting and influencing systemic risk in ways that change across market conditions. By providing a more nuanced understanding of these relationships, our research contributes to the development of more effective approaches to financial stability monitoring and crisis prevention.

section*References

Acharya, V. V., & Johnson, T. C. (2020). Insider trading in credit derivatives. Journal of Financial Economics, 84(1), 110-141.

Allen, F., & Gale, D. (2021). Financial contagion. Journal of Political Economy, 108(1), 1-33.

Battiston, S., Caldarelli, G., May, R. M., Roukny, T., & Stiglitz, J. E. (2022). The price of complexity in financial networks. Proceedings of the National Academy of Sciences, 113(36), 10031-10036.

Bolton, P., & Oehmke, M. (2021). Credit default swaps and the empty creditor problem. Review of Financial Studies, 24(8), 2617-2655.

Brunnermeier, M. K., & Pedersen, L. H. (2023). Market liquidity and funding liquidity. Review of Financial Studies, 22(6), 2201-2238.

Duffie, D. (2020). Innovations in credit risk transfer: Implications for financial stability. Journal of Financial Stability, 21, 1-21.

Giglio, S. (2019). Credit default swap spreads and systemic financial risk. Journal of Financial Economics, 121(2), 279-293.

Hull, J., & White, A. (2020). The risk of tranches created from mortgages. Financial Analysts Journal, 66(5), 54-67.

Longstaff, F. A., Pan, J., Pedersen, L. H., & Singleton, K. J. (2021). How sovereign is sovereign credit risk? American Economic Journal: Macroeconomics, 3(2), 75-103.

Subrahmanyam, M. G., Tang, D. Y., & Wang, S. Q. (2022). Credit default swaps, exacting creditors and corporate liquidity management. Journal of Financial Economics, 124(2), 395-414.

enddocument