Applying the Data and Tools: Development of Macroprudential Policy for Financial Stability

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Financial Stability Analysis: Using the Tools, Finding the Data Conference

May 31, 2013

Washington, DC

Based on the recent work

1. **Econometric Measures of Connectedness and Systemic Risk in the Finance and Insurance Sectors**
   Monica Billio, Mila Getmansky, Andrew W. Lo and Loriana Pelizzon, *Journal of Financial Economics*, Volume 104, Issue 3, June 2012, Pages 536-559
2. **On a New Approach for Analyzing and Managing Macrofinancial Risks**
   Monica Billio, Mila Getmansky, Dale Gray, Robert C. Merton, Andrew W. Lo, and Loriana Pelizzon, *Financial Analysts Journal*, Volume 69, Issue 2, 2013, Pages 22-33
3. **Sovereign, Bank, and Insurance Credit Spreads: Connectedness and System Networks**
   Monica Billio, Mila Getmansky, Dale Gray, Robert C. Merton, Andrew W. Lo, and Loriana Pelizzon, Working Paper
4. **Chapter in IMF Global Financial Stability Report on Sovereign Credit Default Swaps** (Chapter 2, Box 2.1 **Interconnectedness Between Sovereigns and Financial Institutions**) Monica Billio, Mila Getmansky, Dale Gray, Robert C. Merton, Andrew W. Lo, and Loriana Pelizzon. Edited by IMF, 2013

Objectives

- Analyzing and managing sovereign risk, the risks of financial institutions, and the interactions among sovereigns and financial institutions are important for financial stability
- Concentrate on credit
- CDS values do not fully account for default risk, as they only reflect the default after the first loss. Underestimated due to values of guarantees.
- Important to account for implicit and explicit guarantees
- We propose Expected Loss Ratios (based on CCA) and network measures to analyze financial system interactions and systemic risk

On and OFF-Balance Sheet Credit Assets and Liabilities US Government 2010

Table 1: Credit-related Assets and Liabilities of the U.S. Government, 2010

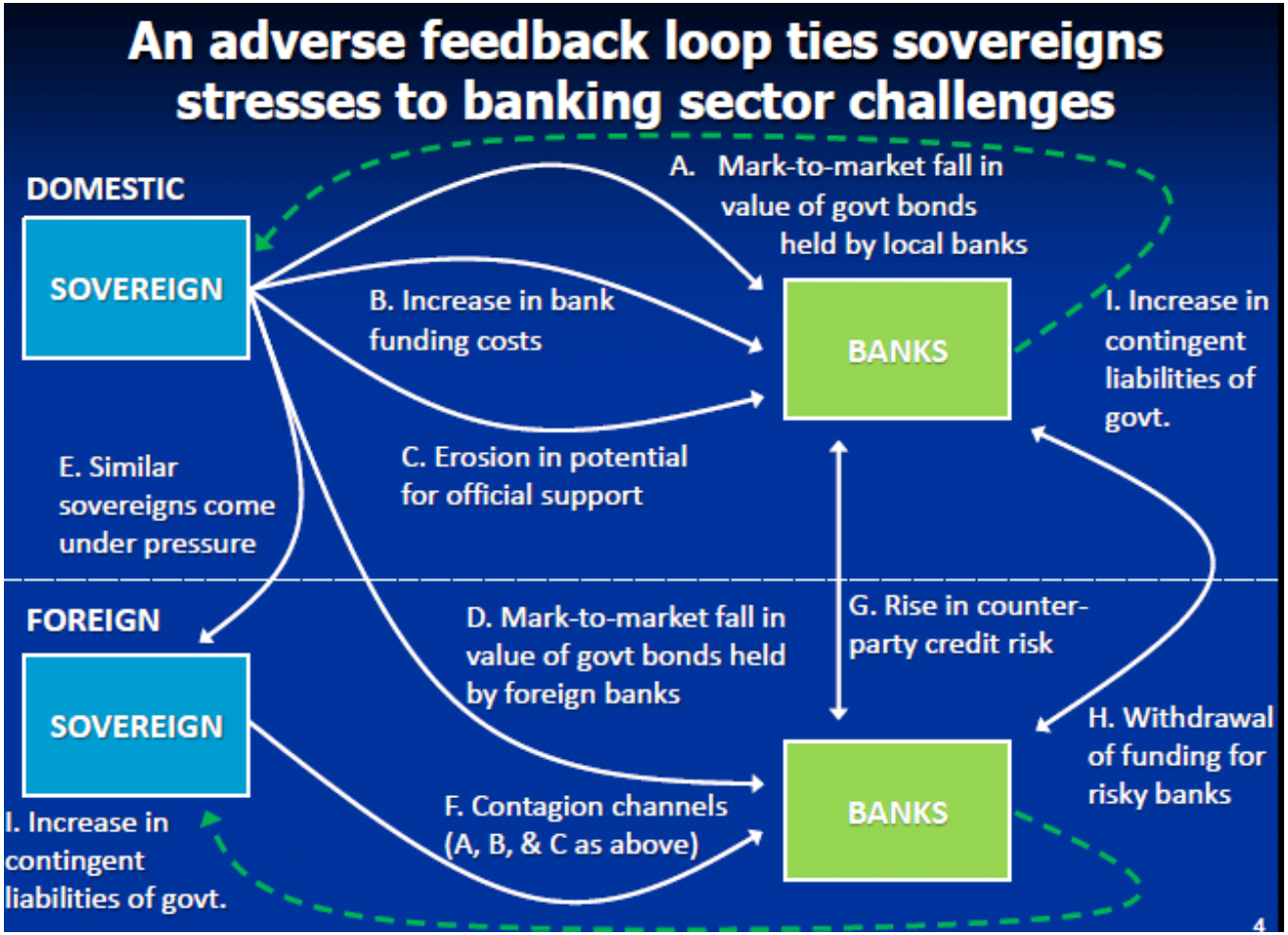
(billions of dollars)

Assets		Liabilities	
Direct loans	828	Treasury debt held by public	9,060
Guaranteed loans	1,867	Off-balance-sheet guaranteed loan financing	1,867
Mortgages guaranteed or held by Fannie Mae and Freddie Mac	5,321	Fannie and Freddie debt	1,453
		Fannie and Freddie MBSs	3,868
Other federally-backed credit (FDIC, FHLBs, FCS, PBGC, Federal 10,140Reserve loans and SIVs)	10,140	Off-balance-sheet financing of other federally-backed credit	10,140
		Taxpayer/stakeholder equity	-8,232

Source: Author's tabulations based on Treasury Financial Statements, FDIC and Federal Reserve Releases, OMB Analytical Perspectives, and FHFA 2010 Annual Report to Congress

From *Credit Policy as Fiscal Policy, Deborah Lucas, MIT, November 15, 2011, p. 29*

Feedback Loops of Risk from Explicit and Implicit Guarantees



Source: IMF GFSR 2010, October

Measuring Connectivity and Influence on Credit Ratings Between Sovereigns and Financial Institutions

- Expected Loss Ratio = Guarantee/Riskfree Debt
  = PUT/B exp[-rT]
  = ELR
- Fair Value CDS Spread = -log (1 – ELR)/ T
- $ELR_k(t) = a_{jk} + b_{jk} ELR_j(t-1) + \varepsilon_t$
  $ELR_j(t) = a_{kj} + b_{jk} ELR_k(t-1) + \zeta_t$
- If b_{jk} is significantly > 0, then j influences k
- If b_{kj} is significantly > 0, then k influences j
- If both are significantly > 0, then there is feedback, mutual influence, between j and k.

Data

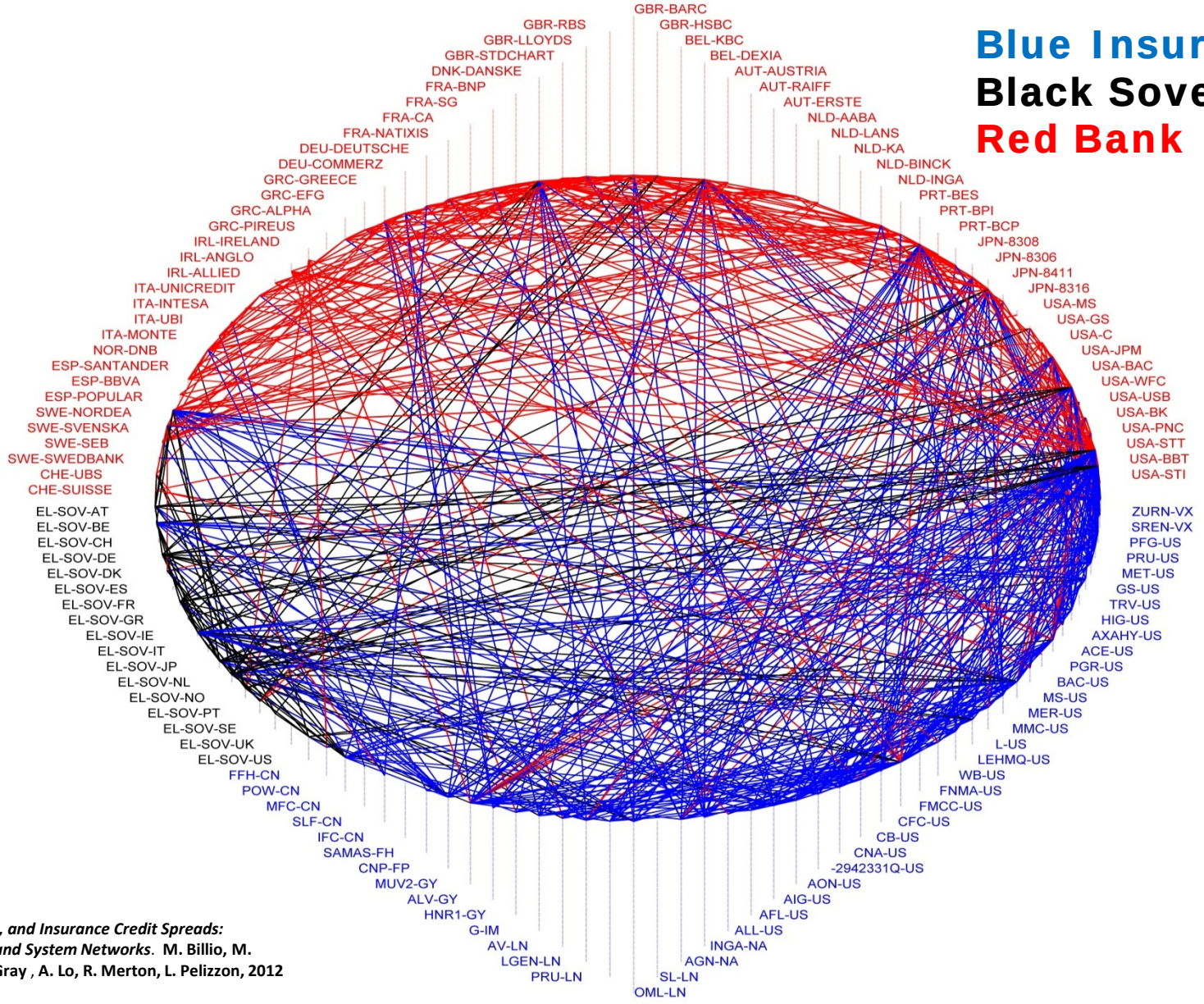
- Sample: Jan 01-Mar12
- Monthly frequency
- Entities:
  - 17 Sovereigns
  - 63 Banks
  - 39 Insurance Companies
- Moody's KMV CreditEdge:
  - Expected Loss Ratio (ELR)

Sovereign, Bank, and Insurance Credit Spreads: Connectedness and System Networks. **M. Billio, M. Getmansky, D. Gray , A. Lo, R. Merton, L. Pelizzon, 2012**

Network Measures

- Degrees
  - Indegree (IN): number of incoming connections
  - Outdegree (FROM): number of outgoing connections
  - Totdegree: Indegree + Outdegree
- Connectivity
  - Number of node connected: Number of nodes reachable following the directed path
  - Average Shortest Path: The average number of steps required to reach the connected nodes
- Centrality
  - Eigenvector Centrality (EC): The more the node is connected to central nodes (nodes with high EC) the more is central (higher EC)

Connectedness July 2004-June 2007: Sovereigns, Banks, and Insurance Companies



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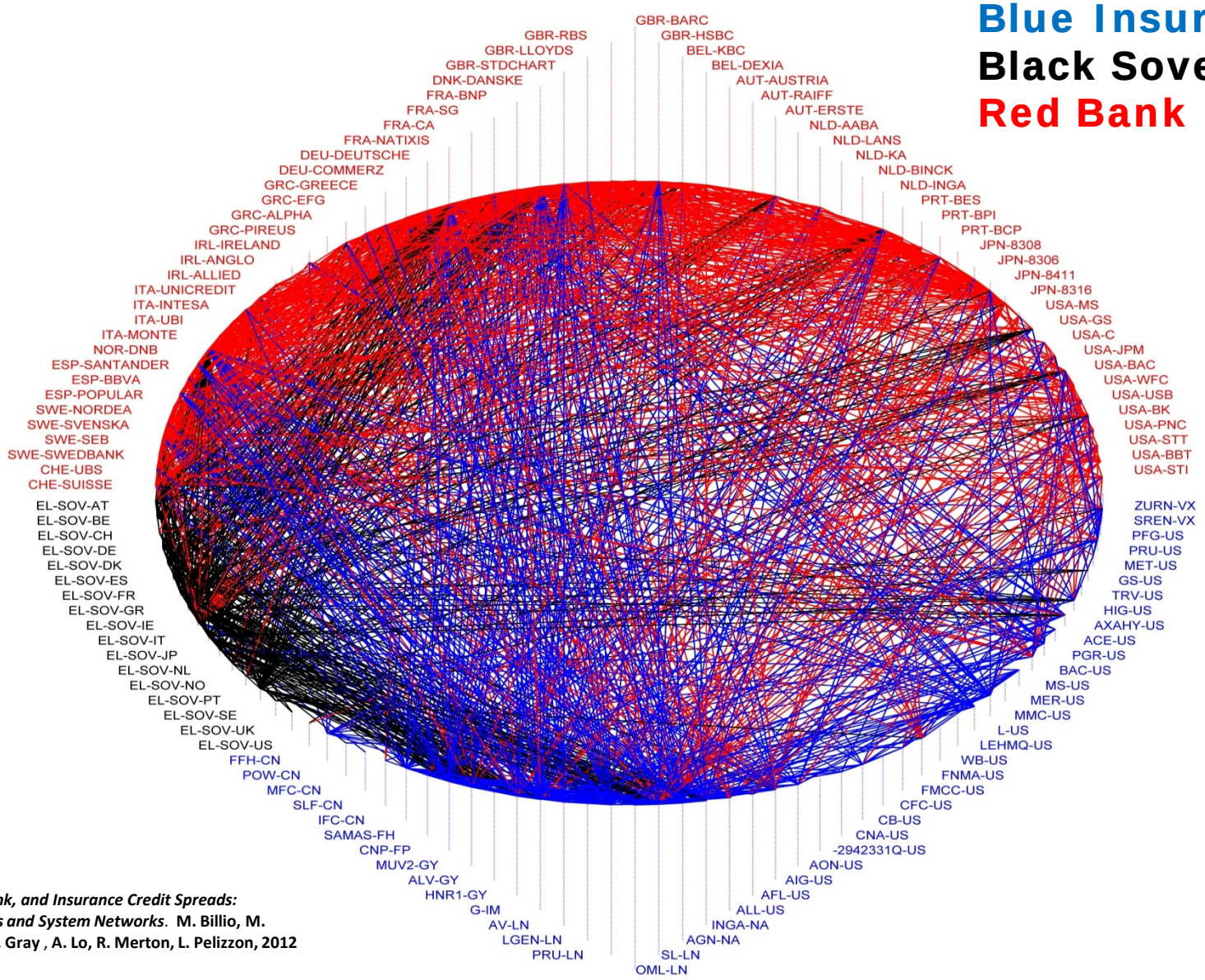
P-Value=0.01

Connectedness April 2009-March 2012: Sovereigns, Banks, and Insurance Companies



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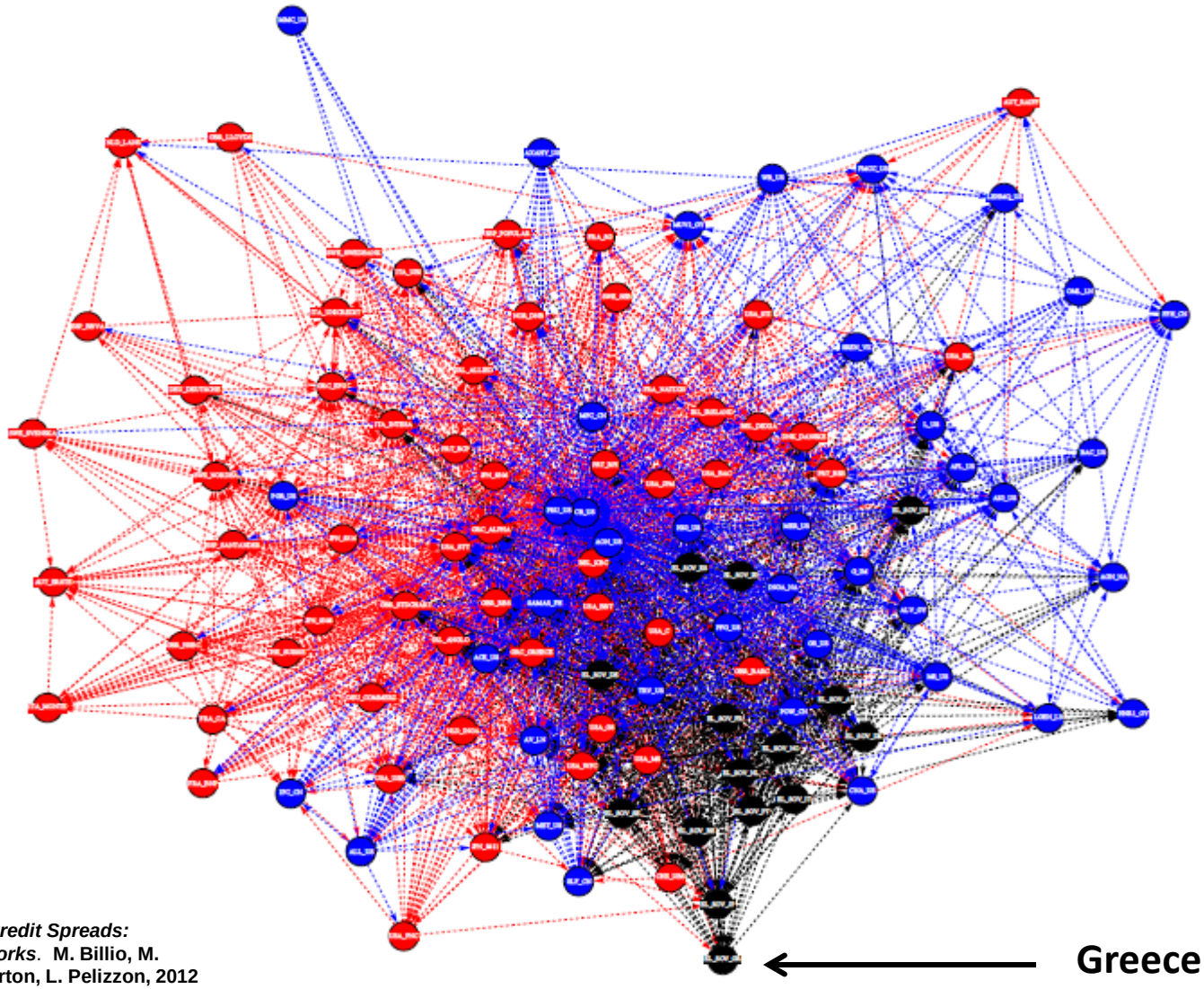
Connectedness to Greece: August 2008



Blue Insurance
Black Sovereign
Red Bank

Greece

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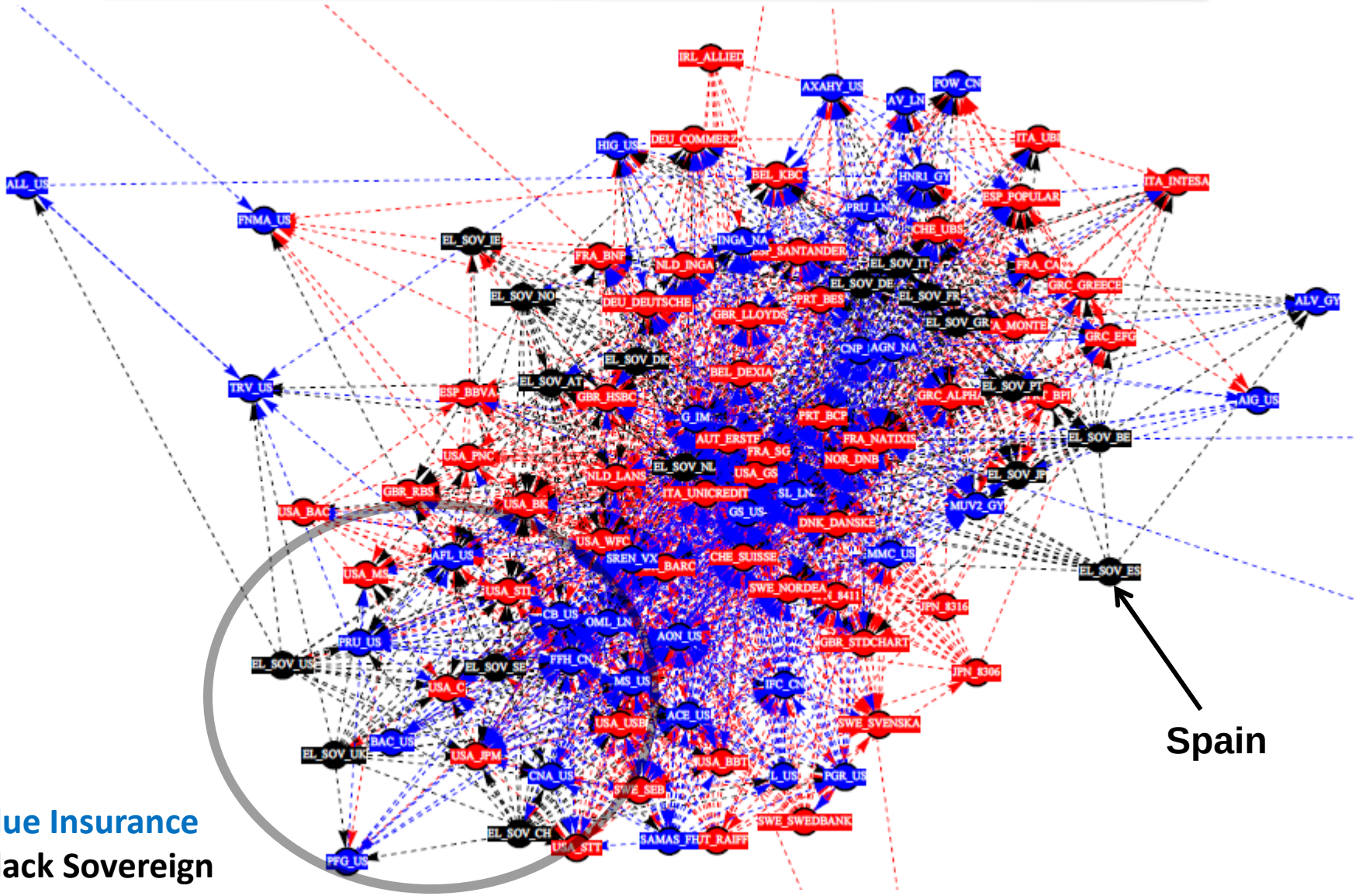
Connectedness to Spain: December 2011



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Red Bank

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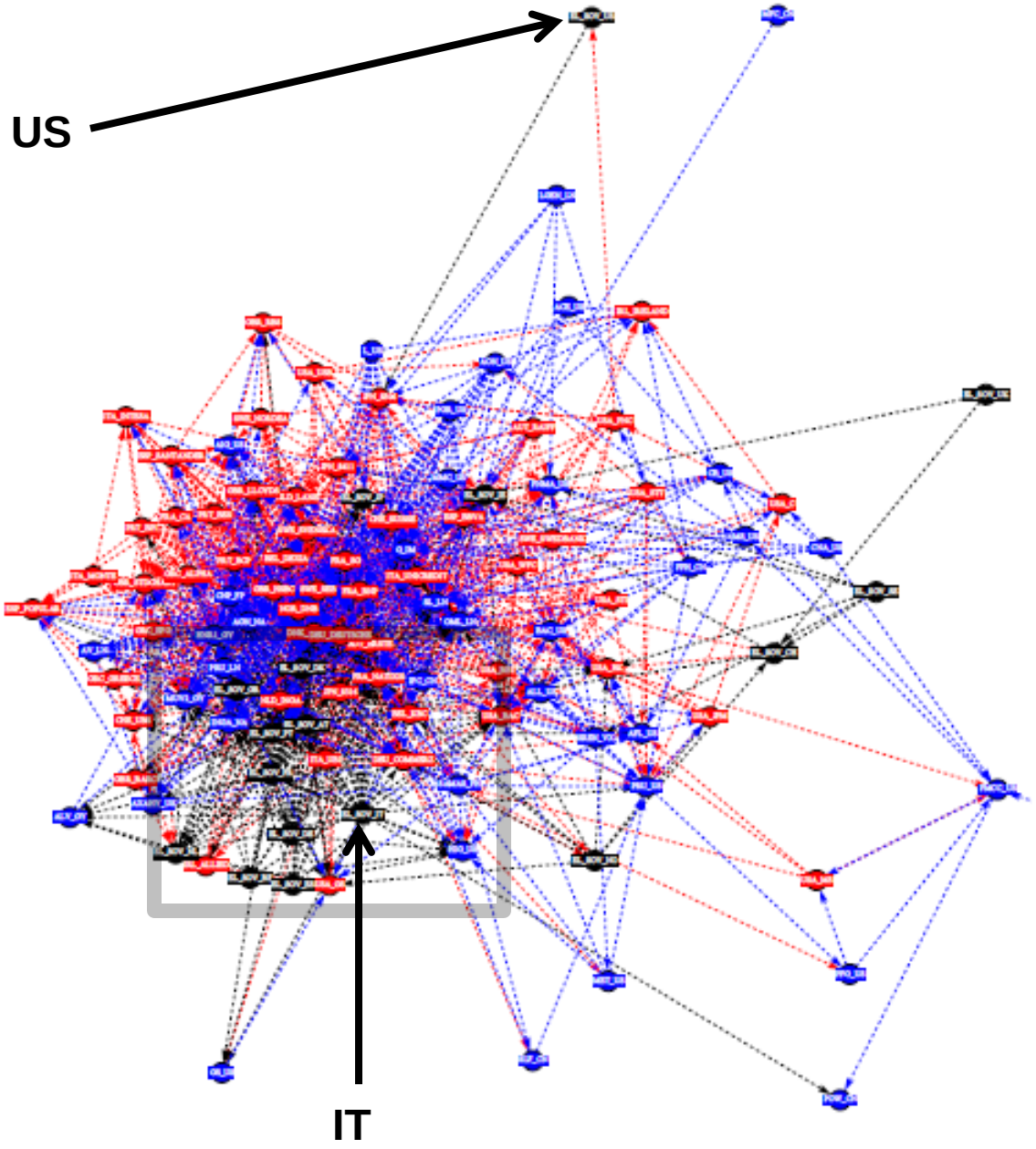
Connectedness to Italy and US: March 2012



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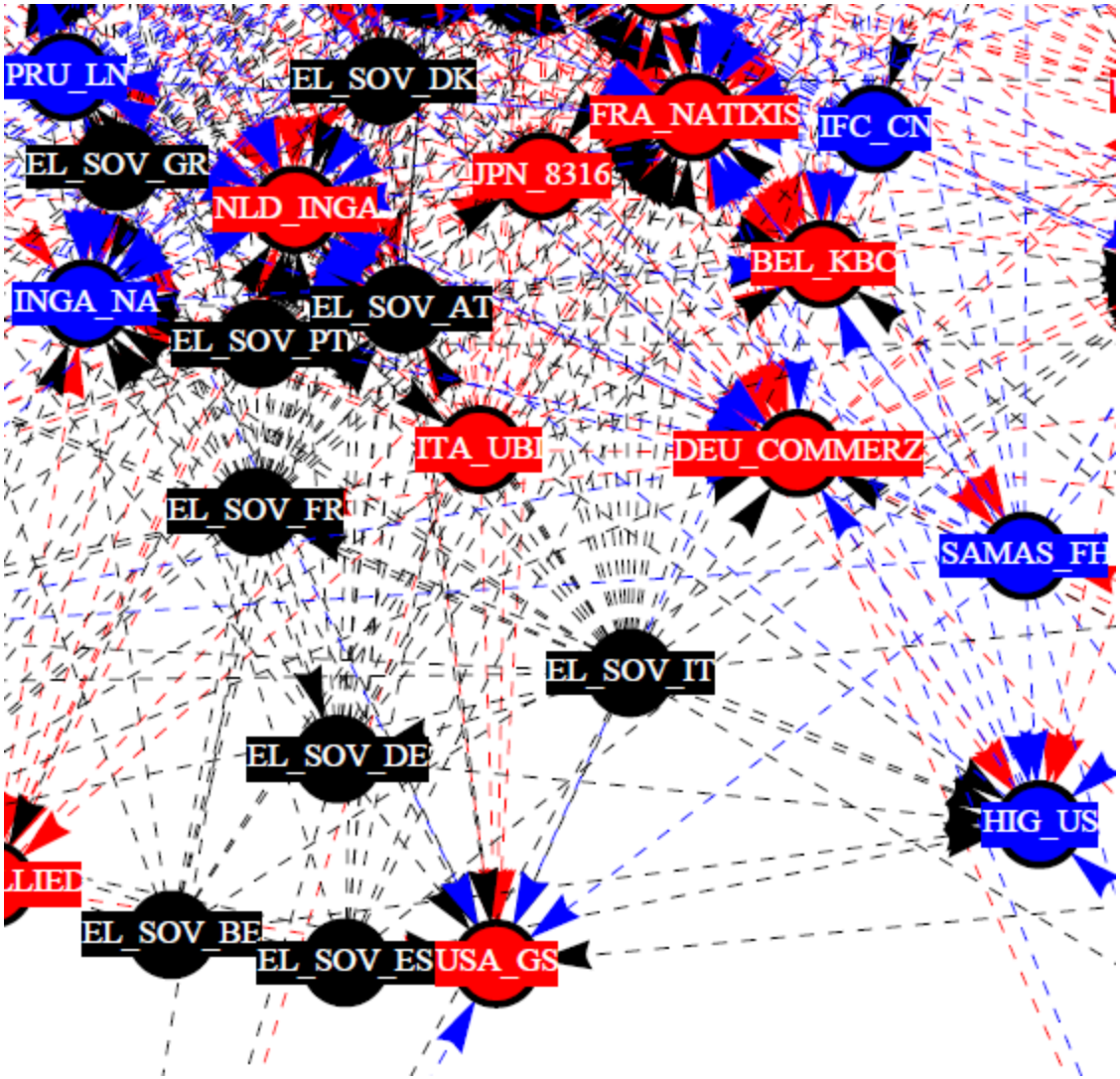
Connectedness to Italy: March 2012



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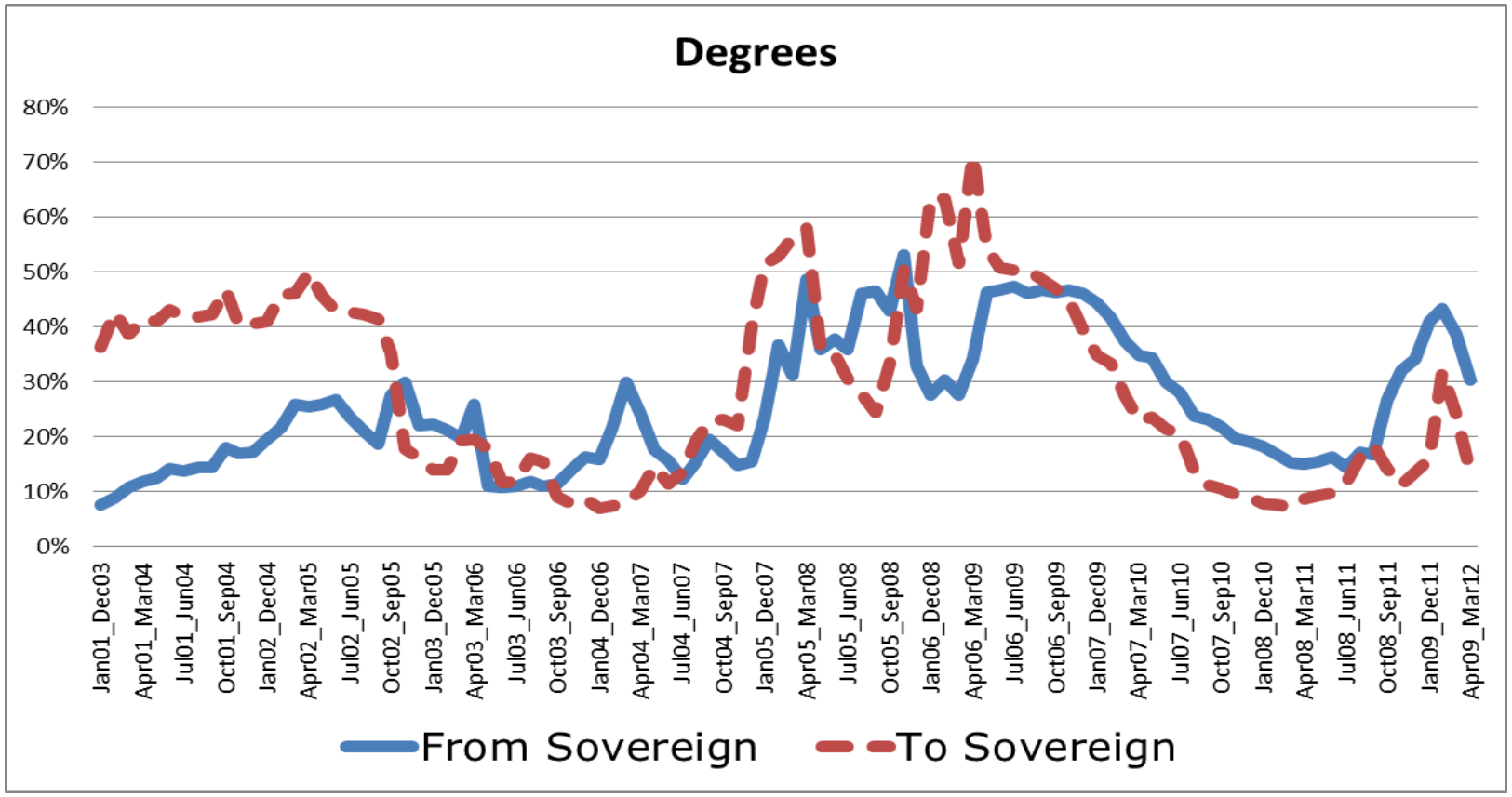
Network Measures: FROM and TO Sovereign



17 X 102= 1734 potential connections FROM (TO)

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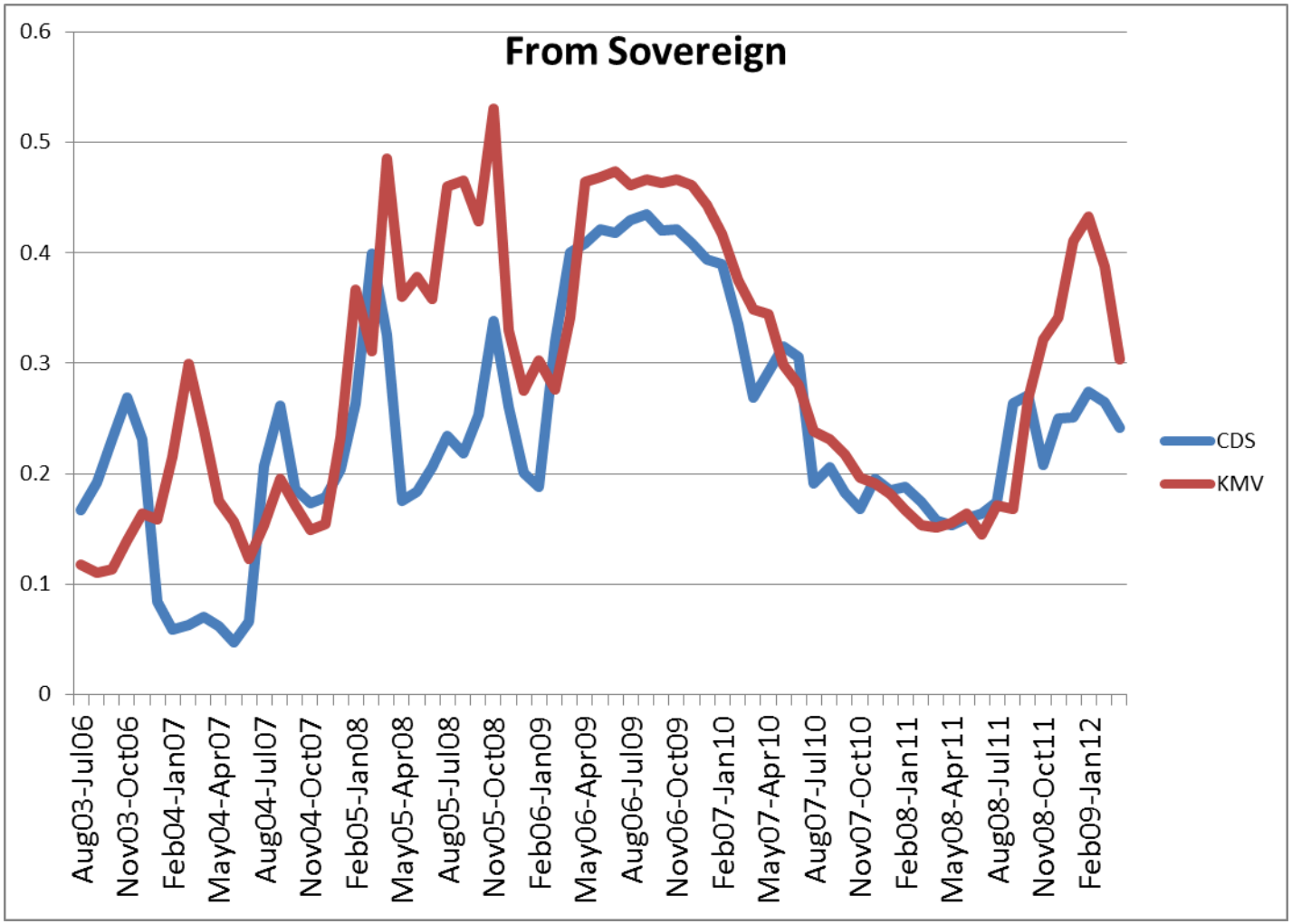
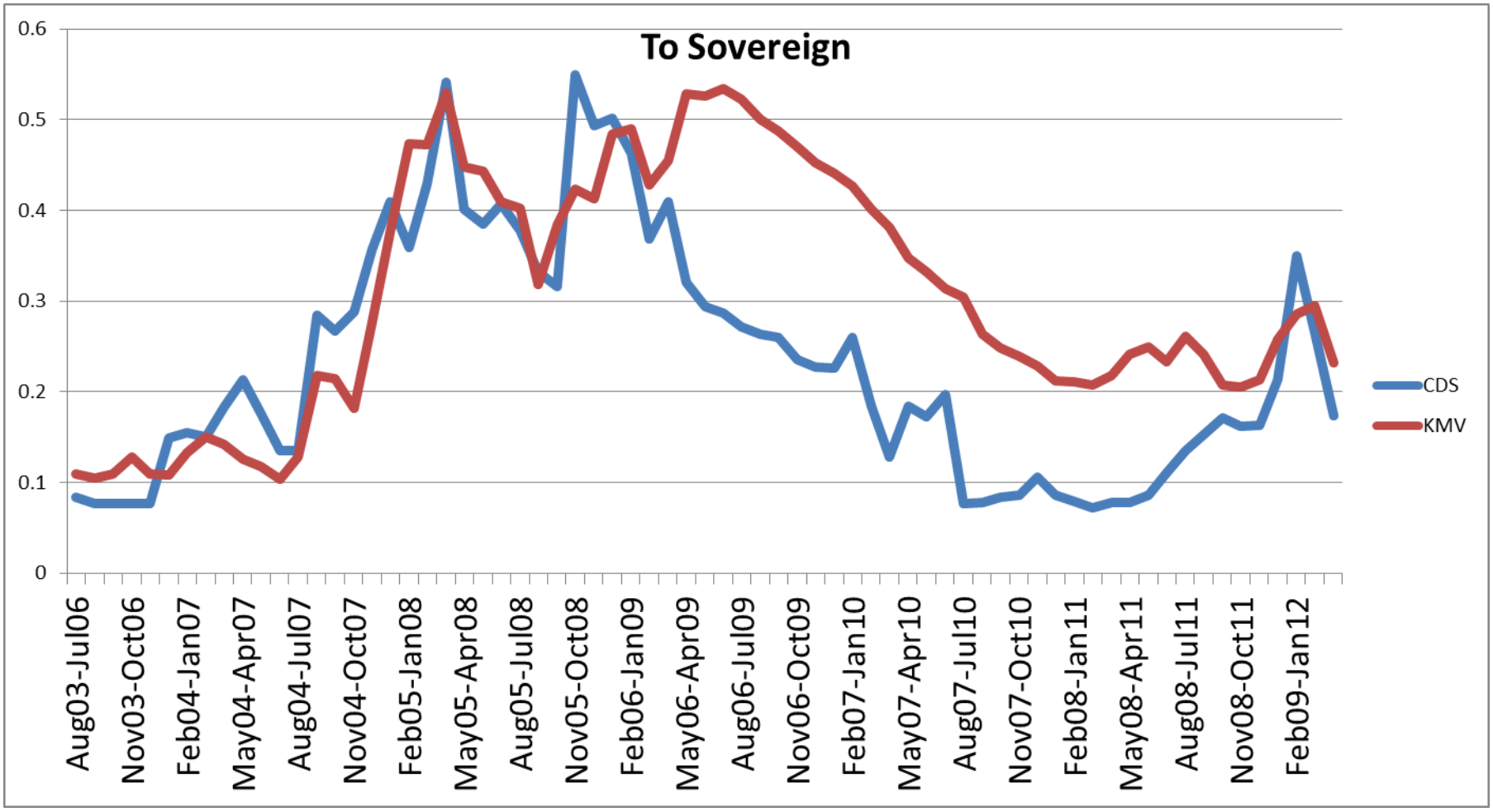
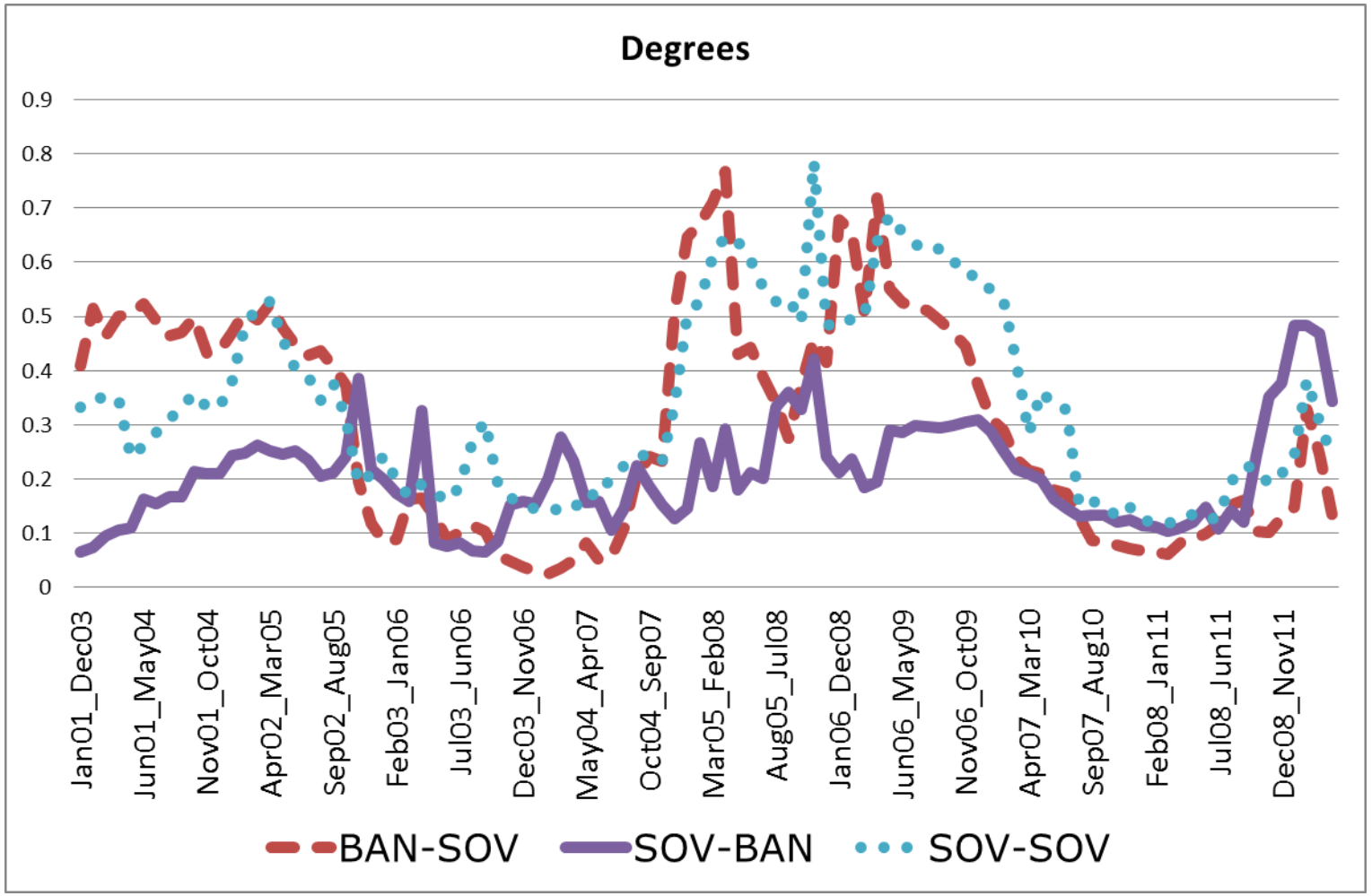
Network Measures: FROM Sovereign



Network Measures:
TO Sovereign



Network Measures: FROM and TO Sovereign



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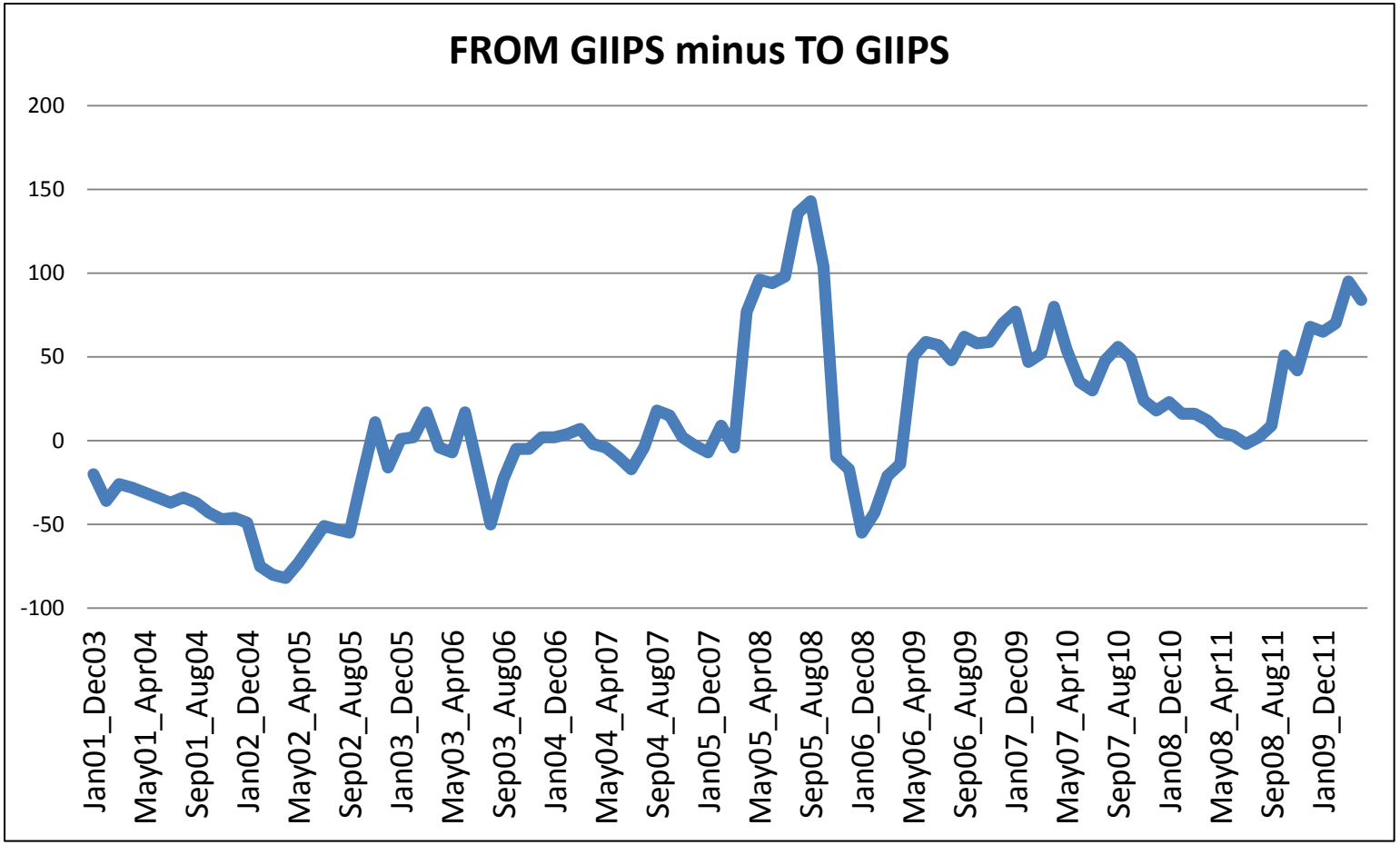
Greece, Ireland, Italy, Portugal and Spain: GIIPS



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Conclusion

- The system of banks, insurance companies, and sovereigns in our sample is highly dynamically connected
- Important to use the right data to measure interconnectedness
- Sovereigns are interconnected with other sovereigns
- Network measures allow for early warnings and assessment of the system complexity

Functional Description of Being a Lender or Guarantor of Debt When There is Risk of Default

RISKY DEBT + GUARANTEE OF DEBT = RISK-FREE DEBT

RISKY DEBT = RISK-FREE DEBT - GUARANTEE OF DEBT

<table>
<tr><td colspan="2">Corporation</td></tr>
<tr><td rowspan="2">Operating Assets, A</td><td>Debt (face value B), D</td></tr>
<tr><td>Common Stock, E</td></tr>
</table>

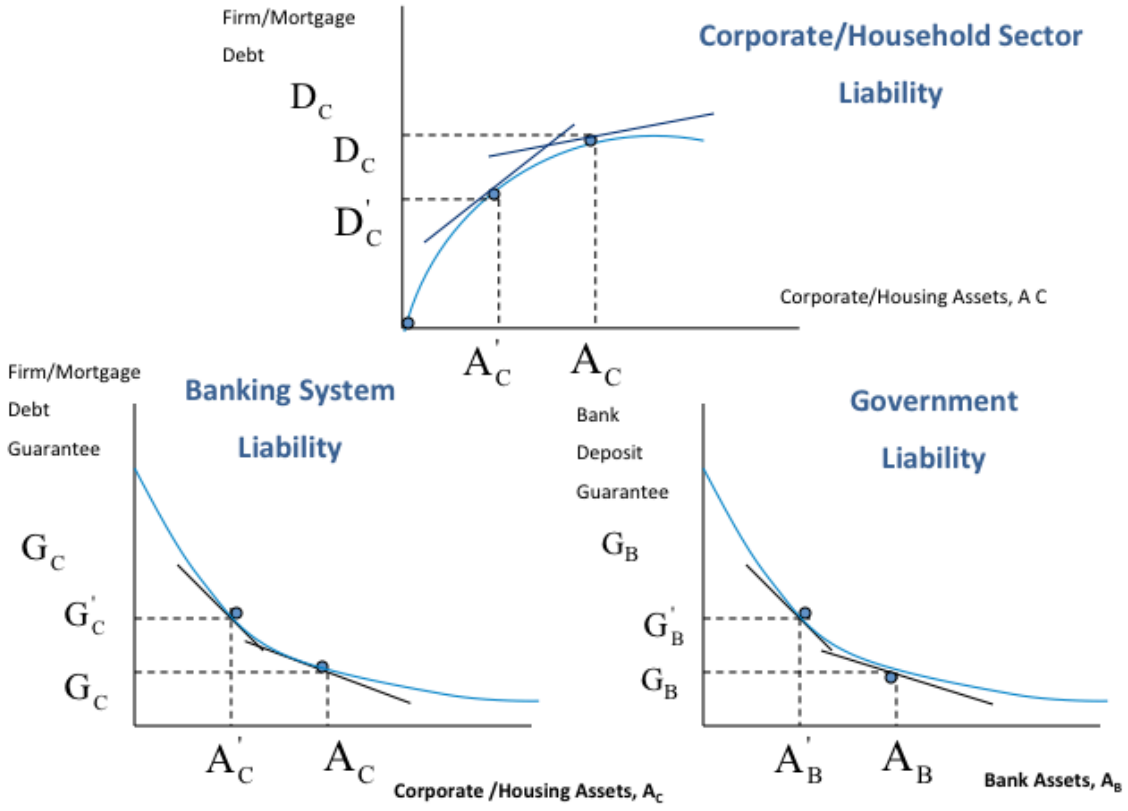
A = D + E

IN DEFAULT, THE HOLDER OF THE GUARANTEE RECEIVES PROMISED VALUE OF THE DEBT MINUS VALUE OF ASSETS RECOVERED FROM DEFAULTING ENTITY = MAX [0, B – A]

VALUE OF GUARANTEE = PUT OPTION ON THE ASSETS OF BORROWER

CREDIT DEFAULT SWAPS ARE GUARANTEES OF DEBT AND THEREFORE ARE PUT OPTIONS ON THE ASSETS OF THE BORROWER

Non-linear Macro Risk Buildup



General Measures of Credit Connectedness and Influence among Institutions: Linear Granger Causality Tests

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \epsilon_t$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t$$

- $Y \Rightarrow_G X$ if $\{b_j\}$ is different from 0
- $X \Rightarrow_G Y$ if $\{c_j\}$ is different from 0
- If both $\{b_j\}$ and $\{c_j\}$ are different from 0, feedback relation
- Test is robust to autocorrelation and heteroschedasticity

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