CONTAGION RISK IN THE JAMAICAN FINANCIAL SYSTEM

Toni-Anne Milwood
Bank of Jamaica

Presented at the 46th Annual Monetary Studies Conference
Port-of-Spain, Trinidad

November 18, 2014

OUTLINE

- Motivation
- Literature Review
- Network Topology Measures and Results
- Simulation Model and Results
- Conclusion and Policy Implications

MOTIVATION

- GFC highlighted the vulnerabilities in financial systems including the degree of complexity or interconnectedness.
- Interconnectedness of the financial system as a shock-amplifier vs. shock-absorber during periods of stress.
- Understanding the structure of financial flows allows for assessment of systemic stability and provision of liquidity.
- Objectives:
  - Determine the structure of Jamaica's financial system network and identify significant institutions using network topology.
  - Determine the resilience of the network to credit and funding shocks using network simulations.

LITERATURE REVIEW

- Bach and Atalay (2008) – USA: New York
  - Federal funds market network sparse; most banks with few counterparties and few banks with large number of counterparties.
- Iazetta and Manna (2009) – Italy
  - Few banks pivotal to redistribution of liquidity; 10 banks interconnected with 3 amoung top 10 by volume of traded deposits.
- Hausenblas, Kubicova and Lesanovska (2012) - Czech Republic
  - Sparse and heterogenous network; few banks form core, many banks form periphery; limited contagion based on simulations.
- Ogawa, Park, Singh and Thacker (2013) – Eight CARICOM countries
  - Interconnectedness in large banking groups and conglomerates; Bahamas and Barbados recorded highest inflows of funds due to large offshore sectors.

NETWORK TOPOLOGY (1)

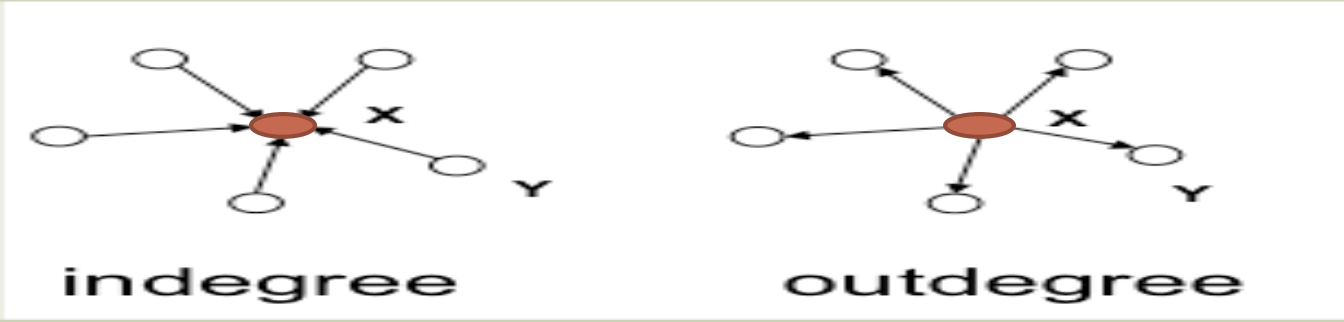
- Nodes – financial institutions vs. Links – connections between financial institutions (credit exposures/ funding relationships).

- Descriptive network statistics
  - *Connectivity or Dens*ity - the unconditional probability that two institutions have a link with each other.

  - *Clustering coefficient* - the probability that two neighbours with a direct link to a node are linked together.

NETWORK TOPOLOGY (2)

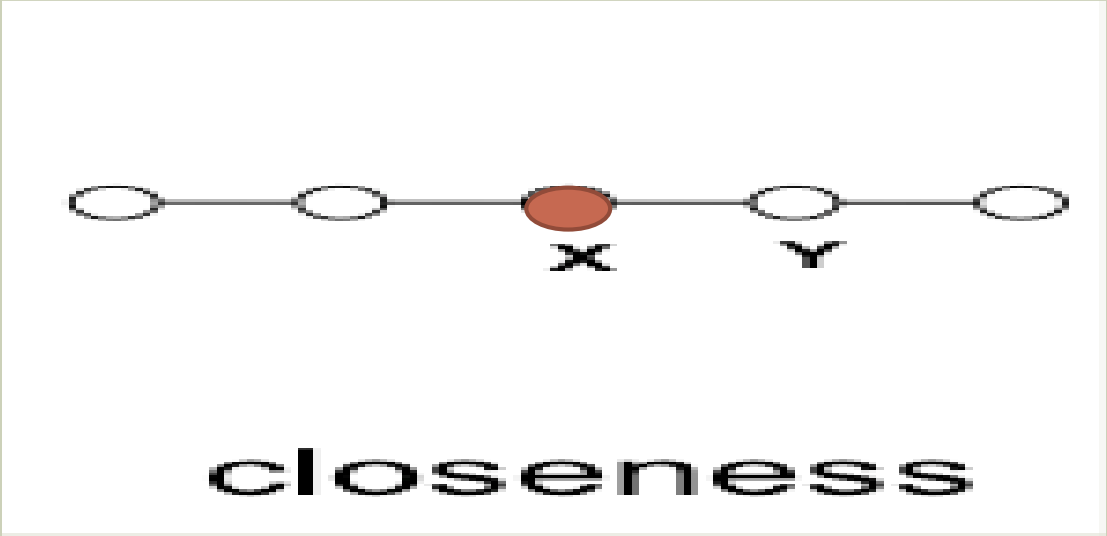
- Centrality Measures
- Degree centrality - counts the number of directed links that are connected to a node.
  - In-degree –No. of institutions that the node of interest has received funding from (liabilities of a node).
  - Out-degree –No. of institutions that the node of interest has funded (assets of a node).



- Average Degree – No. of links divided by the No. of nodes.

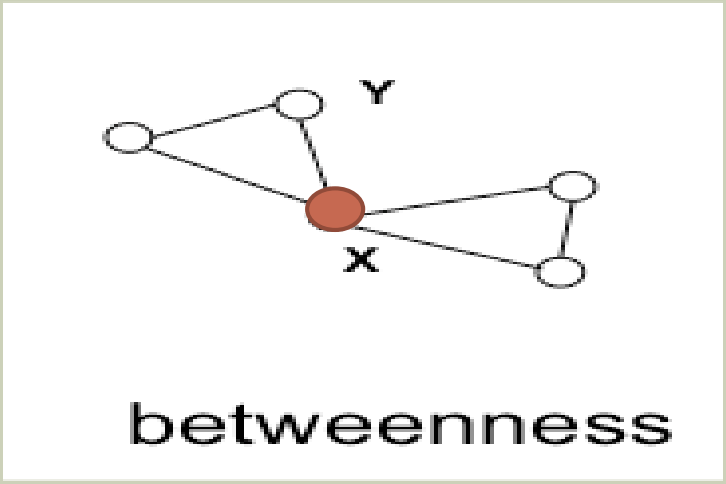
NETWORK TOPOLOGY (3)

- Closeness Centrality or Average Path Length
  - Average shortest distance between two nodes.
  - Measures how far away nodes are from each other.
  - A node is considered important if it is relatively close to all other institutions.

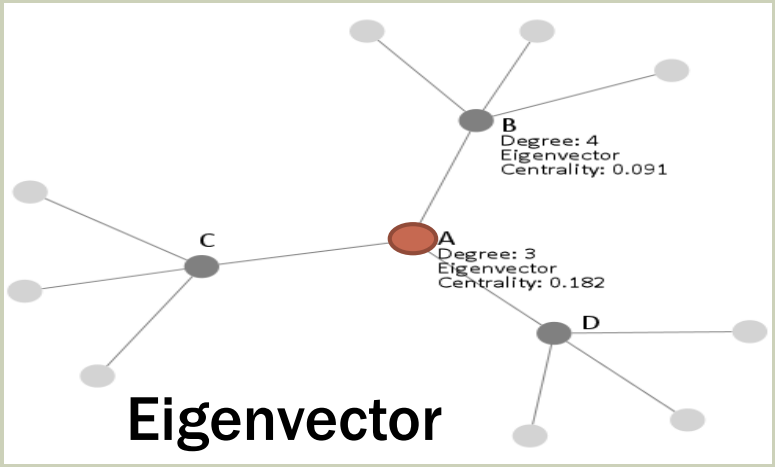


NETWORK TOPOLOGY (4)

- Betweenness Centrality
  - No. of shortest paths that pass through a node.
  - A node is important if it is needed to connect other pairs of nodes.

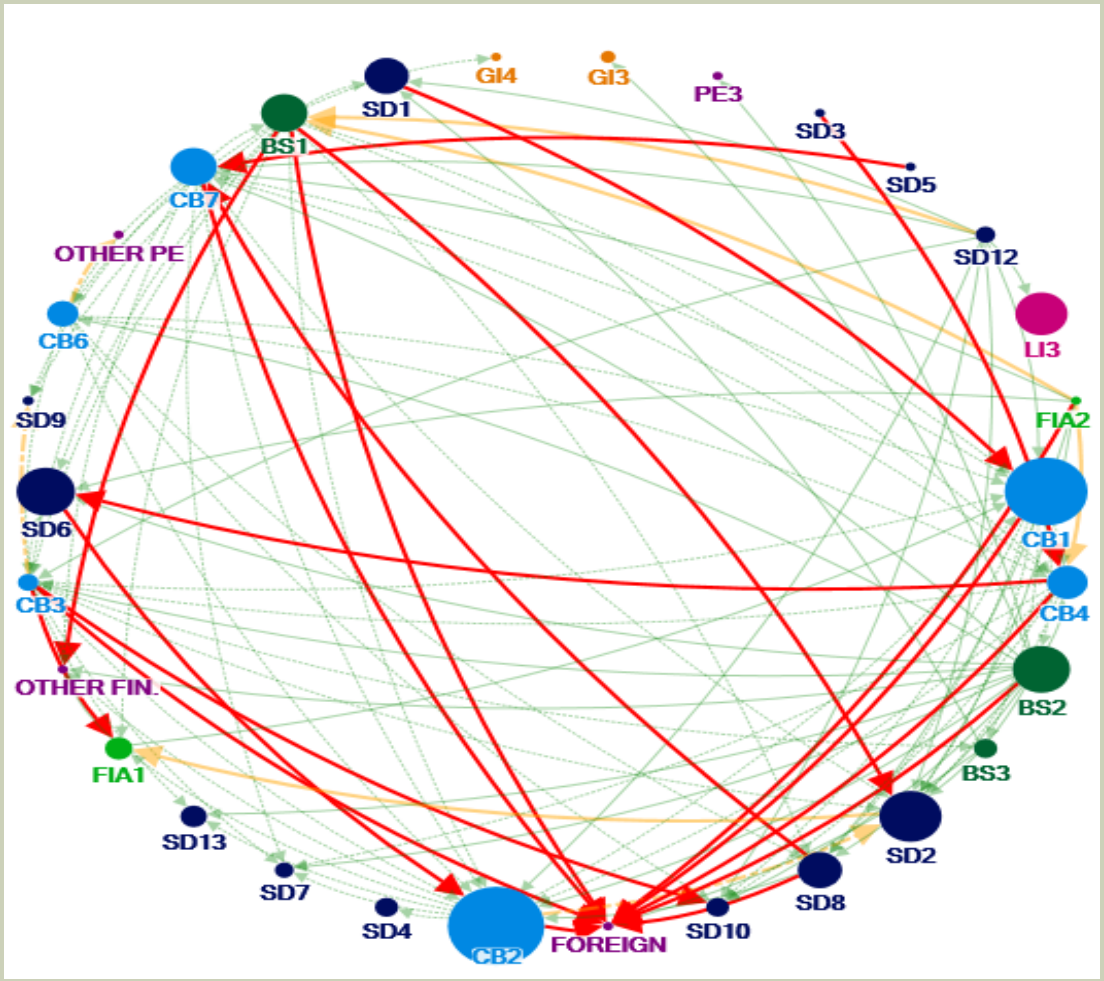


- Eigenvector Centrality
  - Quality of the connections within the network.
  - Examines to what extent a node is connected to other highly connected players.



NETWORK TOPOLOGY RESULTS (1)

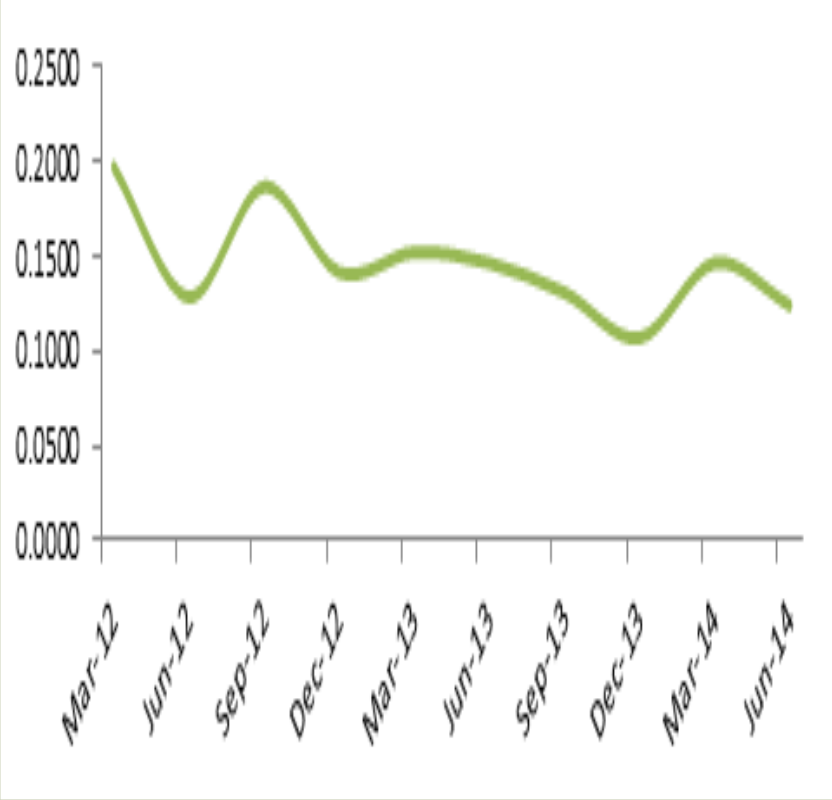
Fig. 1 Network graph at end-June 2014



- DTIs, top SDs, ICs, top CUs, OFIs, PEs and Foreign.
- Net credit exposures are determined by netting the transactions between two institutions.
- Positive net credit exposures indicate net creditors (provided net funding to other nodes).
- Graph indicates exposures of several institutions to foreign institutions primarily in the form of deposits.

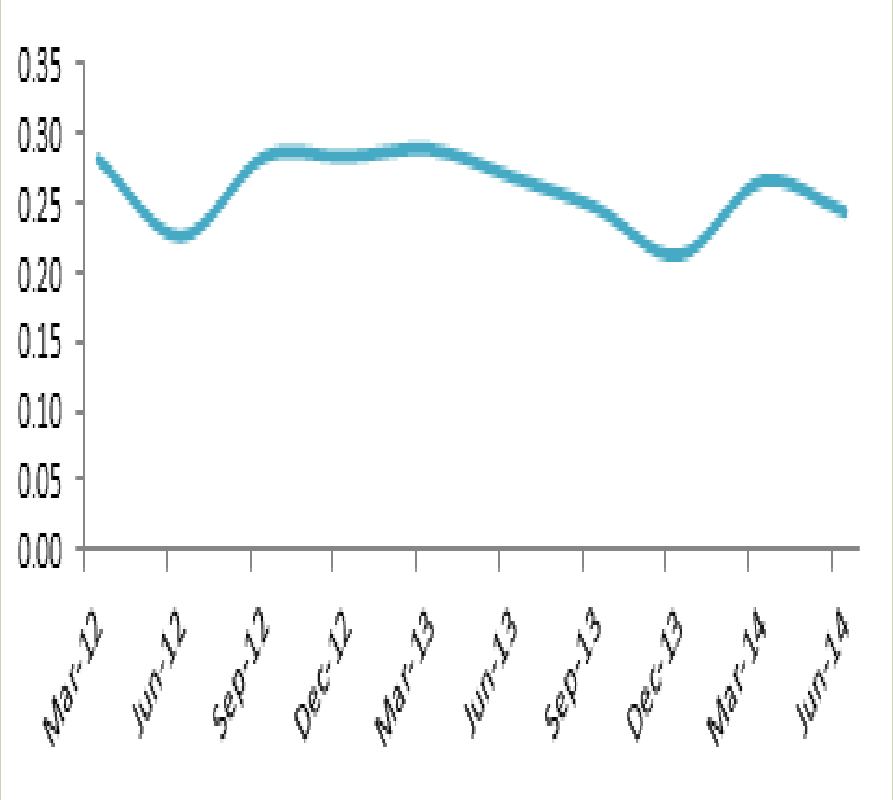
NETWORK TOPOLOGY RESULTS (2)

Fig. 2: Connectivity



- At June 2014 12.4% of links utilised relative to 19.7% at March 2012.

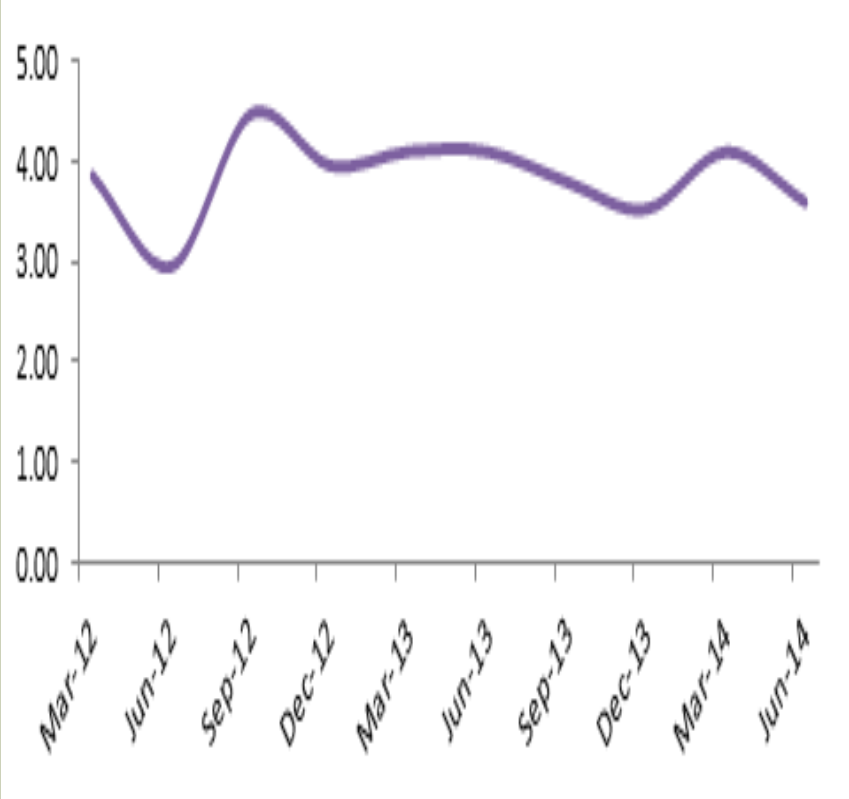
Fig. 3: Clustering coefficient



- At June 2014, 24.4% chance that neighbours of a node are connected.

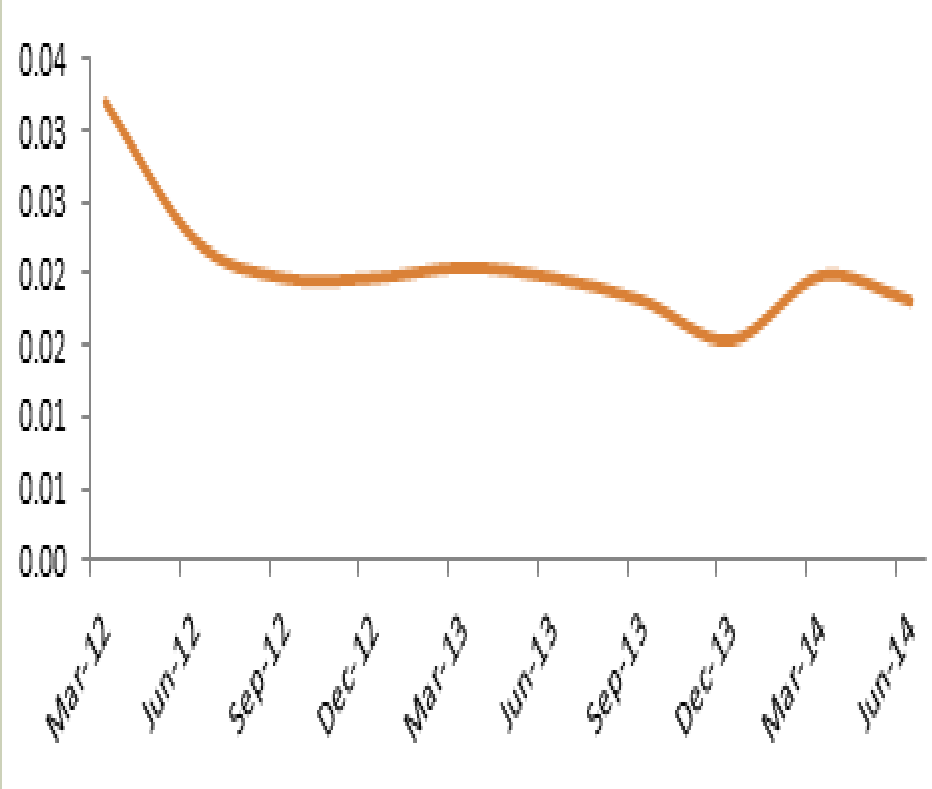
NETWORK TOPOLOGY RESULTS (3)

Fig. 4: Average Degree



- Average institution had approx. 4 counterparties.

Fig. 5: Closeness Centrality



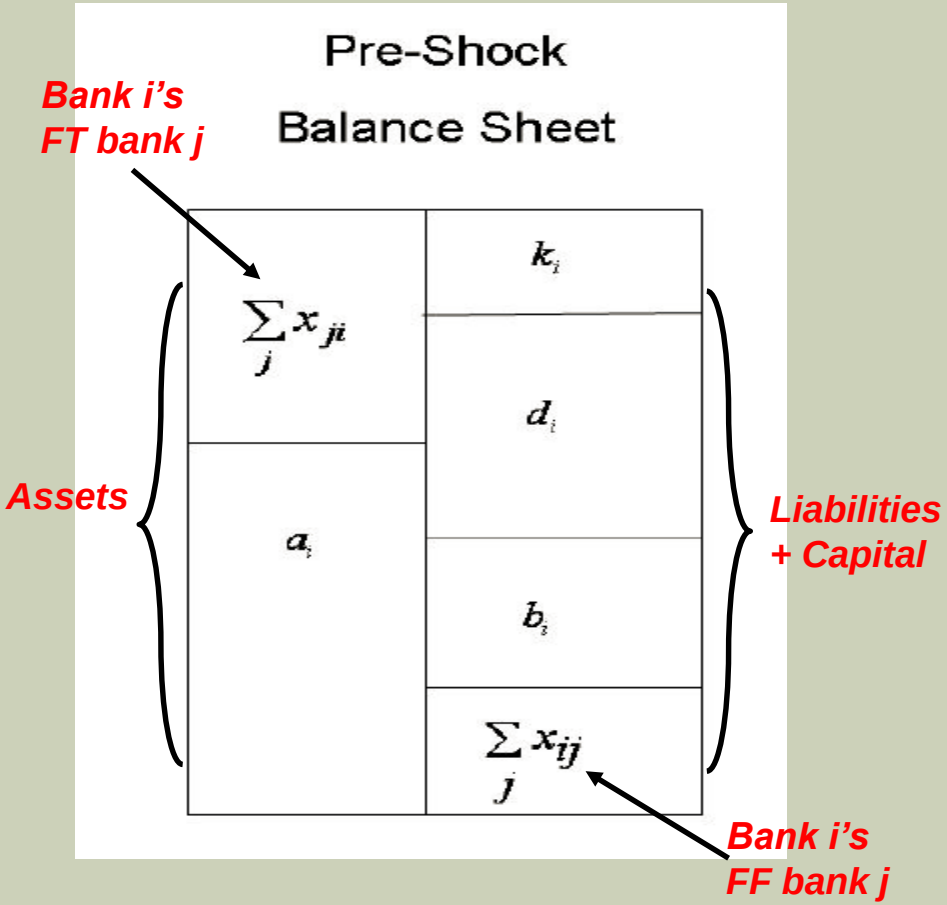
- Closeness relatively low ranging 1.5% and 3.2% over the period.

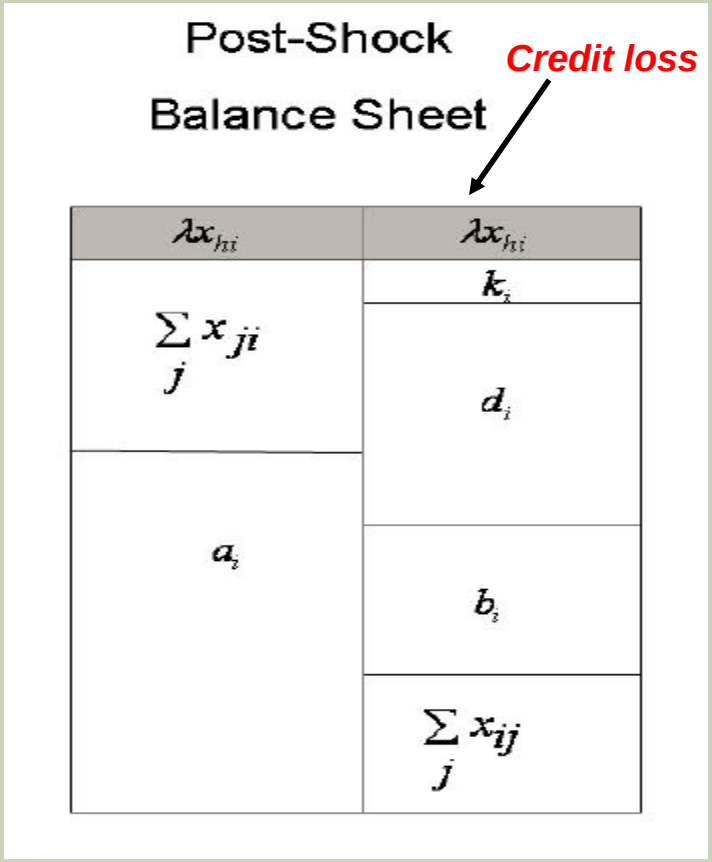
NETWORK TOPOLOGY RESULTS (4) – CENTRALITY MEASURES

Table 1: Centrality for top 5 institutions at June 2014

Rank - June 2014	Degree Centrality: In-Degree		Degree Centrality: Out-Degree		Closeness Centrality		Betweenness Centrality		Eigenvector Centrality
1	FOREIGN	10	BS2	15	CB3	0.024	BS2	142.2	CB2	0.070
2	CB2	9	BS1	14	CB2	0.024	BS1	116.6	CB3	0.069
3	SD2	9	CB3	11	CB7	0.024	CB2	106.5	CB7	0.067
4	CB1	8	CB7	11	CB1	0.023	CB7	99.1	BS1	0.067
5	CB4	7	SD12	9	BS1	0.023	CB3	83.3	CB1	0.066

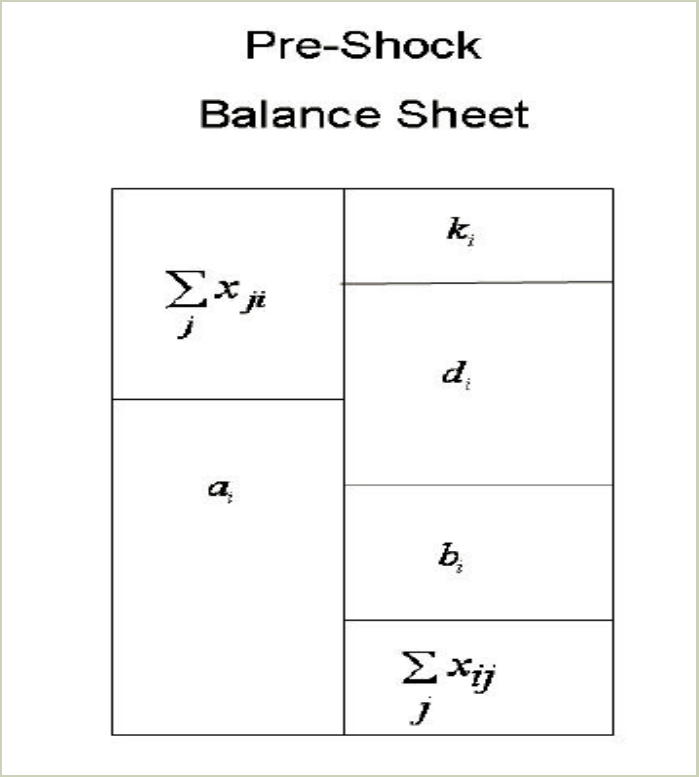
ESPINOSA-VEGA AND SOLÉ SIMULATION MODEL (1)

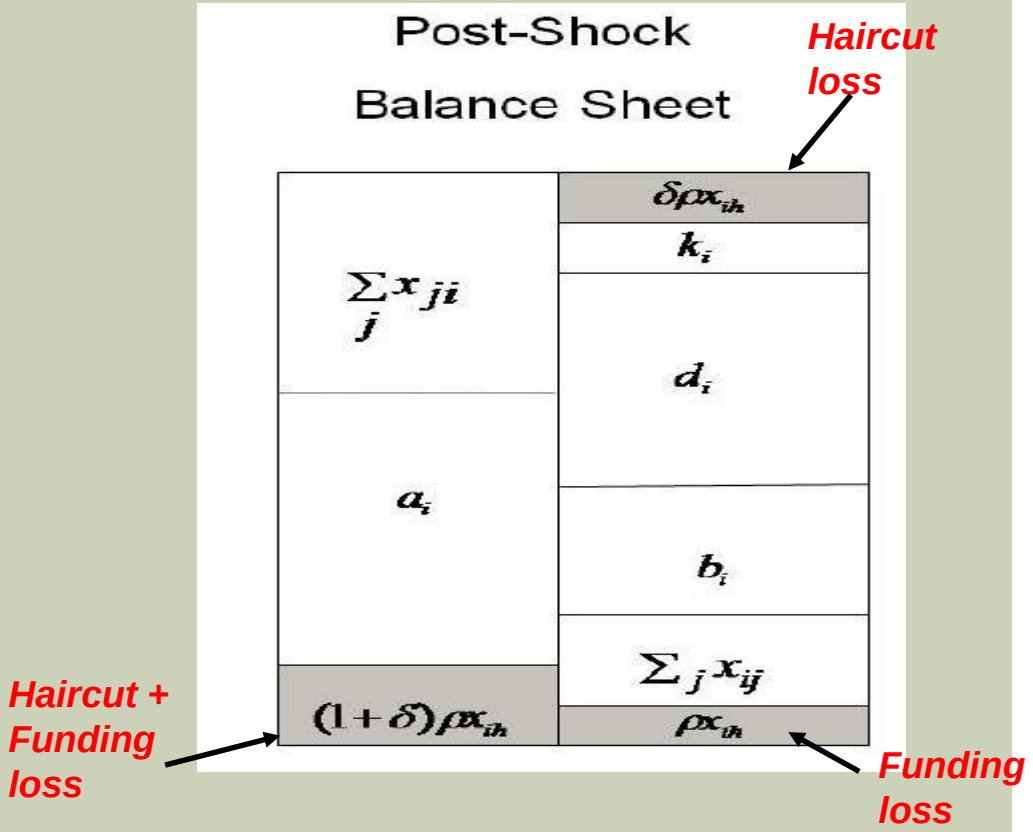




- Credit Channel - domino effects triggered by the default of an institution's interbank obligations.

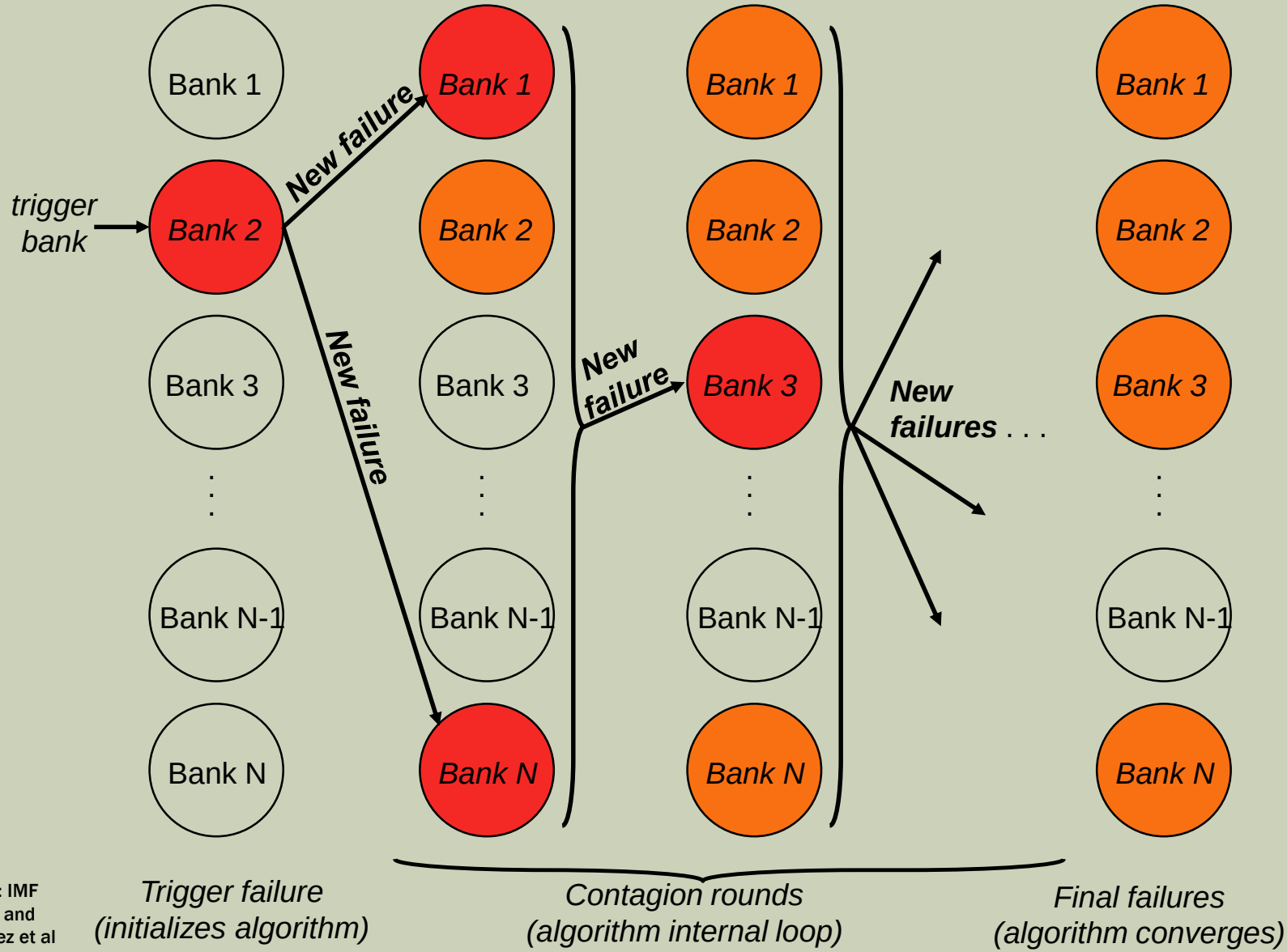
ESPINOSA-VEGA AND SOLÉ SIMULATION MODEL (2)





- Credit+Funding Channel - institutions no longer able to replace all the funding granted by the defaulted institutions, resulting in a fire sale of assets.

ESPINOSA-VEGA AND SOLÉ SIMULATION MODEL (3)



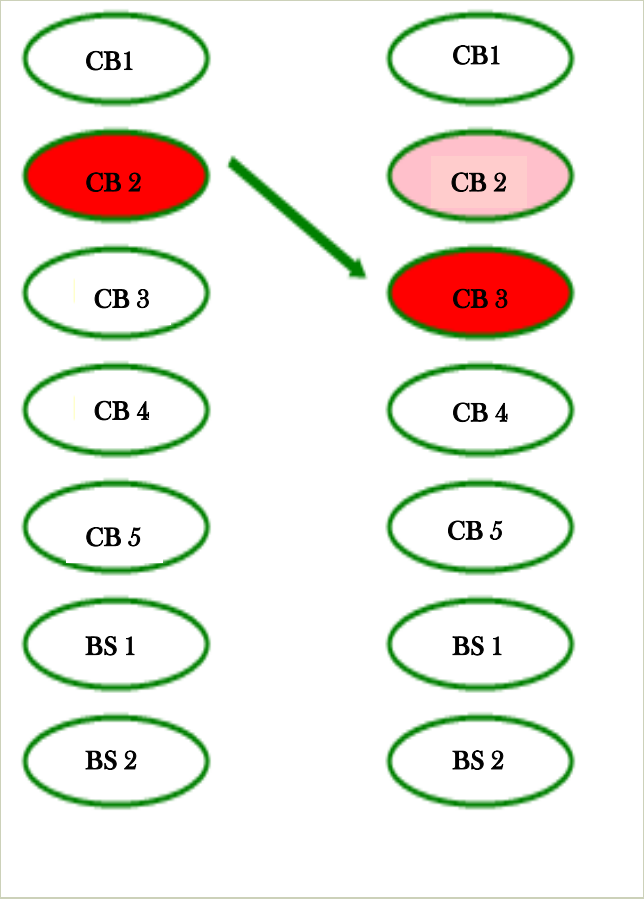
source: IMF (2009) and Marquez et al (2009)

ESPINOSA-VEGA AND SOLÉ SIMULATION MODEL (4)

- Assessed contagion pass through effects in the quarters before, during and after the National Debt Exchange (NDX).
- Utilized gross bilateral exposures for DTIs and SDs as most of the transactions are concentrated among these institutions.
- Domestic Intuitions only vs. Domestic + Foreign Institutions
- λ = 100 per cent as the model utilizes unsecured or uncollateralised transactions.
- Initial ρ = 16.4 per cent, (1- ρ) = 86.6 per cent roll-over ratio of interbank debt.
- Initial δ= 25.0 per cent haircut in the fire sale of assets.

SIMULATION RESULTS (1) – DOMESTIC CREDIT CHANNEL

Mar13



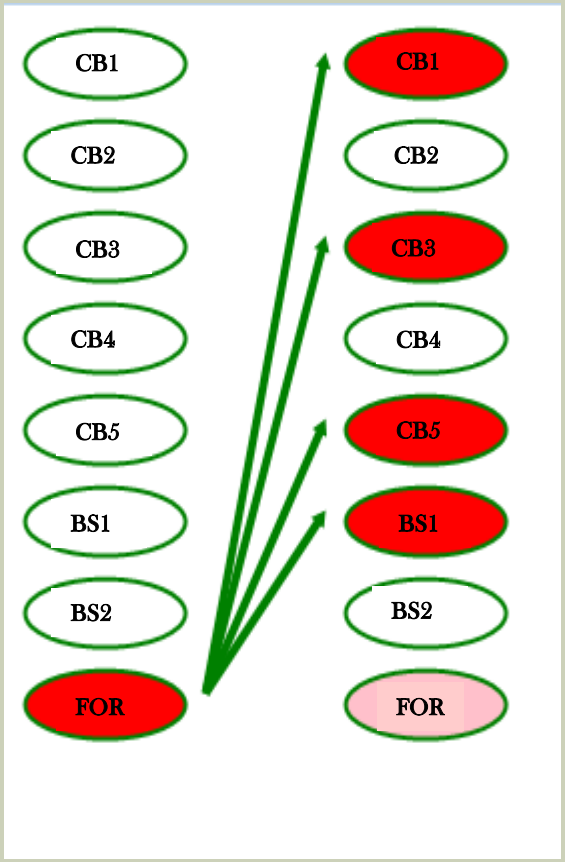
	Dec-12	Mar-13	Jun-13	Dec-12	Mar-13	Jun-13	Dec-12	Mar-13	Jun-13
	Failed Capital (in % of total capital)			Index of Contagion			*Index of Vulnerability- Author's Calculations*		
CB1	**12.1**	**12.1**	**11.9**	1.9	2.3	2.3	*0.9*	*1.9*	*0.2*
CB2	**15.3**	**17.4**	**16.8**	3.3	**11.1**	**11.8**	*0.1*	*0.2*	*0.1*
CB3	1.3	1.4	1.3	0.3	0.7	0.3	*1.8*	***22.3***	***47.3***
CB4	3.0	2.9	2.7	0.7	0.9	1.6	*14.3*	*19.6*	*3.7*
BS4	0.9	1.0	1.0	1.4	1.2	0.4	*13.0*	*9.6*	*4.4*
SD1	7.6	7.6	7.6	0.0	0.0	0.0	*8.1*	*5.8*	*23.5*
SD2	10.3	9.9	9.8	0.0	0.0	0.0	*4.4*	*3.9*	*8.5*
SD3	0.0	0.6	0.6	0.0	0.0	0.0	-	***24.6***	***21.3***
SD4	2.2	2.1	2.0	0.3	0.3	0.3	*0.1*	*0.8*	*1.5*
SD5	0.9	0.5	0.5	0.5	0.2	0.2	***62.5***	***32.6***	***31.7***
SD6	10.3	8.6	8.2	0.0	0.0	0.0	*2.0*	***22.7***	***46.5***

SIMULATION RESULTS (2) – DOMESTIC CREDIT-PLUS-FUNDING CHANNEL

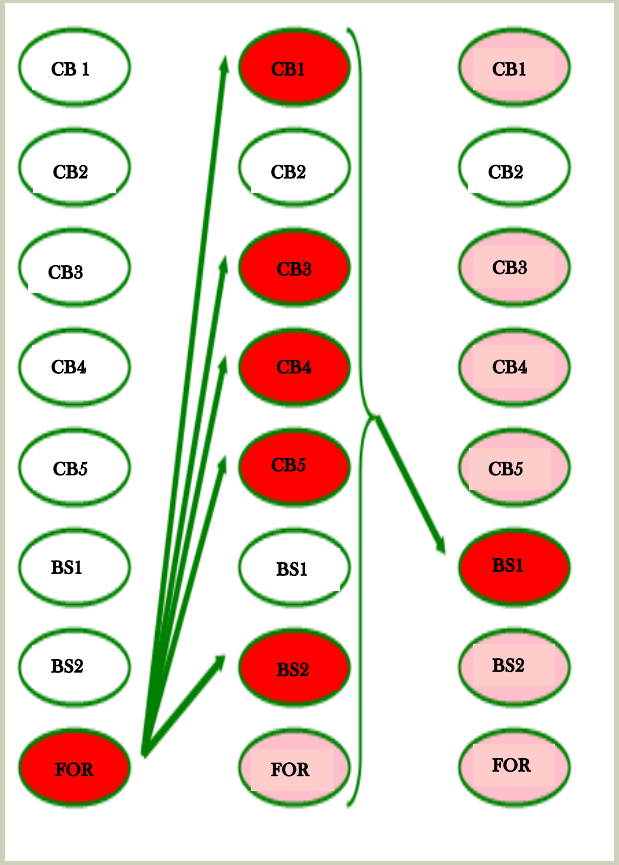
	Dec-12	Mar-13	Jun-13	Dec-12	Mar-13	Jun-13	*Dec-12*	*Mar-13*	*Jun-13*
	Failed Capital (in % of total capital)			Index of Contagion			*Index of Vulnerability- Author's Calculations*		
CB1	**12.1**	**12.1**	**11.9**	2.0	3.3	2.3	*0.7*	*1.3*	*0.8*
CB2	**15.3**	**17.4**	**16.8**	3.3	**11.4**	**11.9**	*0.7*	*1.9*	*2.3*
CB3	1.3	1.4	1.3	0.3	1.6	0.9	*1.2*	*9.9*	*8.7*
CB4	3.0	2.9	2.7	1.6	1.8	1.9	*6.2*	*6.0*	*3.9*
BS4	0.9	1.0	1.0	1.5	1.3	0.5	***90.9***	***69.8***	*13.3*
SD1	7.6	7.6	7.6	0.7	0.9	1.0	*8.1*	*5.8*	*23.5*
SD2	10.3	9.9	9.8	1.3	1.2	2.3	*3.7*	*3.9*	*8.5*
SD3	0.0	0.6	0.6	0.0	0.1	0.1	*0.0*	*24.6*	*21.3*
SD4	2.2	2.1	2.0	0.3	0.4	0.4	*1.5*	*2.6*	*3.1*
SD5	0.9	0.5	0.5	0.8	0.3	0.3	***89.5***	*5.4*	***49.5***
SD6	10.3	8.6	8.2	0.2	2.1	4.1	*1.4*	***22.7***	***46.5***

SIMULATION RESULTS (3) –DOMESTIC AND FOREIGN CREDIT CHANNEL

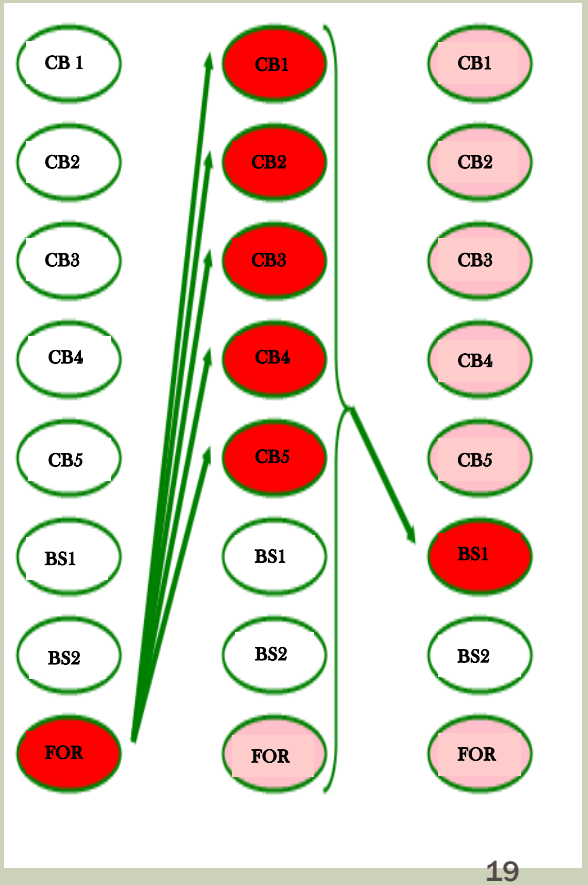
Dec-12



Mar-13



Jun-13



CONCLUSION AND POLICY IMPLICATIONS (1)

- The financial institution network in Jamaica was revealed to be relatively sparse utilizing less than 20.0 per cent of possible links over the period March 2012 to June 2014.
- Funding relationships were concentrated in a small number of institutions which had a large number of counterparties.
- 5 institutions identified based on centrality measures as important at end-June 2014.
- Topology information complements other methodologies such as Basel III SIFI scoring framework and conditional value-at-risk (CoVaR) to identify SIFIs.
- BOJ should assess the topology alongside the value of interbank transactions to identify trends in lending patterns throughout the network and tailor regulations towards reducing contagion risk.

CONCLUSION AND POLICY IMPLICATIONS (2)

- Identification of firm and group interconnectedness becomes a crucial element in the construction of institutional recovery plans.
- Domestic DTIs and SDs were significantly exposed to foreign institutions resulting in failures upon hypothetical defaults of foreign institutions.
- Simulations excluding foreign institutions revealed only one default between two commercial banks.
- Simulations can be utilized by the BOJ to conduct stressed simulations (e.g. macroeconomic shocks) and track the path of contagion.

THANK YOU!

COMMENTS?