

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

IS FINANCIAL CENTRALITY A STAIRWAY TO ECONOMIC GROWTH OR A HIGHWAY TO RECESSION?

PHD STUDENTS WORKSHOP IN ECONOMICS

Susana Martins

School of Economics and Management

June 25, 2013

OUTLINE

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- 1 Introduction
- 2 Related Work
- 3 Financial Network Analysis
- 4 Experiments
- 5 Conclusions and Future Work

1. INTRODUCTION

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- Financial markets and financial structure play a powerful role in systemic risk and economic recession.
- Earlier financial models seem to be unrealistic [Kirman, 2010].
- Issues to achieve:
 - 1 Identify the most important countries in a financial network and their role on the evolution and dynamics of the financial network structure;
 - 2 Analyze the interconnectedness of countries within the network and relate it to macroeconomic variables;
 - 3 Whether network theory is more appropriate to understand how interbank markets can freeze and influence economic activity.

2. RELATED WORK

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- Relative to network formation and stability, Babus [2007], concluded that better connected networks are more flexible to contagion.
- However, the stability costs of a financial network become larger than its benefits if the network becomes excessive.

2. RELATED WORK

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- Relative to economic growth, macroeconomic studies generally suggest a positive effect of foreign direct investment (FDI) and financial globalization on economic growth, under particular conditions:
 - 1 In countries with a highly educated workforce [Borensztein et al., 1998].
 - 2 In sufficiently rich countries [Blomstrom et al., 1994].
 - 3 The growth effects can only be exploited through trade openness [Balasubramanyam et al., 1996].
- The local financial markets lack of development limits the economy's ability to exploit FDI [Alfaro et al., 2004].

3. FINANCIAL NETWORK ANALYSIS

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

To achieve the main goal it is necessary to

- 1 construct the cross-border banking exposure network,
- 2 extract the dynamic properties
- 3 and finally use them as regressors in the economic growth regressions.

3. FINANCIAL NETWORK ANALYSIS

3.1 DEFINITION

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- Social Network Analysis (SNA) focus on the relationships between social entities rather in the social entities themselves.
- SNA has its origins in social science, network analysis and graph theory [Cheliotis, 2010].
- The application of SNA to macroeconomics like financial network analysis (FNA) added new tools for analyzing financial interactions and their relation to human behavior.

3. FINANCIAL NETWORK ANALYSIS

3.2 DATA AND CONCEPTS

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- Bank for International Settlements consolidated banking statistics on an immediate borrower basis.
- 25 reporting countries and the amounts outstanding for cross-border bank exposures between the reporting country and 198 other countries (including other reporting countries).
- Each country is defined as a node.
- Each exposure from a reporting country to another country is defined as a link.

3.3 NETWORK VISUALIZATION

IS FINANCIAL CENTRALITY A STAIRWAY TO ECONOMIC GROWTH OR A HIGHWAY TO RECESSION?

FINANCIAL NETWORK ANALYSIS

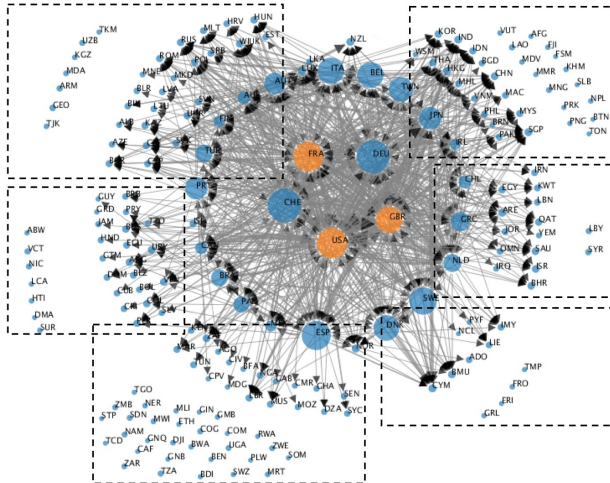


FIGURE : Network Visualization [2011]

3. FINANCIAL NETWORK ANALYSIS

3.4 NETWORK PROPERTIES

■ How large is the network?

- 1 **Order** is the number of nodes (countries).
- 2 **Size** is the number of links (bank exposures) between countries.

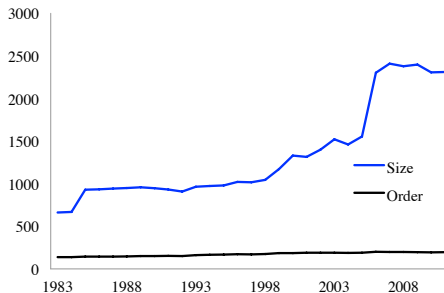


FIGURE : Network Size and Order

3. FINANCIAL NETWORK ANALYSIS

3.4 NETWORK PROPERTIES

■ How well-connected are the countries?

- 1 **Clustering Coefficient** measures how countries are clustered together.
- 2 **Connectivity** is the likelihood of connection between countries.

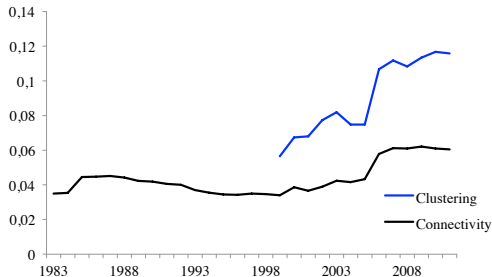


FIGURE : Network clustering and connectivity

4. EXPERIMENTS

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

To achieve the main goal it is also necessary to

- 1 construct the cross-border banking exposure network,
- 2 extract the dynamic properties for each node
- 3 and finally use them as regressors in the economic growth regressions.

4. EXPERIMENTS

4.1 MODEL

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- The dynamic model being estimated is:

$$GDP_gr_{i,t} = \alpha_i + \beta GDP_{i,t-1} + \gamma_k X + \delta_t + \varepsilon_{i,t} \quad (1)$$

$i = 1, 2, 3, \dots, 186$ countries.

$t = 1, 2, 3, \dots, 7$ Non-overlapping periods of four years.

- According to Arellano and Bond [1991], Arellano and Bover [1995] and Blundell and Bond [1998] GMM System allows the coefficient estimates with lower bias and higher accuracy.

4. EXPERIMENTS

4.2 VARIABLES

- 1 **GDP_gr**: annual average growth rate as the logarithmic change between two consecutive periods of PPP Converted GDP Per Capita (Laspeyres) at 2005 constant prices.
- 2 **Ki**: Investment Share of PPP Converted GDP Per Capita at 2005 constant prices.
- 3 **Openk**: country openness at 2005 constant prices.
- 4 **Pop_gr**: annual average population growth rate.
- 5 **Degree**: for each country is the number of other countries it links to.
- 6 **Cutvertex**: a country whose removal would disconnect the remaining network.
- 7 **PageRank**: expected time spent visiting a node in a random walk over the network.
- 8 **CheiRank**: calculated by first transposing the network and then calculating its PageRank.

4. EXPERIMENTS

4.3 RESULTS [TABLE 1 - FOUR-YEAR PERIODS AND KI]

Variables	(1) GDP-gr	(2) GDP-gr	(3) GDP-gr	(4) GDP-gr	(5) GDP-gr
GDP_{t-1}	0.00113 (1.216)	-0.000520 (-0.580)	-0.000557 (-0.538)	-0.000302 (-0.264)	0.00114 (1.029)
Ki	0.000171** (2.554)	0.000219*** (2.715)	0.000198** (2.273)	0.000211*** (2.946)	0.000171*** (2.701)
Degree	-1.80e-05 (-1.216)	7.48e-05* (1.741)			
Degree ²		-5.08e-07** (-2.297)			
Cutvertex			0.00272** (2.434)		
CheiRank				0.000834 (0.0183)	
PageRank					-4.982** (-2.106)
Constant	-0.0111 (-1.442)	0.000817 (0.116)	0.00215 (0.209)	-0.000360 (-0.0347)	0.0135*** (3.069)
Obs.	1,015	1,015	995	1,015	1,015
No. countries	186	186	186	186	186
Hansen Test	0.00156	0.000361	0.00642	0.00170	0.000354
AR (1)	0.00185	0.00184	0.00299	0.00222	0.00173
AR (2)	0.140	0.160	0.170	0.161	0.121

4. EXPERIMENTS

4.3 RESULTS [TABLE 2 - FOUR-YEAR PERIODS AND KI, POP_GR, OPENK]

Variables	(1) GDP_gr	(2) GDP_gr	(3) GDP_gr	(4) GDP_gr
GDP _{t-1}	-0.000799 (-0.669)	0.000593 (0.324)	-0.00104 (-0.749)	9.75e-05 (0.193)
Ki	0.000200 (1.473)	0.000206 (1.382)	0.000348*** (2.656)	0.000181*** (3.067)
Openk	-4.84e-06 (-0.226)	-1.18e-05 (-0.455)	2.89e-06 (0.120)	
Pop_gr	-1.641 (-0.338)	-1.693 (-0.202)	-4.427 (-0.795)	-12.48* (-1.763)
Degree	0.000192*** (2.691)			
Degree2	-1.17e-06*** (-2.977)			
Cutvertex		0.00372*** (2.644)		
CheiRank			0.0270 (0.551)	
PageRank				-2.469** (-2.198)
Constant	0.00280 (0.293)	-0.00673 (-0.496)	0.00225 (0.211)	0.00967*** (2.592)
Obs.	1,015	995	1,015	1,015
No. countries	186	186	186	186
Hansen Test	0.310	0.213	0.0147	0.000201
AR (1)	0.00163	0.00238	0.00196	0.00225
AR (2)	0.146	0.152	0.183	0.142

4. EXPERIMENTS

4.3 RESULTS [TABLE 3 - FOUR-YEAR PERIODS AND LAGGED NODE PROPERTIES]

Variables	(1) GDP _{gr}	(2) GDP _{gr}	(3) GDP _{gr}	(4) GDP _{gr}
GDP _{t-1}	0.000534 (0.470)	-0.000537 (-0.556)	0.000183 (0.189)	0.000264 (0.450)
Openk	3.72e-05* (1.759)	3.81e-05** (2.151)	3.75e-05** (1.976)	4.18e-05** (2.253)
Ki	8.35e-05 (1.355)	0.000143** (2.123)	0.000149** (2.506)	7.56e-05 (1.162)
Degree _{t-1}	-1.38e-05 (-0.595)			
Cutvertex _{t-1}		0.00232** (2.568)		
CheiRank _{t-1}			-0.0163 (-0.515)	
PageRank _{t-1}				-3.422*** (-2.665)
Constant	-0.00737 (-0.845)	-2.63e-05 (-0.00323)	-0.00632 (-0.751)	0.0121** (2.170)
Obs.	979	958	979	979
No. countries	186	186	186	186
Hansen Test	0.00795	0.0109	0.00898	0.0372
AR (1)	0.00376	0.00445	0.00341	0.00401
AR (2)	0.159	0.175	0.171	0.158

4. EXPERIMENTS

4.3 RESULTS [TABLE 4 - THREE-YEAR PERIODS AND KI, POP_GR, OPENK]

Variables	(1) GDP_gr	(2) GDP_gr	(3) GDP_gr	(4) GDP_gr	(5) GDP_gr
GDP _{t-1}	0.000455 (0.476)	4.02e-05 (0.0342)	-0.00112* (-1.694)	-0.000788 (-0.623)	0.000801 (0.891)
Ki	0.000149*** (2.577)	0.000163** (2.403)	0.000175** (2.460)	0.000181*** (2.898)	0.000203*** (3.158)
Openk	2.99e-05** (2.034)	3.28e-05** (2.399)	4.54e-05*** (3.276)	3.87e-05** (2.519)	
Degree	-1.15e-05 (-0.857)	5.49e-05 (1.116)			
Degree ²		-4.09e-07* (-1.842)			
Cutvertex			0.00233** (1.981)		
CheiRank				0.0148 (0.342)	
PageRank					-4.115** (-2.186)
Constant	-0.00824 (-1.079)	-0.00583 (-0.682)	0.00312 (0.475)	0.000662 (0.0639)	0.0107*** (2.722)
Obs.	1,325	1,325	1,299	1,325	1,325
No. countries	186	186	186	186	186
Hansen Test	0.0191	0.0147	0.0115	0.00533	0.00276
AR (1)	0.00162	0.00158	0.00211	0.00171	0.00147
AR (2)	0.918	0.914	0.891	0.927	0.842

5. CONCLUSIONS AND FUTURE WORK

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

- A country may benefit from its links with other countries enhancing economic growth but only if this interconnectedness is not too excessive, in which case, the growth costs are larger.
- If one country is a cutvertex, its economic growth rate is higher than other countries.
- A more central country, as it acts more as lender than as borrower, has a lower economic growth rate relative to other countries.

5. CONCLUSIONS AND FUTURE WORK

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

■ Future work:

- 1 Explore other node properties developed by social network analysis.
- 2 Use a foreign direct investment flows network and other alternative software (such as *Gephi* or *Pajek*) to compare results.
- 3 Test if the same results stand for the economic development.
- 4 Analyze whether network formation and configuration is the optimal for enhancing economic growth.

REFERENCES

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES



A. Kirman, "The economic crisis is a crisis for economic theory," *CESifo Economic Studies*, vol. 56, no. 4, pp. 498–535, 2010.



A. Babus, "The formation of financial networks," *Tinbergen Institute Discussion Paper*, 2007.



E. Borensztein, J. De Gregorio, and J.-W. Lee, "How does foreign direct investment affect economic growth?" *Journal of International Economics*, vol. 45, no. 1, pp. 115–135, 1998.



M. Blomstrom, R. E. Lipsey, and M. Zejan, "What explains the growth of developing countries?" *Convergence of productivity: Cross-national studies and historical evidence*, pp. 243–259, 1994.



V. N. Balasubramanyam, M. Salisu, and D. Sapsford, "Foreign direct investment and growth in ep and is countries," *The Economic Journal*, pp. 92–105, 1996.



L. Alfaro, A. Chanda, S. Kalemli-Ozcan, and S. Sayek, "Fdi and economic growth: the role of local financial markets," *Journal of international economics*, vol. 64, no. 1, pp. 89–112, 2004.



M. Arellano and S. Bond, "Some tests of specification for panel data: Monte carlo evidence and an application to employment equations," *The Review of Economic Studies*, vol. 58, no. 2, pp. 277–297, 1991.



M. Arellano and O. Bover, "Another look at the instrumental variable estimation of error-components models," *Journal of econometrics*, vol. 68, no. 1, pp. 29–51, 1995.



R. Blundell and S. Bond, "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, vol. 87, no. 1, pp. 115–143, 1998.

IS FINANCIAL
CENTRALITY
A STAIRWAY
TO ECONOMIC
GROWTH OR
A HIGHWAY
TO
RECESSION?

SUSANA
MARTINS

INTRODUCTION

RELATED
WORK

FINANCIAL
NETWORK
ANALYSIS

EXPERIMENTS

CONCLUSIONS
AND FUTURE
WORK

REFERENCES

Any question?