DEUTSCHE BUNDESBANK
EUROSYSTEM

Workshop on

“The Costs and Benefits of International Banking”

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Federal Reserve Bank of San Francisco

Presentation to

“Global banking network and cross-border capital flows“

Global Banking Networks and Cross-border Capital Flows

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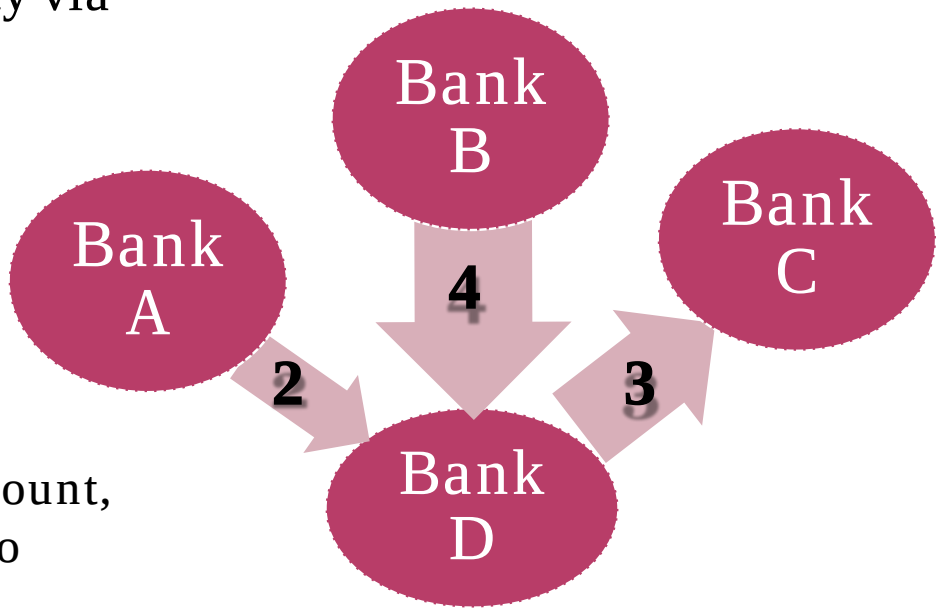
Objectives:

- Construct global banking network (GBN)
- Test whether ***bilateral foreign asset positions*** can be partly explained by ***network proximity of banks*** in the two countries
- Understand *macroeconomic and institutional determinants of cross-country differences in banks' positions* in the GBN
- Test whether ***banks' positions in the GBN*** help explain ***long-run patterns of cross-border capital flows*** in a cross-section and ***year-to-year changes in gross cross-border capital flows*** in a panel

Bank relationships constructed through lending

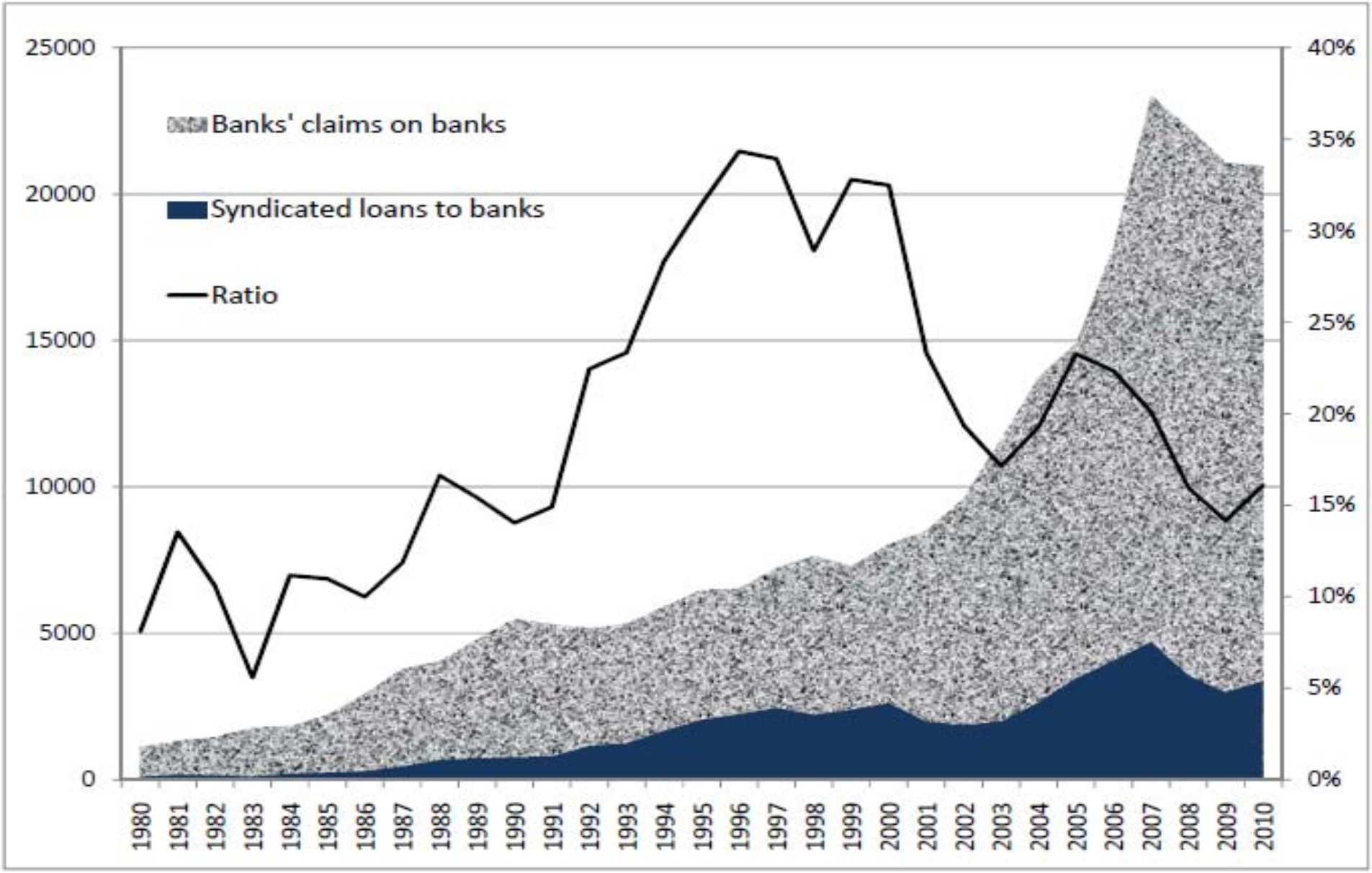
- Bank relationships are constructed from bank-to-bank lending activity via syndicated loans
- Network is *directed*
  - Thus there may not be a path from one node to another
- Edges have *weights*
  - Weights are equal to the total amount, deflated by US CPI, bank A lent to bank B in a given year
  - Only used for aggregation – network is treated as unweighed



Constructing global banking network

- Obtain all *loans to financial institutions* from Dealogic (split syndicates)
  - Deflate all loan values by US CPI (2000=100)
  - Treat **subsidiaries** as separate entities
  - Edge list: Bank A (lent to) Bank B (amount) X
- Compute network statistics for each bank
- Match banks to countries on **locational** basis
- Create a bank-level and country-level data set
  - Country-level data set contains weighted averages of network statistics

Relevance of syndicated loans to banks



Construct two main networks

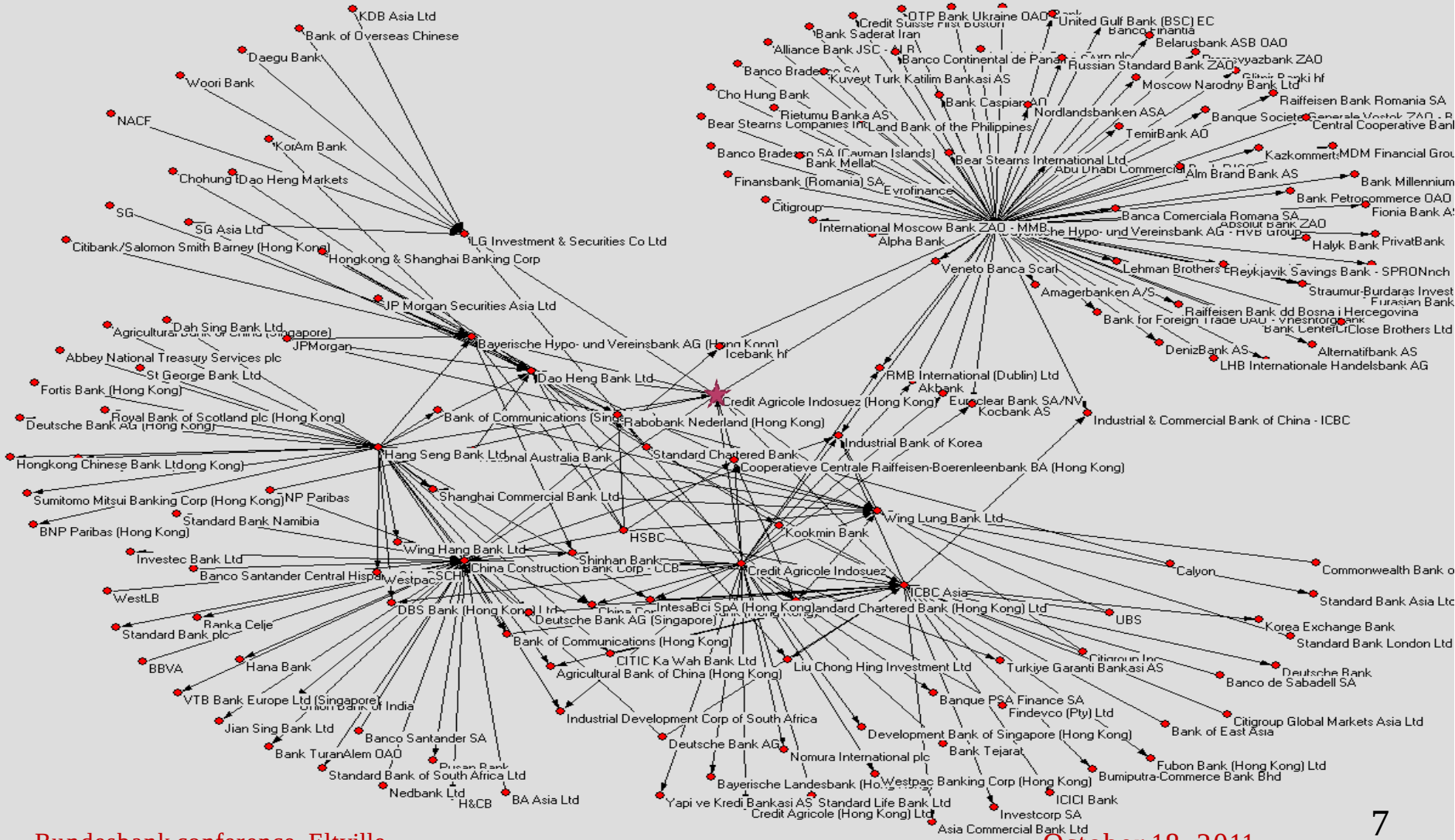
Early network

- Loans: 1980-2000
- 6866 banks
- 125 countries
- 54204 edges

Late network

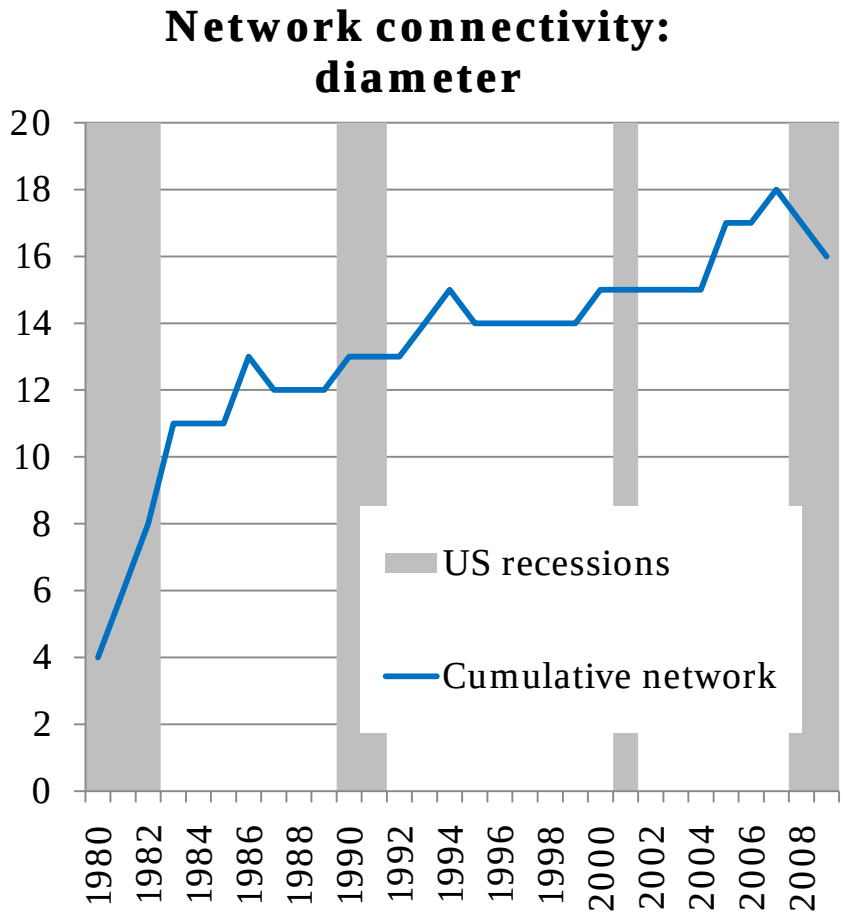
- Loans: 2001-2007Q2
- 2598 banks
- 117 countries
- 19471 edges

A piece of the network – two degrees around one bank (Credit Agricole Indosuez (HK))

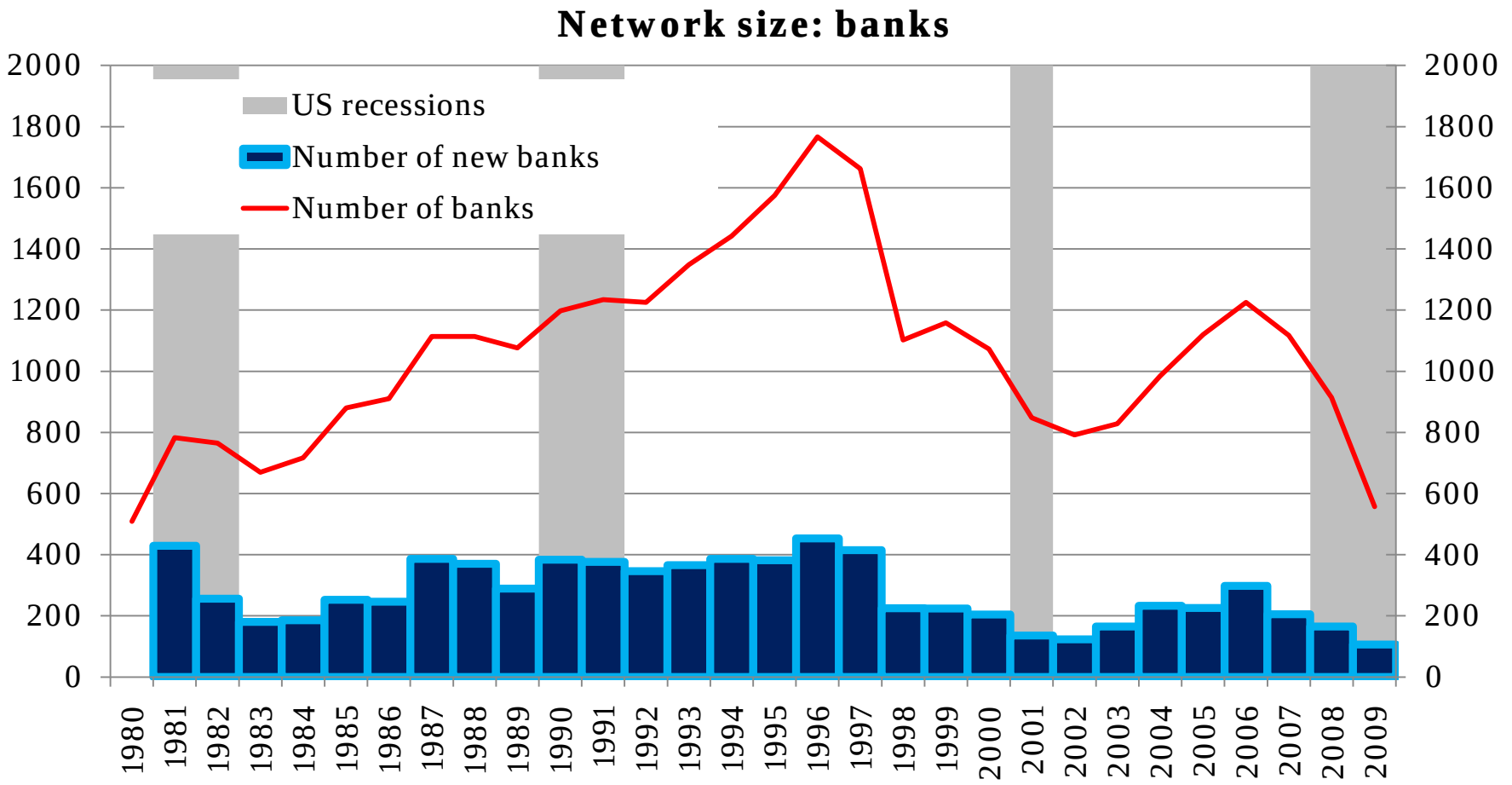


Network distance

- Geodesic path is the shortest path between two nodes, g is the length of geodesic path:
  - Even though in our network edges have weights, we use unweighed distances
  - Diameter (longest geodesic path's length) in our data:
    - early sample diameter = 15
    - late sample diameter = 22



A little bit about network (from another paper)



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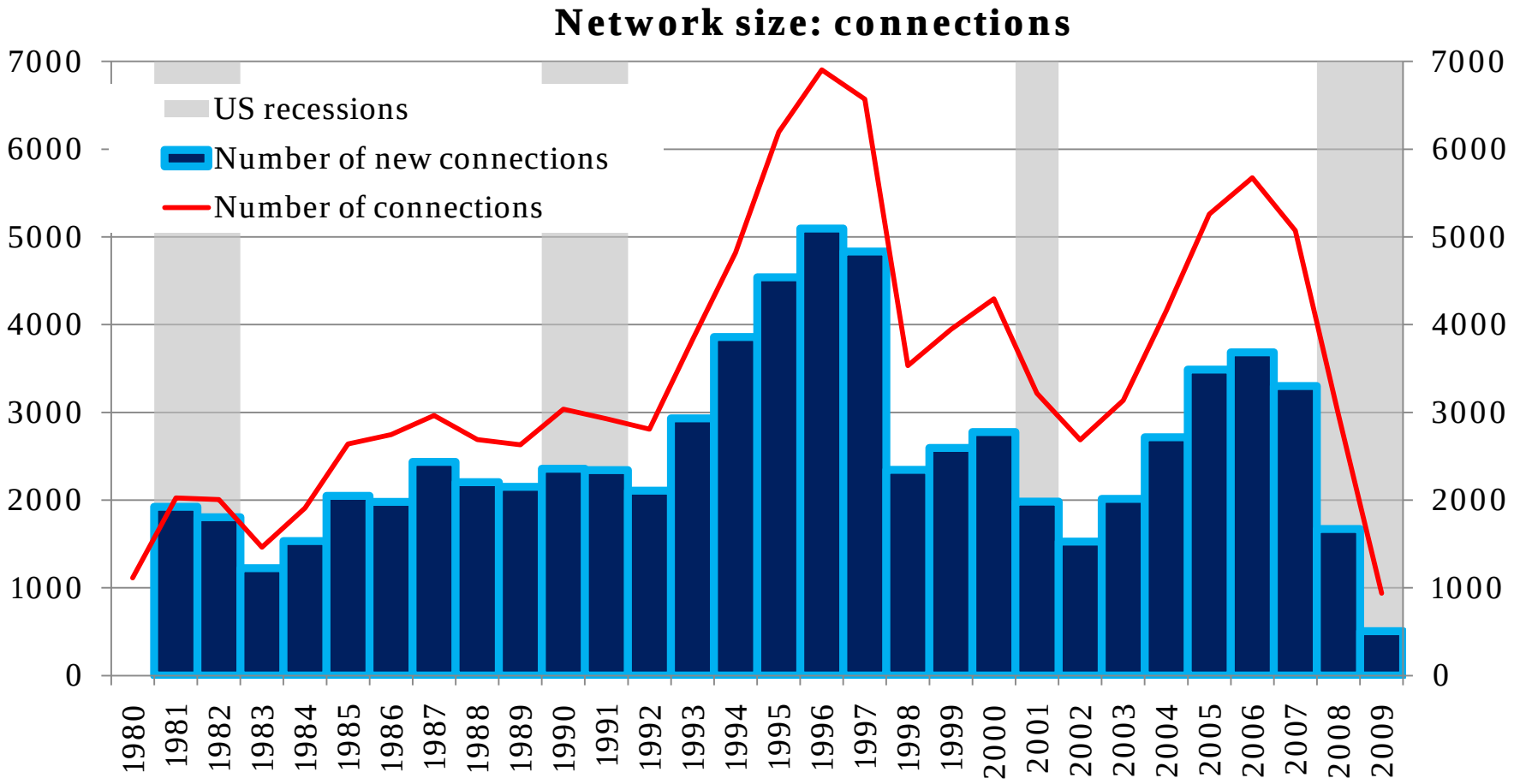

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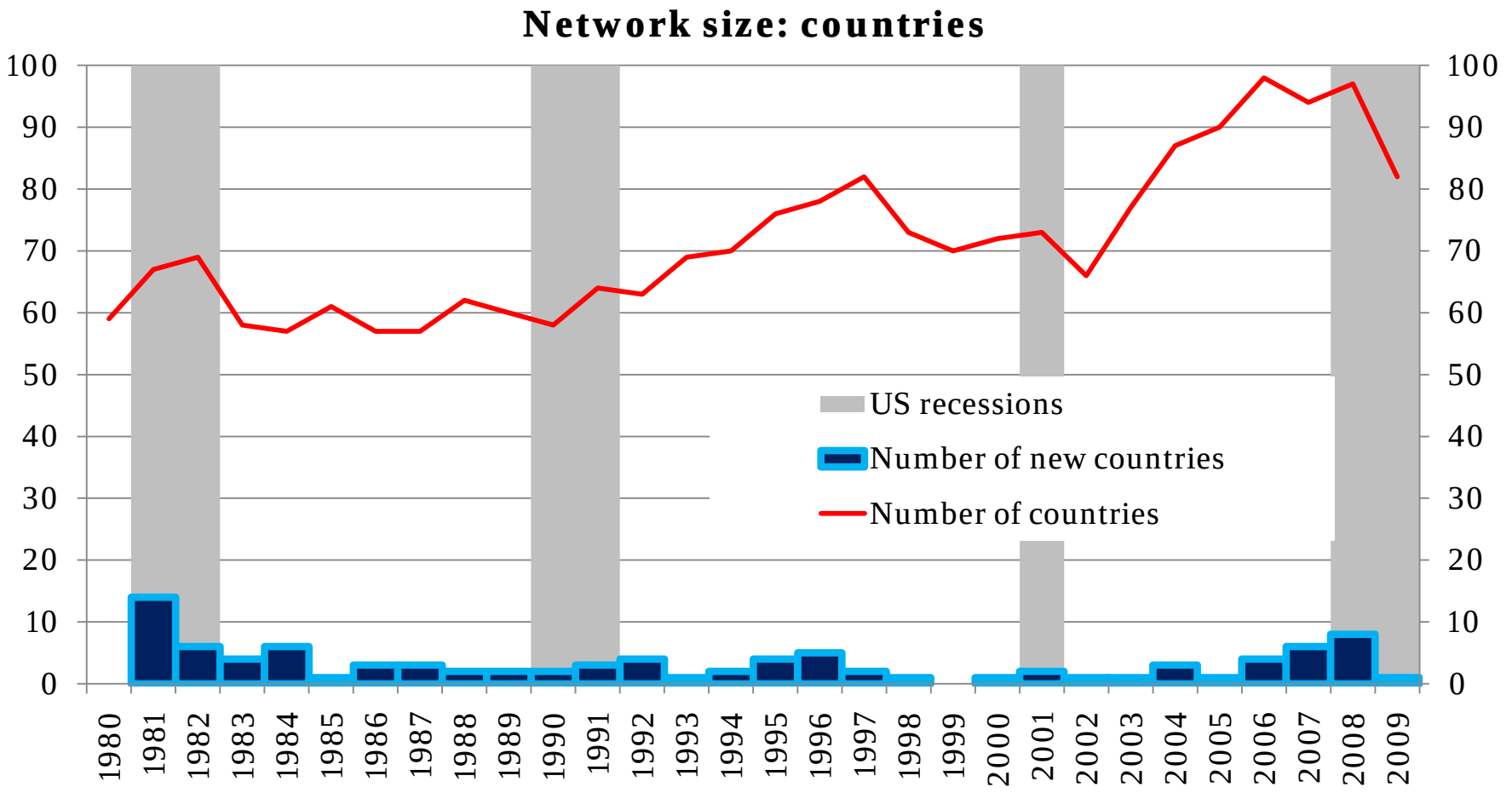
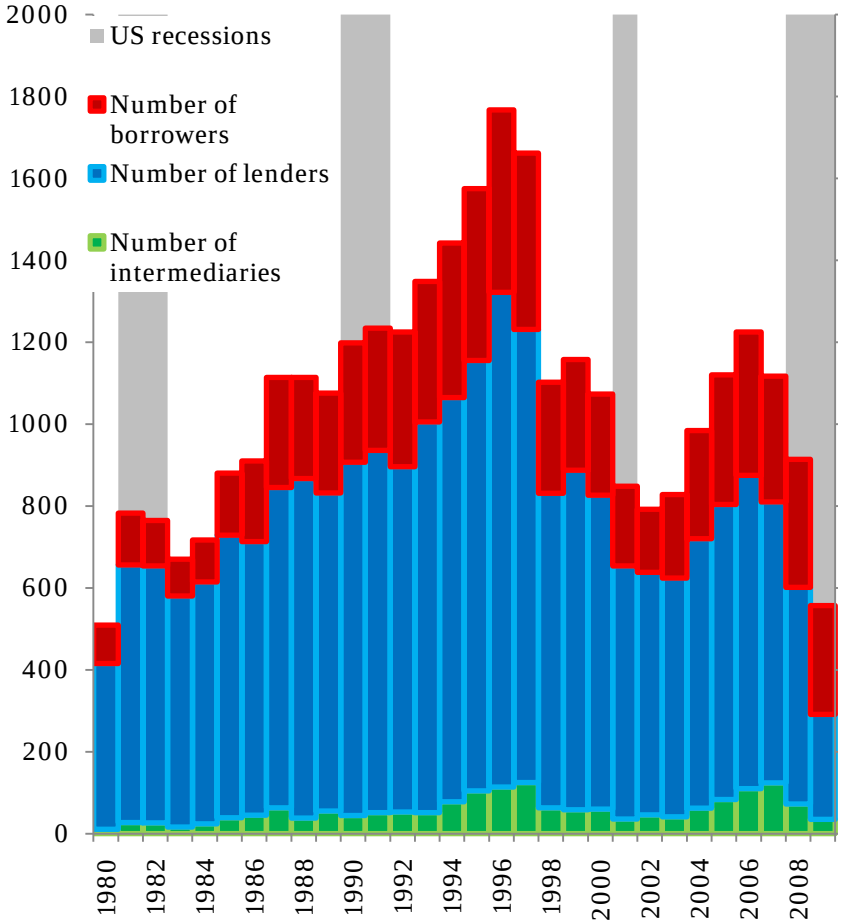
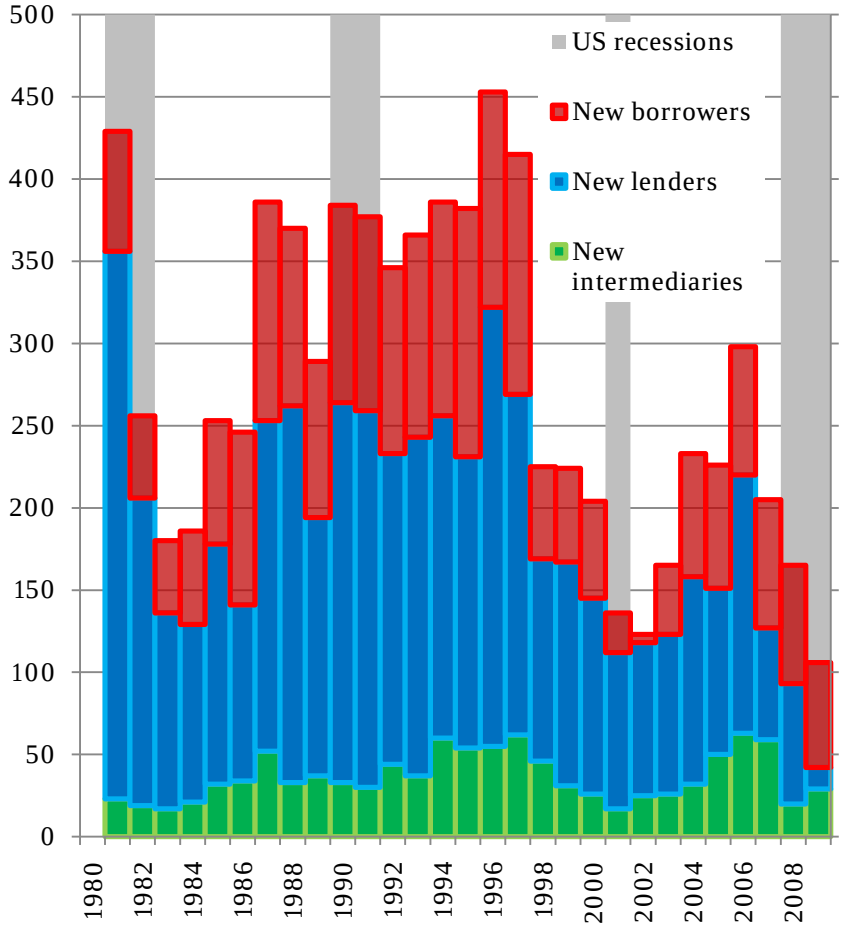


A little bit about network (from another paper)
Lenders, borrowers, and lender-borrowers

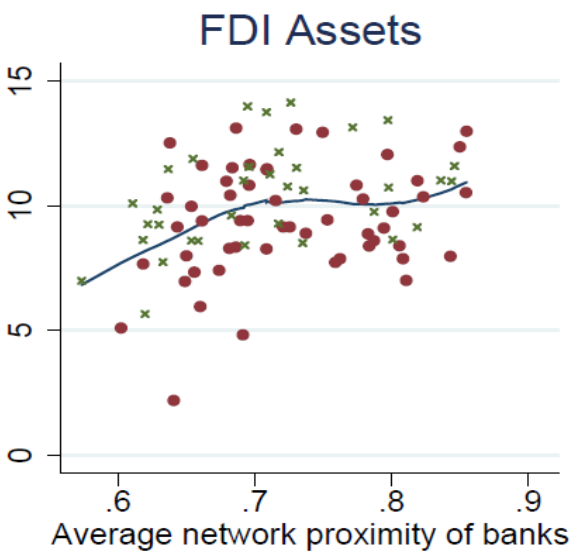


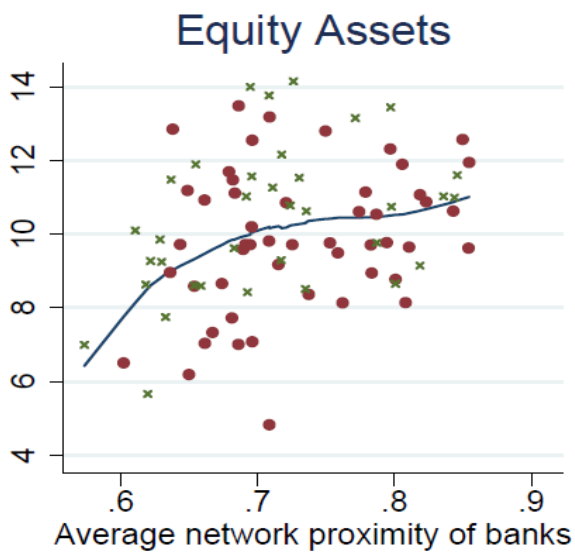


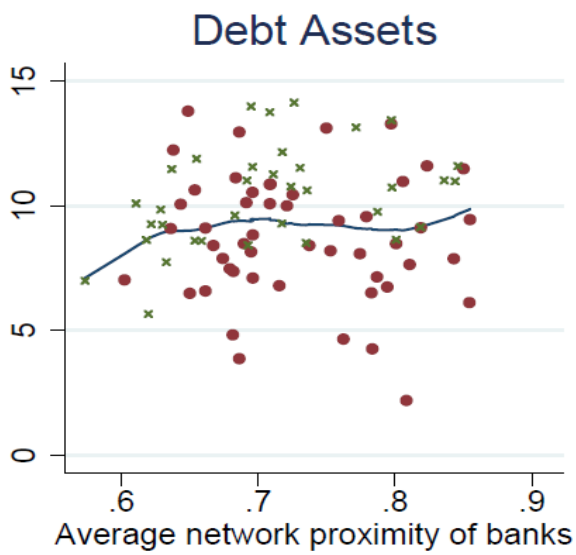
1. Analyzing the effect of bank network proximity on bilateral external asset holdings

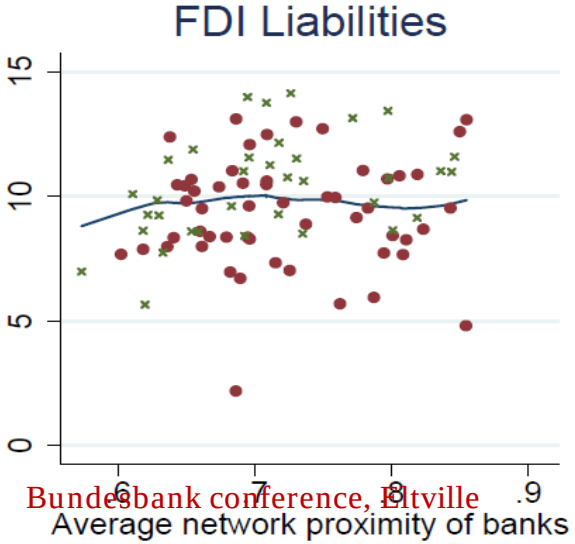
- Bilateral data on FDI, portfolio equity, and portfolio debt assets and liabilities from Milesi-Ferretti et al. (2010)
  - As of the end of 2007
  - Canada, China, Hong Kong, Japan, Singapore, Switzerland, UK, US + Euro Area and Emerging Asia => 90 observations
- Proximity = 1/length of geodesic path between two nodes
  - Compute average proximity between banks in country *i* and country *j*.
- **Estimation:** standard gravity set-up with country fixed effects, geographical distance, product of GDPs
  - Robust to including additional gravity controls

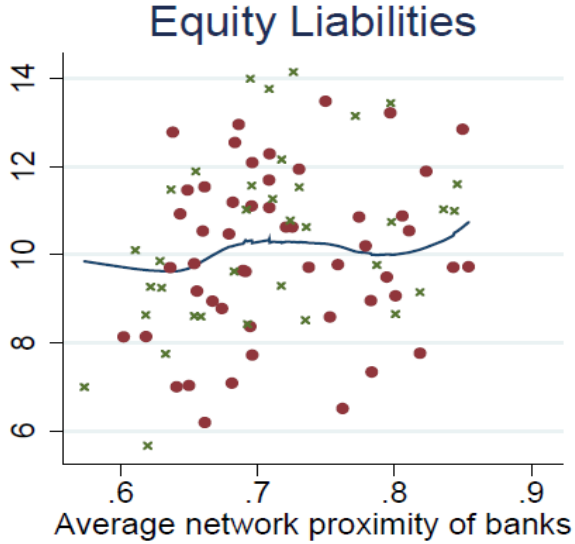
Positive correlation between foreign assets and liabilities and the network proximity of banks

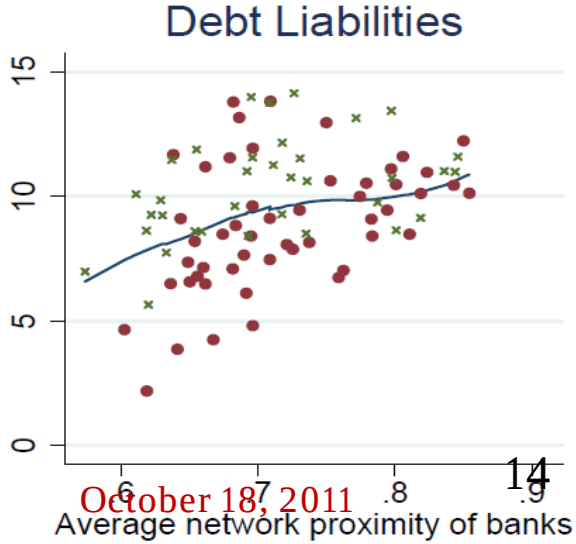












Positive effects persist when controlling for standard gravity variables + old connections matter more

	Full sample				No regional aggregates			
	1980-2000	1985-2000	1990-2000	1995-2000	1980-2000	1985-2000	1990-2000	1995-2000
FDI out	19.850***	17.137***	11.045***	8.456**	34.964***	28.882***	14.190***	9.757**
	0.69	0.70	0.69	0.70	0.79	0.70	0.73	0.73
	0.63	0.63	0.63	0.63	0.64	0.64	0.64	0.64
FDI in	18.216**	14.821**					.905**	9.163**
	0.71	0.71	0.70	0.73	0.78	0.71	0.73	0.75
	0.66	0.66						0.67
Equity out	11.220**	8.354**	3.310	2.383	17.540***	13.506***	6.293*	3.916*
	0.74	0.73	0.72	0.72	0.79	0.73	0.77	0.76
	0.72	0.72	0.72	0.72	0.75	0.75	0.75	0.75
Equity in	14.037***	11.220***	8.283***	5.160***	17.248***	13.545***	5.607*	3.624
	0.80	0.80	0.81	0.80	0.85	0.80	0.83	0.82
	0.77	0.77	0.77	0.77	0.81	0.81	0.81	0.81
Debt in	13.712***	10.877***	5.803**	4.226**	20.198***	15.771***	6.584**	4.455**
	0.90	0.89	0.89	0.89	0.92	0.89	0.90	0.90
	0.87	0.87	0.87	0.87	0.89	0.89	0.89	0.89
Debt out	8.385	6.833*	5.807**	4.247**	17.726***	13.209**	7.132**	4.699**
	0.89	0.89	0.90	0.90	0.92	0.89	0.91	0.91
	0.89	0.89	0.89	0.89	0.90	0.90	0.90	0.90

Adjusted R^2 with proximity included

Adjusted R^2 without proximity measure

- Country pairs in which banks were closer to each other prior to 2000:
  - Accumulated larger positions of FDI, portfolio debt, and portfolio equity vis-à-vis each other by 2007

Results #1: network proximity matters in gravity analysis of capital flows

  - The largest effects are on FDI suggesting the importance of payment channel
  - Results on portfolio flows suggest the importance of information channel
  - Network proximity adds substantial explanatory power

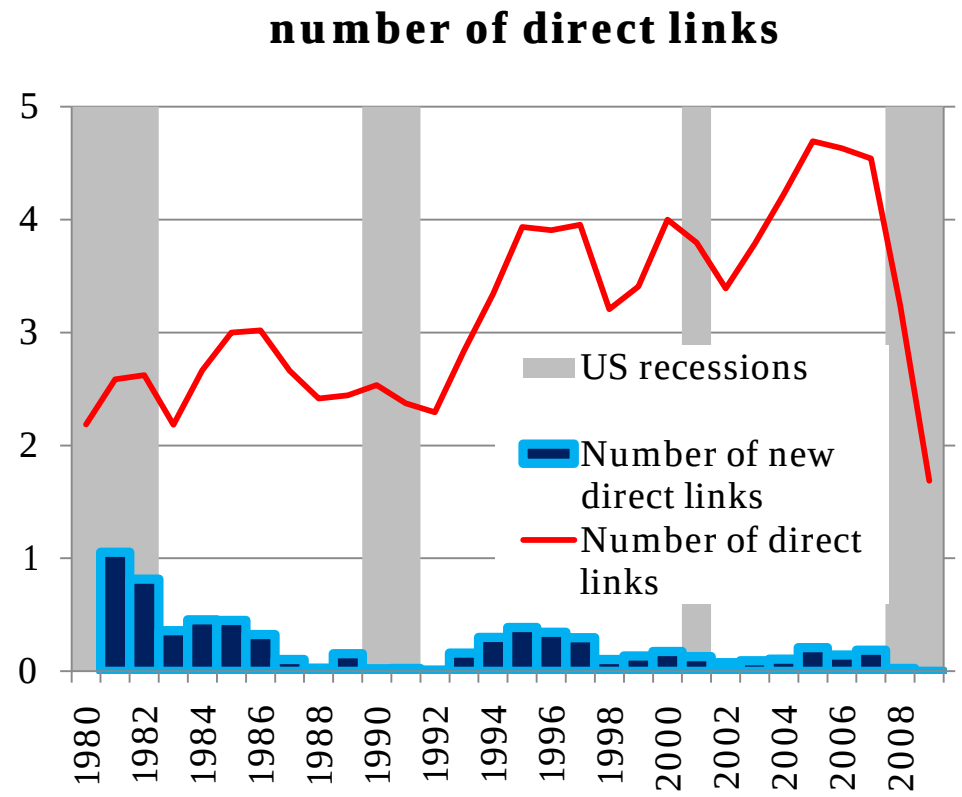
2. Analyzing the effects of banks' position in the GBN on gross capital inflows and outflows

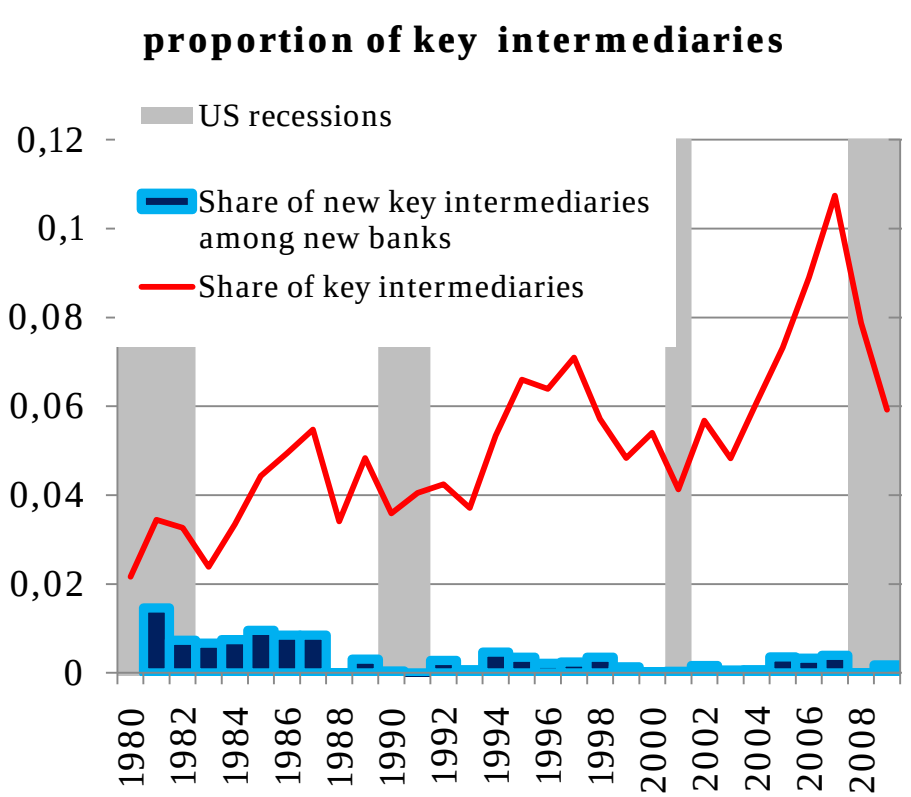
Two-step approach:

- Analyze the effects of macro and institutional variables on the network statistics of a given country's banks
  - Use *late network* (2001-2007:H1) and macro data *prior to 2000*
- Analyze the effects of network statistics of banks on
  - **long-term** gross capital inflows and outflows in cross-section
    - Use *early network* (1980-2000) and average capital flows in *2001-2007*
    - Control for macro variables *prior to 2000* and for total lending/borrowing
  - **short-term** fluctuations in capital inflows and outflows in country FE panel
    - Use *cumulative network* for each year 1980-2007, lagged one year, and annual capital flows
    - Control for the same set of macro variables and for total lending/borrowing

Banks' position in the global banking network can be described by:

- OutDegree is the number of edges incident from a node
- InDegree is the number of edges incident to a node
- Betweenness is the share of geodesic paths between any pair $j \neq i$ and $k \neq i$ that go through node i





2a. Macroeconomic determinants of bank relationships

- Data:
  - 2001 through 2007:Q2 (late) banking network
  - Macroeconomic data for 1980-2000 for developed and 1990-2000 for developing countries
- Procedure:
  - Run a cross-country regression of bank-level network characteristics on a host of macro and institutional variables, separately for developed (rich) and developing (poor) countries, clustering standard errors by country
  - Retain variables that matter
  - Both LHS and RHS variables are in logs

Macroeconomic determinants of bank relationships, rich

	indegree	outdegree	betweenness
Avg. GDP Growth	-0.98	-0.42	-0.84***
	(1.29)	(1.20)	(0.27)
Trade/GDP	-2.11	2.37	0.024
	(1.95)	(1.55)	(0.33)
Inflation	6.48***	-4.72***	1.14**
	(2.05)	(1.41)	(0.52)
ICRG government score	1.91	0.27	1.46***
	(2.39)	(2.00)	(0.44)
GDP PC, PPP	3.35	-8.50	-3.93**
	(8.30)	(6.55)	(1.43)
Constant	-75.2	78.1	-5.52
	(78.7)	(62.1)	(13.1)
Observations	1416	1416	1416
Adjusted R^2	0.031	0.032	0.018

Macroeconomic determinants of bank relationships, poor

	indegree	outdegree	betweenness
Avg. GDP Growth 90 to 00	-0.71***	0.89**	0.14
	(0.26)	(0.34)	(0.14)
Trade/GDP	-5.25***	6.69***	1.10
	(1.40)	(0.86)	(0.68)
CV of NominalExchange Rate	0.34***	-0.39***	-0.036
	(0.047)	(0.044)	(0.024)
GNI (nominal)	-1.21*	2.98***	1.07***
	(0.65)	(0.76)	(0.32)
ICRG government score	0.78	0.79	0.96**
	(0.79)	(0.81)	(0.47)
Average distance	3.54	-13.6	-6.14**
	(8.18)	(8.26)	(2.89)
Constant	8.67	-12.9	-18.2
	(72.0)	(70.6)	(26.7)
Observations	836	836	836
Adjusted R^2	0.10	0.14	0.017

- Industrial countries
  - Better government or smaller country– higher betweenness
  - Higher inflation – more direct links in terms of borrowing, fewer direct links in terms of lending, higher betweenness
  - Very low R-squared
- Developing countries
  - Lower indegree and higher outdegree are observed in countries that are larger, grow faster, more open to trade, and have less volatile exchange rate
  - Betweenness is higher in countries with more stable political systems, those that are larger and less remote geographically
  - R-squared as high as 0.14 (for outdegree)

Results #2a. Macroe variables do not explain large portion of differences in the banks' network positions

2b. Effects of bank relationship on international capital flows: long-term view

- Use network data from lending between 1980-2000: network stats are averaged for each country (weighted by banks' borrowing/lending)
- Use data on international capital flows – sum of 2001-2007:Q2 / GDP
  - Balance of Payments statistics (IFS BOP): assets, liabilities, net
  - Augmented by Forbes and Warnock (2011)
- Run country-level cross-section regressions
- Control for total borrowing and lending in 1980-2000
- Control for macro factors that were found to matter, as of 1980-2000 (1990-2000 for developing)

Cross-country regressions summary: more central are banks, more capital flows

	industrial countries			developing countries		
	InD	OutD	Betw	InD	OutD	Betw
FDI Out	-0.006	0.0006	0.0015	-0.0018	0.00089	0.00049
	0.71	0.75	0.76	-0.079	-0.084	-0.055
	0.73	0.78	0.78	-0.039	-0.037	-0.032
FDI In	-0.016*	-0.003	0.002	0.0012	0.0004	0.0019**
	0.66	0.33	0.36	0.37	0.40	0.44
	0.41	0.39	0.40	0.39	0.43	0.40
Equity Out	0.0050	-0.0025	0.0011	0.0027	0.0019	0.0006**
	0.54	0.40	0.50	0.21	0.32	0.30
	0.55	0.46	0.54	0.17	0.28	0.18
Equity In	0.016*	0.0064	0.006**	0.001	0.0013	0.00018
	0.079	-0.25	0.19	0.20	0.21	0.17
	-0.35	-0.23	-0.31	0.23	0.20	0.19
Debt Out	0.0045	-0.0055	0.005	0.0002	-0.0008	0.00041*
	0.22	0.23	0.26	0.56	0.58	0.62
	0.30	0.31	0.30	0.58	0.60	0.60
Debt In	-0.007	-0.0015	0.0043	-0.002	-0.002	0.00095**
	-0.53	-0.53	-0.49	0.13	0.17	0.21
	-0.37	-0.36	-0.36	0.16	0.20	0.14

Countries in which banks are more central tend to have larger capital in- and out- flows

- Industrial countries
  - If banks are more central, larger equity inflows
  - More direct links are associated with larger equity inflows, but smaller FDI inflows
  - Substantial explanatory power of betweenness centrality
- Developing countries
  - If banks are more central, larger FDI and portfolio debt inflows, larger portfolio equity and debt outflows
  - Substantial explanatory power of betweenness centrality

Results #2b. Countries in which banks were more central in the network built prior to 2000, had larger capital in- and outflows in 2001-2007

2c. Effects of bank relationship on international capital flows: short-term view

- Build year-by-year network from cumulative loan data (1980-81, 1980-82, 1980-83 etc. to 1980-2006)
- Examine changes in capital flows due to changes in banks' position in the GBN that are due to newly formed connections, controlling for changes in macro
- Add country fixed effects to absorb time-invariant differences between countries
- Add year effects to absorb all common trends dynamics

Panel regressions summary: changes in banks' network positions matter very little for fluctuations in international capital flows

	industrial countries			developing countries		
	InD	OutD	Betw	InD	OutD	Betw
FDI Out	0.003	-0.003	-0.00	-0.00	-0.002	0.0001***
	0.31	0.31	0.31	0.15	0.17	0.16
	0.31	0.31	0.31	0.15	0.17	0.16
FDI In	0.002	-0.003	-0.00	-0.001	-0.001	-0.001
	0.21	0.21	0.21	0.087	0.093	0.092
	0.21	0.21	0.21	0.088	0.095	0.089
Equity Out	0.003*	0.004	0.00	-0.001	-0.002	-0.00
	0.42	0.42	0.43	0.075	0.079	0.080
	0.42	0.42	0.43	0.075	0.075	0.081
Equity In	0.002	-0.003*	-0.00	-0.0003	-0.001	0.00
	0.12	0.12	0.12	0.062	0.064	0.064
	0.12	0.12	0.12	0.065	0.066	0.066
Debt Out	-0.0004	-0.0004	0.00	-0.00	0.0002	-0.00
	0.54	0.54	0.54	0.065	0.064	0.066
	0.54	0.54	0.54	0.067	0.066	0.068
Debt In	-0.002	0.004	-0.00	-0.009**	-0.008**	-0.0004
	0.34	0.34	0.34	0.10	0.11	0.095
	0.34	0.34	0.34	0.089	0.091	0.094

- Some evidence for the effect of banks' connections and reach on the *short-run* capital flow changes in *developed* countries is consistent with *diversification motive*
- Evidence consistent with *short-run exclusion from capital markets* for *developing* countries
  - Only marginal improvement in the fit of the regression for short-run fluctuations in capital flows

Result #2c: Banks' positions in the GBN matter much more for long-run capital flows patterns than for short-run fluctuations in capital flows

Take-aways

1. Gravity analysis of bilateral foreign asset position shows that ***lending relationships*** *between banks may be important in facilitating* ***FDI and portfolio*** *capital flows between countries*
2. Macroeconomic and institutional factors explain country's banks' position in the GBN for developing but not so much for industrial countries
3. Banks' (betwenness) ***centrality*** in the GBN is ***positively*** associated with ***capital inflows and outflows*** for developing and with equity inflows for industrial countries, explaining a substantial portion of cross-country differences in these
4. Changes in banks' positions in the GBN have very little effect on short-run fluctuations in capital flows

Thank you

Top-10 banks by lending

Early sample	Later sample
Merrill Lynch International Ltd	Deutsche Bank AG
Morgan Stanley International	HSBC
Lehman Brothers International (Europe)	JPMorgan
Goldman Sachs International Ltd	Citibank NA
Deutsche Bank AG	Citigroup Inc
Merrill Lynch & Co Inc	BNP Paribas
Deutsche Bank AG (London)	Danske Bank
Merrill Lynch Capital Markets Bank Ltd (Frankfurt)	Standard Chartered Bank
JP Morgan Securities Ltd	Bank of New York
Bank of America International Ltd	Wachovia Bank NA

Top-10 banks by borrowing

Early sample

Merrill Lynch & Co Inc

Bank of America Corp

Morgan Stanley Dean Witter & Co

National Australia Bank

Deutsche Bank AG (London)

Abbey National Treasury Services plc

LBBW

Landesbank Baden-Wuerttemberg Capital Markets plc

Bank for Foreign Economic Affairs of USSR - Vnesheconombank (Old)

Dean Witter Discover & Co

Later sample

Euroclear Bank SA/NV

Merrill Lynch & Co Inc

Morgan Stanley & Co Inc

Bear Stearns Companies Inc

Morgan Stanley

Citigroup Global Markets Holdings Inc

Banque PSA Finance SA

Morgan Stanley Dean Witter & Co

Citigroup

Salomon Smith Barney Holdings Inc

Top-10 countries

Early sample		Late sample	
by lending	**by borrowing**	**by lending**	**by borrowing**
United Kingdom	United States	United States	United States
Germany	United Kingdom	Germany	Belgium
United States	Germany	United Kingdom	United Kingdom
France	Australia	Japan	Turkey
Japan	Netherlands	France	Hong Kong
Hong Kong	France	Netherlands	Russian Federation
Jersey	Italy	Italy	Guernsey
Puerto Rico	Guernsey	Spain	Puerto Rico
Guernsey	Jersey	Austria	South Korea
Virgin Islands (British)	Virgin Islands (British)	Australia	Australia

Data for G-20 countries

Early sample

country	lending	borrowing	banks
Argentina	971	23,744	53
Australia	61,351	271,437	181
Brazil	1,338	32,629	99
Canada	44,859	55,326	70
China	2,127	39,655	77
France	192,136	186,263	195
Germany	521,777	318,435	244
India	1,011	9,121	20
Indonesia	318	14,126	79
Italy	56,144	140,231	252
Japan	135,439	71,052	276
Mexico	753	26,652	33
Russian Federation	1,357	52,569	42
Saudi Arabia	3,487	0	15
South Africa	87	7,974	18
South Korea	7,491	101,336	142
Turkey	1,031	31,419	71
United Kingdom	1,625,961	527,443	747
United States	466,023	783,442	1150

Late sample

country	lending	borrowing	banks
Argentina	7	2,508	7
Australia	15,913	16,729	36
Brazil	166	6,746	28
Canada	15,822	223	33
China	2,994	2,821	25
France	39,731	14,218	70
Germany	86,672	3,351	112
India	872	9,282	29
Indonesia	23	306	6
Italy	20,851	3,755	105
Japan	42,424	15,436	146
Mexico	0	2,159	8
Russian Federation	1,460	23,761	107
Saudi Arabia	1,378	2,231	18
South Africa	543	7,171	21
South Korea	715	18,870	43
Turkey	516	35,787	31
United Kingdom	83,052	40,098	213
United States	121,683	192,808	280

Node-level statistics used in the analysis

- Degree measures how many direct connections a given node has
- Out(In)Degree is the number of edges incident from (to) a given node

  - In our data
    - Early sample:

Variable	Obs	Mean	Std. Dev.	Min	Max
indegree	6866	7.894553	24.4083	0	568
outdegree	6866	7.894553	23.43919	0	368

    - Late sample:

Variable	Obs	Mean	Std. Dev.	Min	Max
indegree	2598	7.494611	18.79729	0	216
outdegree	2598	7.494611	21.43169	0	302

G-20 network statistics: median indegree & outdegree

Early sample

country	indegree	outdegree
Argentina	2	0
Australia	2	0
Brazil	2	0
Canada	0	1
China	0	1
France	0	2
Germany	0	3
India	7	1
Indonesia	12	0
Italy	0	1
Japan	0	3
Mexico	6	0
Russian Federation	14.5	0
Saudi Arabia	0	7
South Africa	20	0
South Korea	0	2
Turkey	12	1
United Kingdom	0	2
United States	0	1
Network mean	7.9	7.9

Late sample

country	indegree	outdegree
Argentina	7	0
Australia	1.5	1
Brazil	4	0
Canada	0	1
China	1	2
France	0	2
Germany	0	6
India	18	0
Indonesia	1.5	0.5
Italy	0	1
Japan	0	1
Mexico	7	0
Russian Federation	10	1
Saudi Arabia	0	4
South Africa	0	1
South Korea	1	1
Turkey	34	1
United Kingdom	0	2
United States	0	1
Network mean	7.5	7.5

Node level statistics used in the analysis

- Farness measures how far away from center of the network the node is located, it is a reciprocal of *closeness*, a centrality measure
- Out(In)Farness is the average length of a geodesic path incident from (to) a given node
  - In our data
    - Early sample

Variable	Obs	Mean	Std. Dev.	Min	Max
infarness	6866	1.373746	2.017877	0	8.48807
outfarness	6866	2.260061	2.221725	0	10.61835

    - Late sample

Variable	Obs	Mean	Std. Dev.	Min	Max
infarness	2598	1.590678	2.841073	0	14.41284
outfarness	2598	2.483458	2.693161	0	11.535

G-20 network statistics: median infarness & outfarness

Early sample

country	infarness	outfarness
Argentina	1.0	0.0
Australia	1.5	0.0
Brazil	1.5	0.0
Canada	0.0	1.0
China	0.0	1.0
France	0.0	2.2
Germany	0.0	3.3
India	3.3	1.0
Indonesia	4.1	0.0
Italy	0.0	1.0
Japan	0.0	3.5
Mexico	3.7	0.0
Russian Federation	3.6	0.0
Saudi Arabia	0.0	3.6
South Africa	3.9	0.0
South Korea	0.0	4.0
Turkey	3.2	1.0
United Kingdom	0.0	2.7
United States	0.0	1.0
Network mean	1.4	2.3

Late sample

country	infarness	outfarness
Argentina	1.4	0.0
Australia	1.5	1.0
Brazil	1.5	0.0
Canada	0.0	1.0
China	1.0	4.1
France	0.0	2.8
Germany	0.0	3.0
India	4.7	0.0
Indonesia	1.3	0.5
Italy	0.0	1.0
Japan	0.0	1.0
Mexico	2.9	0.0
Russian Federation	2.8	1.0
Saudi Arabia	0.0	6.3
South Africa	0.0	1.0
South Korea	1.0	1.0
Turkey	2.8	1.8
United Kingdom	0.0	2.2
United States	0.0	1.0
Network mean	1.6	2.5

Node level statistics used in the analysis

- Betweenness measures how important the bank is in the intermediation, it is a centrality measure
- Betweenness will be high for nodes that connect clusters to each other
- Betweenness is the share of geodesic paths between any pair $j \neq i$ and $k \neq i$ that go through node i :

  - In our data
    - Early sample

Variable	Obs	Mean	Std. Dev.	Min	Max
betweenness	6866	.0000564	.0006448	0	.0252413

    - Late sample

Betweenness	2598	.0001363	.0012625	0	.0291877

G-20 network statistics: median betweenness=o; weighted means:

Early sample (mean 0.0001)

country	betweenness
Argentina	0.0012%
Australia	0.0009%
Brazil	0.0002%
Canada	0.0001%
China	0.0154%
France	0.0022%
Germany	0.0000%
India	0.0022%
Indonesia	0.0001%
Italy	0.0006%
Japan	0.0002%
Mexico	0.0016%
Russian Federation	0.0069%
Saudi Arabia	0.0000%
South Africa	0.0002%
South Korea	0.0042%
Turkey	0.0000%
United Kingdom	0.0001%
United States	0.0001%

Late sample (mean 0.0001)

country	betweenness
Argentina	0.0000%
Australia	0.0016%
Brazil	0.0000%
Canada	0.0000%
China	0.0014%
France	0.0018%
Germany	0.0002%
India	0.0047%
Indonesia	0.0033%
Italy	0.0000%
Japan	0.0000%
Mexico	0.0000%
Russian Federation	0.0002%
Saudi Arabia	0.0011%
South Africa	0.0001%
South Korea	0.0006%
Turkey	0.0092%
United Kingdom	0.0001%
United States	0.0003%