



The evolution of China's global financial linkages

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HKIMR Conference, 23 November 2022

The views expressed are those of the authors and not necessarily those of the BIS, IMF or Breakout Capital.

Main questions, data used

1. Map the evolution of China's global financial linkages

- How is China linked to the rest of the world?
- Any signs of financial fragmentation?
- How does financial instability in China affect others?

2. Data

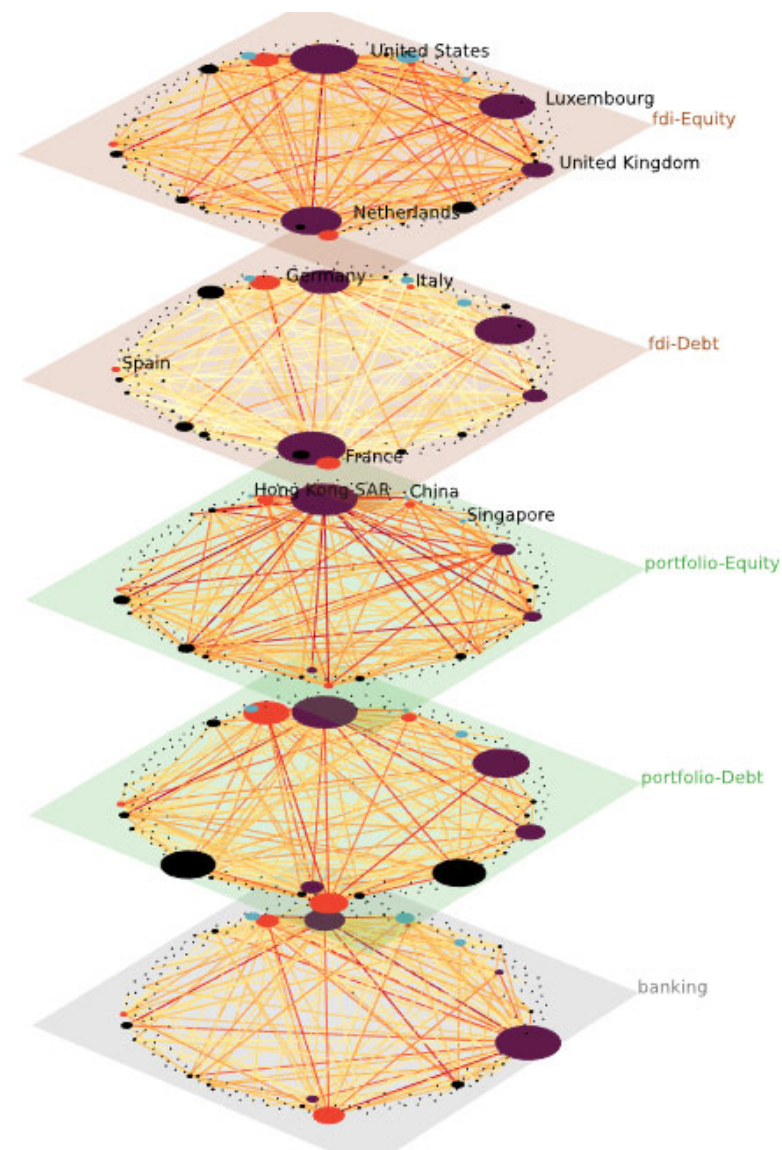
- Annual, 2008 – 2021, 138 countries
- Multiple layers:
 - Bilateral FDI equity and debt: IMF Coordinated Direct Investments Survey
 - Bilateral portfolio investments in equity and debt: IMF Coordinated Portfolio Investments Survey
 - Cross-border bank loans and deposits: BIS IBS, *location* based
- Missing data filled with mirror statistics or national data sources (e.g. US TIC database).

3. Key literature

- Networks that consider complex interactions among nodes within a multilayer framework

Multiplex network construction and results (2021)

- PageRank centrality measure to identify systemically-important nodes (for multiplex networks)
 - Helps to locate “central” countries in the global financial network of borrowers and lenders
 - Takes into consideration size of financial activity and direction of linkages
 - Countries more accessible (i.e. with more degrees of linkages to others) are ranked higher
 - Linkages via horizontal (same asset class) and vertical (across asset classes) layers
- Heterogeneity across layers, but central economies largely unchanged since 2008
 - US consistently central in the portfolio channel
 - UK has remained central for bank lending
 - The Netherlands and the US central for FDI



PageRank creditor ranking – Sizable increases in China’s centrality

Centrality measures for creditors

2009				2021		
Rank	FDI	Portfolio	Bank lending	FDI	Portfolio	Bank lending
1	Netherlands	United States	United Kingdom	United States	United States	United Kingdom
2	United States	Luxembourg	United States	Netherlands	Luxembourg	United States
3	Luxembourg	United Kingdom	Germany	Luxembourg	Germany	France
4	United Kingdom	France	France	United Kingdom	Ireland	China
5	France	Germany	Luxembourg	Germany	United Kingdom	Germany
6	Germany	Japan	Switzerland	France	France	Hong Kong SAR
7	Belgium	Ireland	Netherlands	Switzerland	Japan	Singapore
8	Italy	Netherlands	Japan	China	Netherlands	Japan
9	Switzerland	Italy	Hong Kong SAR	Japan	Italy	Netherlands
10	Spain	Switzerland	Singapore	Hong Kong SAR	Canada	Switzerland
...	China (20)	China (33)	China (17)		China (17)	

Source: IMF, BIS, authors' calculations

Summary of outward linkages – Dramatic increases since 2015

Out degree: Number of bilateral outward investment destinations

China						non-China														
						Average					median					standard deviation				
year	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank
2009	52	44	7	3	31	27	23	20	20	32	15	14	2	1	21	27	24	26	27	30
2010	58	53	8	5	35	29	27	20	21	32	18	19	3	1	22	27	27	26	27	30
2011	60	51	7	3	35	31	28	21	21	32	19	19	3	2	22	29	27	26	27	30
2012	69	54	8	4	35	32	30	21	22	38	19	23	3	2	25	30	29	26	28	32
2013	71	55	9	7	35	34	31	22	23	40	21	25	3	2	27	31	29	27	30	33
2014	72	60	9	6	35	34	32	23	25	42	20	23	4	3	28	31	29	28	31	34
2015	77	62	56	81	127	36	34	23	26	44	23	24	5	4	30	32	30	28	32	34
2016	77	60	54	85	127	38	34	24	27	45	25	27	5	7	32	33	30	27	32	34
2017	79	62	56	91	126	39	36	24	28	46	26	28	6	7	33	33	31	27	34	34
2018	129	65	58	95	127	40	36	24	28	46	26	28	6	7	33	33	32	27	34	33
2019	129	63	56	93	128	40	36	24	29	46	25	30	7	6	34	33	32	27	34	34
2020	130	117	55	89	128	40	36	24	29	46	25	29	7	11	33	33	32	27	33	33
2021	130	117	52	88	128	40	36	23	28	46	25	29	6	6	33	33	32	27	34	34

Source: IMF, BIS, Staff calculations

Summary of out strength – Increases in FDI

Out strength: Average investment value per destination (USD bln)

year	China, average					non-China, average														
	FDIE	FDID	PortE	PortD	Bank	Average					median					standard deviation				
						FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank
2009	7	1	0	12	6	5	2	4	6	4	0.06	0.03	0.03	0.07	0.06	24	11	24	31	28
2010	8	1	5	26	7	4	2	5	6	4	0.05	0.03	0.03	0.07	0.06	24	10	27	31	30
2011	8	2	7	77	8	5	2	4	6	4	0.05	0.03	0.02	0.07	0.06	26	10	25	32	32
2012	7	1	6	59	10	5	2	5	6	3	0.05	0.03	0.02	0.08	0.03	28	11	28	33	27
2013	7	2	5	19	10	5	2	6	6	3	0.05	0.03	0.03	0.08	0.02	32	12	35	32	24
2014	7	2	2	13	13	5	2	6	6	3	0.05	0.03	0.03	0.07	0.02	35	14	36	31	23
2015	7	2	3	1	5	5	2	6	5	2	0.04	0.02	0.02	0.06	0.02	36	13	36	30	20
2016	7	2	3	1	6	5	2	6	5	2	0.04	0.02	0.02	0.06	0.01	37	13	37	31	20
2017	8	2	5	2	6	6	2	8	5	3	0.04	0.02	0.03	0.06	0.02	41	13	47	33	23
2018	10	2	4	2	6	6	2	7	5	3	0.05	0.03	0.03	0.06	0.01	39	13	42	33	23
2019	11	3	6	2	7	6	2	8	6	3	0.05	0.03	0.03	0.07	0.01	40	12	51	36	24
2020	13	2	10	2	8	6	2	9	6	3	0.05	0.03	0.04	0.08	0.01	42	12	57	40	27
2021	13	2	11	3	9	6	2	11	6	3	0.05	0.03	0.04	0.08	0.01	42	12	70	41	28

Source: IMF, BIS, Staff calculations

Outward investment geographic dispersion

Investment as a share of total cross-border investment in other economies, %

		FDI - Equity			FDI - Debt		
Source	Average	China	AE	ROW	China	AE	ROW
EMEs	2009 - 2015	13	17	45	17	12	29
	2016 - 2022	11	17	47	19	15	31
Hong Kong SAR	2009 - 2015	80	1.2	2.2	42	0.5	2
	2016 - 2022	76	1.3	2.5	41	0.6	3

		Portfolio - Equity			Portfolio - Debt		
Source	Average	China	AE	ROW	China	AE	ROW
EMEs	2009 - 2015	6	13	24	1	7	22
	2016 - 2022	3	11	20	12	8.9	23
Hong Kong SAR	2009 - 2015	3	2.0	2.3	4	0.2	1.6
	2016 - 2022	49	1.4	2.0	30	0.2	1.6

		Bank lending		
Source	Average	China	AE	ROW
EMEs	2009 - 2015	13	13	28
	2016 - 2022	32	13	31
Hong Kong SAR	2009 - 2015	38	2	6
	2016 - 2022	31	3	8

Source: BIS, IMF, Staff calculations

PageRank borrower ranking – FDI borrowing less central, but increases elsewhere

Centrality measures for borrowers

2009				2021		
Rank	FDI	Portfolio	Bank borrowing	FDI	Portfolio	Bank borrowing
1	Netherlands	United States	United Kingdom	United States	United States	United Kingdom
2	United States	United Kingdom	United States	Netherlands	Japan	United States
3	China	Japan	France	United Kingdom	Luxembourg	France
4	Hong Kong SAR	Germany	Germany	Luxembourg	United Kingdom	Germany
5	United Kingdom	France	Switzerland	China	Ireland	Japan
6	Luxembourg	Luxembourg	Ireland	Hong Kong SAR	France	Hong Kong SAR
7	Germany	Netherlands	Netherlands	Germany	Germany	Switzerland
8	France	Italy	Spain	Switzerland	Netherlands	Singapore
9	Switzerland	Ireland	Italy	Singapore	Canada	Canada
10	Belgium	Spain	Belgium	France	China	China
...		China (18)	China (29)

Source: IMF, BIS, authors' calculations

Summary of inward linkages – Sizable increase in bank lenders

In degree: Number of bilateral investment partners

year	China					non-China														
						Average					median					standard deviation				
	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank
2009	126	39	47	38	32	26	23	19	20	32	25	19	12	16	19	24	22	19	18	34
2010	125	48	49	36	34	29	27	20	21	32	26	23	13	17	20	24	23	20	19	34
2011	123	47	49	37	35	30	28	20	21	32	27	23	11	16	20	25	24	20	19	34
2012	122	50	52	43	35	32	30	21	21	38	28	28	12	16	22	25	25	20	19	39
2013	122	48	54	42	35	33	32	22	23	40	31	28	14	17	24	25	26	21	20	40
2014	123	50	56	47	35	34	32	23	24	42	30	29	14	20	25	25	26	21	20	41
2015	123	51	57	49	130	36	34	24	25	44	32	32	15	23	27	25	27	22	21	41
2016	123	50	59	47	130	38	35	24	27	45	34	33	16	25	27	26	27	22	21	41
2017	122	50	57	52	130	39	36	24	28	46	35	34	17	28	27	27	27	23	21	42
2018	127	52	57	51	130	40	36	24	28	46	40	35	17	27	27	27	27	23	22	42
2019	116	54	60	55	131	40	36	24	28	46	40	32	19	28	27	26	27	23	22	42
2020	118	88	59	54	131	40	36	25	28	46	38	33	17	27	27	27	28	23	22	42
2021	118	88	56	54	131	40	36	24	28	46	38	33	16	27	27	27	28	23	21	42

Source: IMF, BIS, Staff calculations

Summary of in strength – FDI and portfolio inflows increased

In strength: Average investment value received (USD bln)

China, average						non-China, average														
						Average					median					standard deviation				
year	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank	FDIE	FDID	PortE	PortD	Bank
2009	5	2	8	1	4	5	2	4	6	4	0.06	0.03	0.03	0.07	0.06	24	11	25	31	29
2010	6	2	9	2	7	4	2	5	6	4	0.05	0.03	0.02	0.07	0.06	24	10	27	32	31
2011	7	2	8	3	10	5	2	4	6	4	0.05	0.03	0.02	0.06	0.06	26	10	25	33	32
2012	8	2	10	3	11	5	2	5	6	3	0.05	0.03	0.02	0.07	0.03	29	11	28	33	28
2013	9	3	9	6	18	5	2	6	6	3	0.05	0.03	0.02	0.08	0.02	32	12	35	33	25
2014	10	3	11	6	20	5	2	6	6	3	0.05	0.03	0.02	0.07	0.02	34	14	36	32	23
2015	11	4	9	5	4	5	2	6	5	2	0.04	0.02	0.02	0.06	0.02	36	13	36	31	21
2016	11	4	9	4	4	5	2	6	5	2	0.04	0.02	0.02	0.05	0.02	36	13	37	32	21
2017	13	4	13	5	5	6	2	7	6	3	0.04	0.02	0.03	0.06	0.02	41	13	47	34	24
2018	12	4	12	5	5	6	2	7	6	3	0.05	0.03	0.02	0.06	0.02	40	13	42	34	24
2019	14	4	13	6	5	6	2	8	6	3	0.05	0.03	0.03	0.06	0.02	41	12	51	37	24
2020	16	3	17	9	5	6	2	9	7	3	0.05	0.03	0.03	0.07	0.02	44	12	57	42	29
2021	16	3	20	10	5	6	2	11	7	3	0.05	0.03	0.03	0.07	0.01	44	12	70	43	30

Source: IMF, BIS, Staff calculations

Inward investment geographic dispersion

Investments from others as a share of total cross-border investment received, %

		FDI - Equity			FDI - Debt		
Source	Average	China	AE	ROW	China	AE	ROW
EMEs	2009 - 2015	24	6	21	6	7	17
	2016 - 2022	22	7	28	7	11	23
Hong Kong SAR	2009 - 2015	45	0.4	1.5	44	0.7	2
	2016 - 2022	48	0.4	1.8	50	0.9	3

		Portfolio - Equity			Portfolio - Debt		
Source	Average	China	AE	ROW	China	AE	ROW
EMEs	2009 - 2015	15	6	9	14	5	7
	2016 - 2022	17	7	14	26	6.2	10
Hong Kong SAR	2009 - 2015	34	1.1	1.0	72	1.0	2.6
	2016 - 2022	29	1.1	1.2	47	1.4	3.1

		Bank lending		
Source	Average	China	AE	ROW
EMEs	2009 - 2015	19	12	22
	2016 - 2022	25	13	33
Hong Kong SAR	2009 - 2015	50	2	7
	2016 - 2022	39	3	8

Source: BIS, IMF, Staff calculations

Contagion simulation

- Simulated scenarios to gauge feedback loop
- Binary, threshold model:
 - Discrete time, deterministic
 - Node-layers (country-assets) have binary states: healthy/undistressed or infected/distressed
- No distinction between types and magnitude of shocks
- ... but threshold and capital buffers matter
 - Each country has some assets that can be held as buffers in each layer
 - Country is “distressed” if asset loss exceeds buffer in layer
 - Or, if the sum of lost assets over all layers exceed a fraction (predetermined threshold) of total assets
 - Or, the fraction of incoming links’ weights from a defaulted neighbor is above a predetermined threshold

Contagion simulation

- Binary state for country (i) and layer (α):

$$S_{i,\alpha}(t) = \begin{cases} 0, & \text{if } (i, \alpha) \text{ is undistressed at time } t \\ 1, & \text{if } (i, \alpha) \text{ is distressed at time } t \end{cases}$$

- Financial contagion spreading rule:

$$S_{i,\alpha}(t+1) = \begin{cases} 1, & \text{if } \frac{\text{loss}_{i,\alpha}(t)}{a_{i,\alpha}} > b_{i,\alpha} \\ 1, & \text{if } \frac{\text{loss}_i(t)}{a_{i,\alpha}} > c_i \\ 0, & \text{otherwise,} \end{cases}$$

- $b_{i,\alpha}$ (encodes capital buffers) = horizontal threshold
- c_i (encodes intra-country risk-propagation buffers) = vertical threshold

Contagion simulation – A snapshot of possible transmission channels

Simulation results - Impact on EMs vs AM economies

Steps		EMs	Ams	Total number
1	FDI equity	80%	20%	15
	FDI debt	86%	14%	7
	Portfolio equity	67%	33%	3
	Portfolio debt	50%	50%	2
	Bank	57%	43%	7
2	FDI equity	94%	6%	18
	FDI debt	78%	22%	9
	Portfolio equity	73%	27%	15
	Portfolio debt	85%	15%	13
	Bank	89%	11%	37
3	FDI equity	95%	5%	20
	FDI debt	97%	3%	33
	Portfolio equity	96%	4%	23
	Portfolio debt	96%	4%	28
	Bank	92%	8%	13

Source: BIS staff

Simulation results - Geographic dispersion of economies affected

Steps		Africa	Asia	Americas	Europe
1	FDI equity	13%	73%	13%	0%
	FDI debt	0%	71%	29%	0%
	Portfolio equity	0%	67%	0%	33%
	Portfolio debt	0%	100%	0%	0%
	Bank	14%	86%	0%	0%
2	FDI equity	11%	67%	22%	0%
	FDI debt	22%	67%	11%	0%
	Portfolio equity	13%	67%	20%	0%
	Portfolio debt	15%	62%	23%	0%
	Bank	14%	78%	8%	0%
3	FDI equity	25%	65%	10%	0%
	FDI debt	9%	91%	0%	0%
	Portfolio equity	9%	91%	0%	0%
	Portfolio debt	7%	93%	0%	0%
	Bank	62%	31%	8%	0%

Source: BIS staff

Conclusion

- China is systematic
 - Centrality rank increased over time, driven by FDI equity investments and cross-border bank loans
 - FDI particularly important, with potentially global, systemic implications
 - Biggest adverse impact on small, emerging market economies
- Hong Kong is a crucial nexus on multiple fronts
 - HK has a high degree of global linkages
 - It plays a key role in intermediating capital to and from China
 - Policy matters – Connect Schemes instrumental in expanding linkages
 - Global liquidity secondary in boosting interlinkages with China in period studied
- Signs of fragmentation?
 - A generalized increase in the number of linkages suggests deepening financial integration that is difficult to disentangle in the short run