The Global Network of Financial Intermediation and Exchange Rates*

Saleem Bahaj
University College London & BoE

Pasquale Della Corte
Imperial College London & CEPR

Daniele Massacci
King's College London

Eduard Seyde
Imperial College London

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*The views are those of the authors and are not necessarily those of the Bank of England.

Introduction

Fluctuations in the balance sheet of financial intermediaries can affect exchange rates

- Theoretically (e.g., Gabaix and Maggiori, 2015),
- Empirically (e.g., Correa & DeeMarco, 2019; Du, Hebert and Wang, 2021; Fang, 2021).

Financial intermediaries operate through a complex network of cross-border interactions

- It is key for credit intermediation and the propagation of global shocks (e.g., Bruno & Shin, 2014; Hale, Kapan & Minoiu, 2020; Correa, Paligorova, Sapriza & Zlate, 2021).

Does the network structure of financial intermediation matter for exchange rates?

- The current literature focuses on first-order connections,
- But higher-order effects might also be relevant for exchange rates.

This paper

What we have done ...

- A simple model based on Gabaix and Maggiori (2015) that relates higher-order financial connections to future exchange rate returns,
- We use cross-border banking claims and liabilities from restricted version of the Locational Banking Statistics database for our empirical investigation.
- We construct the network centrality using eigenvector centrality, before isolating direct and indirect network effects.

What we have found...

- Higher-order strengths can mitigate/amplify future exchange rate returns in response to trade shocks (domestic or foreign),
- The relevant network is denominated in the currencies of the counterparty currencies (ad not a in vehicle currency).

Our Theory

Our Theory

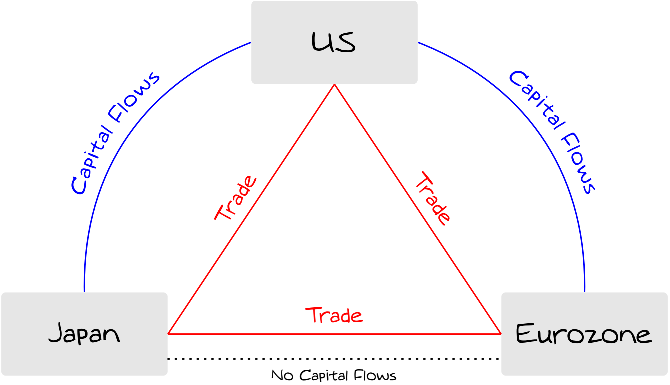
We study the role of financial network effects for exchange rate determination.

- A multi-country version of Gabaix & Maggiori (2015),
- Multiple open economies of different size that consume tradable and non-tradable goods,
- Each household can only invest/borrow through the domestic risk-free bond,
- Global imbalances are intermediated by financiers with limited balance sheet capacity.

Two important features of the model

- Segmentation,
- Limited intermediation capacity.

A Simple Version



A world consisting of three countries – US, Eurozone, and Japan – where all countries have balances external accounts to begin with.

Model's Setup

We consider **two scenarios** from the euro's perspective

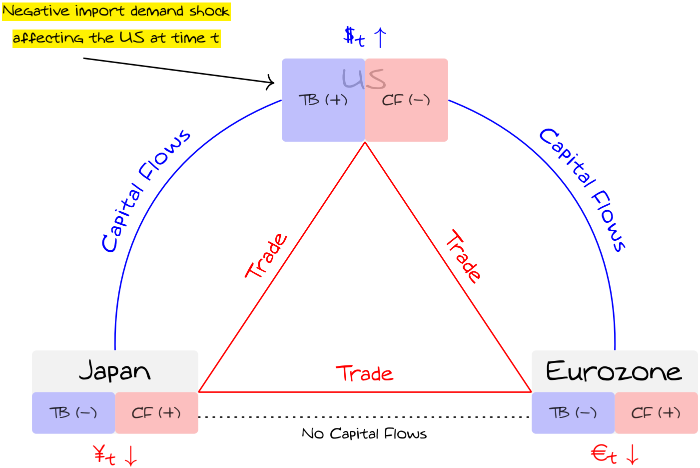
Scenario 1: A negative import demand shock in the US that causes a trade deficit in the Eurozone and Japan.

What happens? An increase in higher-order connections will mitigate the future appreciation of the euro against the dollar.

Scenario 2: A positive import demand shock in the Eurozone that causes a trade deficit in the US and Japan.

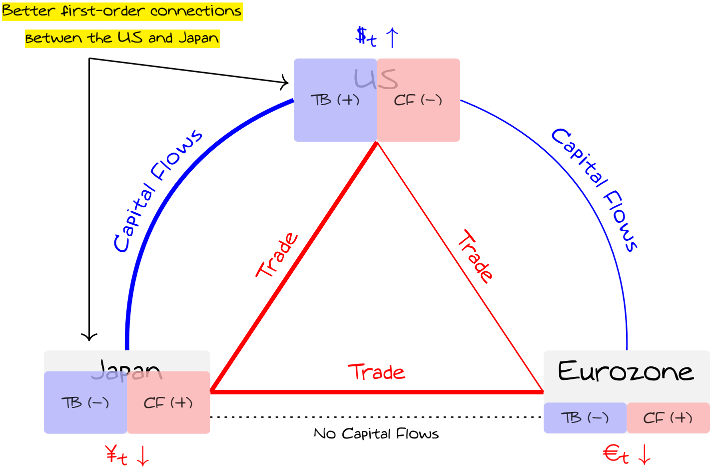
What happens? An increase in higher-order connections will amplify the future appreciation of the euro against the dollar.

Scenario 1



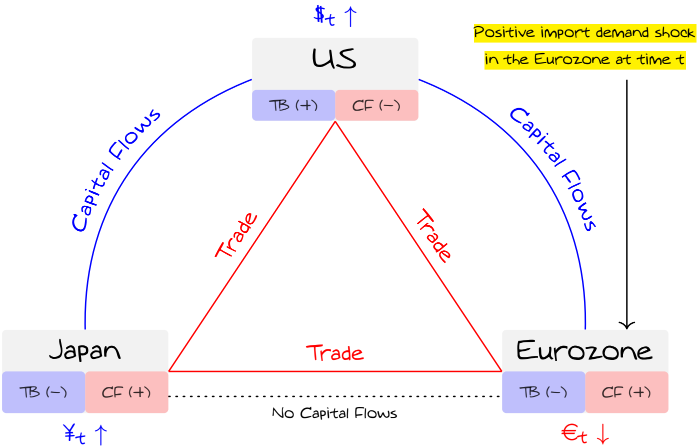
A US trade surplus requires a depreciation today coupled with an appreciation tomorrow of both euro and yen to attract global financiers.

Scenario 1



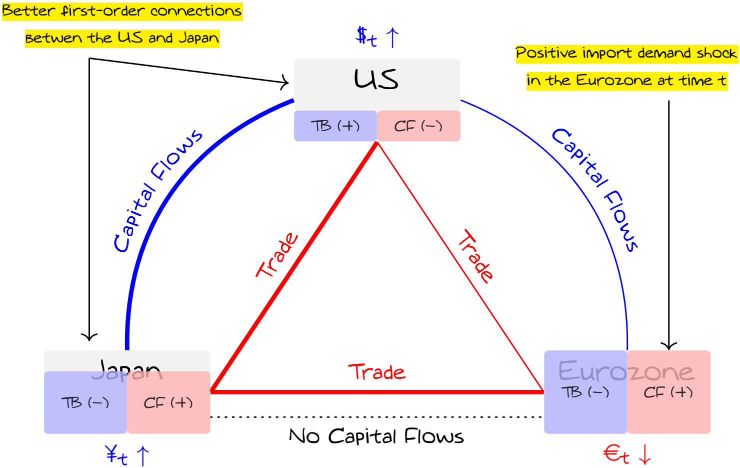
Eurozone's perspective: Higher-order connections mitigate the future appreciation of the euro in response to a large negative import demand shock abroad at time t.

Scenario 2



A Eurozone trade deficit requires a depreciation today coupled with an appreciation tomorrow of the euro to attract global financiers.

Scenario 2



Eurozone's perspective: higher-order connections amplify the future appreciation of the euro in response to a large positive import demand shock at home at time t.

Three Empirical predictions

1. An increase in a country's higher-order financial connections mitigates the impact of large import demand shocks abroad on its future exchange rate return.

2. An increase in a country's higher-order financial connections amplifies the impact of large import demand shocks at home on its future exchange rate return. This effect goes to zero as the country becomes small.

3. The relevant network of financial intermediation is the one denominated in the currencies of the counterparty countries and not the one denominated in a vehicle currency like the dollar.

Our Data

Data sources

Cross-border Banking Activity

- Restricted version of the Locational Banking Statistics by residence from the BIS.
- Aggregate cross-border financial claims and liabilities of internationally active banks located in 45 reporting countries against counterparties in more than 200 countries.
- Quarterly claims and liabilities disaggregated by currency of denomination: major (USD, EUR, JPY, GBP, and CHF) and local currencies from December 1983 and December 2019.

Exchange Rate Data

- Daily spot and forward exchange rates for 71 countries sourced from Datastream,
- Exchange rates are defined as units of dollars per unit of foreign currency,
- We sample end-of-month rates between December 2019 and January 2020.

Data sources

Other Data

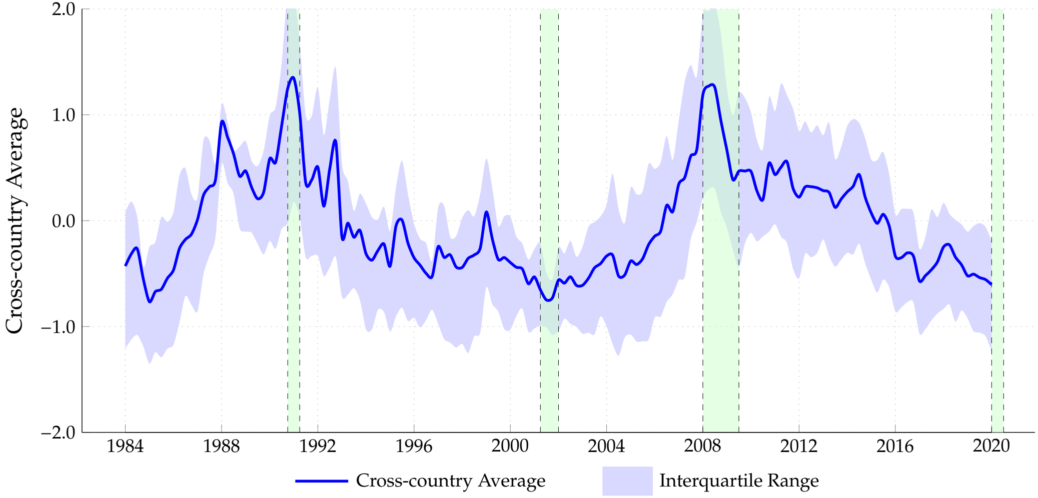
- Quarterly bilateral merchandise exports and imports from the Direction of Trade Statistics,
- Yearly data on gross domestic product from the World Bank database,
- Yearly data on financial openness index of Chinn & Ito (2006),
- Monthly data on the exchange rate classification index of Ilzetzki, Reinhart & Rogoff (2019).

Combined Data

- When monthly data are not available, we retrieve monthly observations by forward filling.
- The final dataset will run between December 1983 and January 2020.

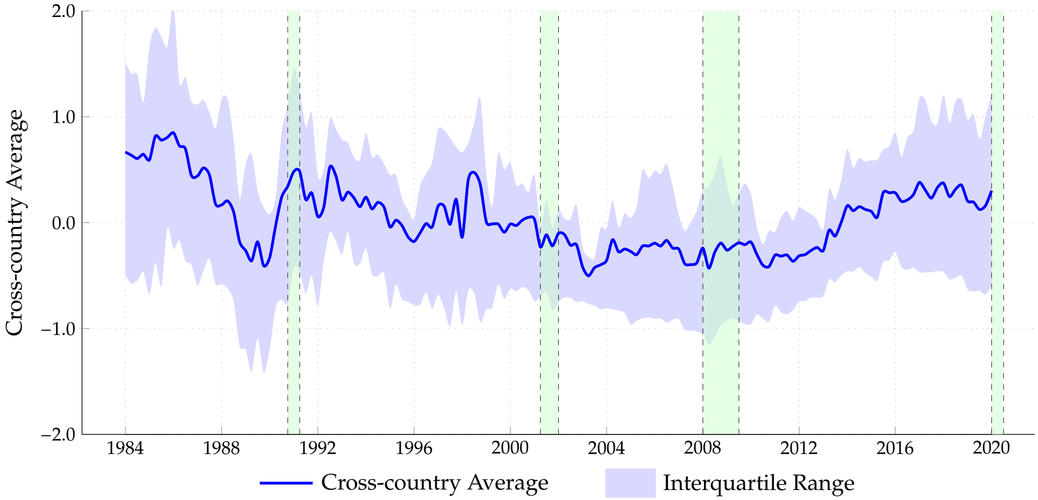
Reporting Countries Counterparty Countries

First-Order Connections



▶ Correlation with Trade Centrality

Higher-Order Connections



▸ Correlation with Trade Centrality

Network Centrality

For each country i, we compute eigenvector centrality at time t as follows

$$\mathcal{C}_{i,t} = \lambda_t^{-1} \sum_{j=1}^{N} \mathcal{A}_{ij,t} \mathcal{C}_{j,t},$$

Centrality of Country i (counterparty country)

Scaling parameter

Claims and liabilities held by country i against banks in country j at time t

Centrality of Country j (reporting country)

Network Centrality

We can rewrite the system of equations as

$$\lambda_t \mathcal{C}_t = \mathcal{A}_t \mathcal{C}_t,$$

Vector of Centralities

Adjacency matrix (zero-diagonal)

Select, the eigenvector of $\mathcal{A}_{i,t}$ corresponding to the largest eigenvalue λ_t.

First-order vs Higher-order Connections

Bonacich (1987) shows that eigenvector centrality converges to power centrality, i.e., the infinite sum of weighted paths activated directly and indirectly by each node in a network as

$$\mathcal{C}_t = \sum_{\ell=0}^{\infty} \lambda_t^{-\ell} \mathcal{A}_{ij,t}^{\ell+1} 1_N,$$

First-order connection is defined as

$$\mathcal{F}_t = \mathcal{A}_{ij,t} 1_N,$$

Higher-order connection is computed as (truncated to $\overline{\ell}$)

$$\mathcal{H}_t = \lambda_t^{-1} \mathcal{A}_{ij,t}^{2} 1_N + \lambda_t^{-2} \mathcal{A}_{ij,t}^{3} 1_N + \ldots + \lambda_t^{\overline{\ell}} \mathcal{A}_{ij,t}^{\overline{\ell}} 1_N.$$

Our Empirical Evidence

Gross Financial Intermediation and Exchange Rates

future exchange rate return

Interaction between first-order connection and trade deficit

$$\Delta s_{i,t+1} = \alpha_1 \mathcal{F}_{i,t} + \alpha_2 \mathcal{H}_{i,t} + \alpha_3 D_{i,t} + \beta \mathcal{F}_{i,t} D_{i,t} + \gamma \mathcal{H}_{i,t} D_{i,t} + Controls_{i,t} + fe + \varepsilon_{t+1}$$

Interaction between first-order connection and trade deficit

Openness index of Chinn & Ito (2006), trade centrality of Richmond (2019), forward premia, and share of world GDP

Gross Financial Intermediation and Exchange Rates

	(1)	(2)	(3)	(4)	(5)
$\mathcal{F}_i$	−0.391	−0.440			0.562
	(0.280)	(0.289)			(0.352)
$\mathcal{F}_i \times D_i$	−0.835***	−0.787***			−0.581**
	(0.316)	(0.295)			(0.278)
$\mathcal{H}_i$			−1.009***	−1.056***	−1.278***
			(0.260)	(0.273)	(0.334)
$\mathcal{H}_i \times D_i$			−0.666**	−0.734***	−0.510*
			(0.296)	(0.258)	(0.262)
# Observations	14,981	14,981	14,981	14,981	14,981
Other Regressors	✓	✓	✓	✓	✓
Time fe	✓	✓	✓	✓	✓
Controls		✓		✓	✓

Standard errors (in parentheses) are clustered at the country level.

Financial Connections and Exchange Rates

future exchange rate return

Higher-order connections times a large trade surplus shock abroad

$$\Delta s_{i,t+1} = \beta\, \mathcal{H}_{i,t}\, I_{us,t} + \gamma\, \mathcal{H}_{i,t}\, I_{i,t} + \theta\, \mathcal{H}_{i,t}\, I_{i,t}\, L_{\alpha,t} + Controls_{i,t} + X_{i,t} + fe + \varepsilon_{t+1},$$

Higher-order connections times a trade deficit shock at home

Higher-order connections times a trade deficit shock at home when country *i* is sufficiently large (top 5% of share of global trade)

Other Regressors (and interactions)

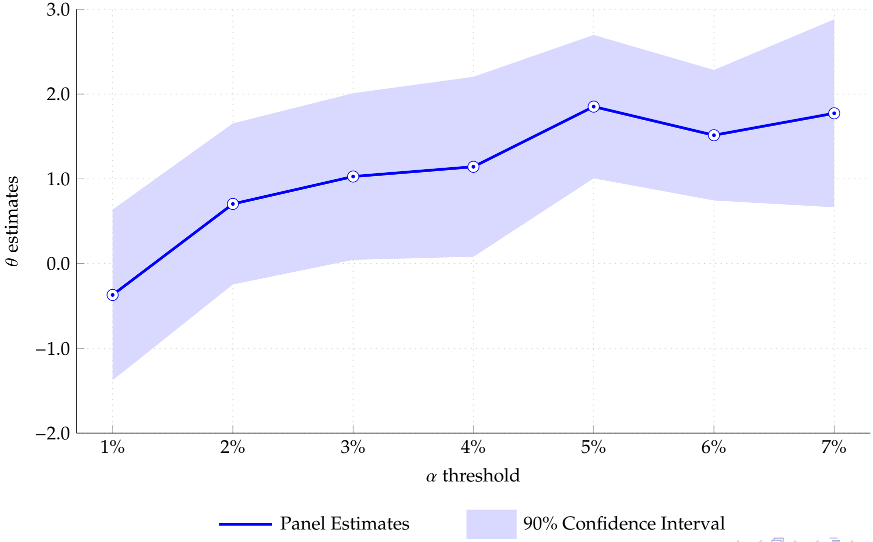
Openness index of Chinn & Ito (2006), trade centrality of Richmond (2019), forward premia, share of world GDP, and first-order connections

Financial Connections and Exchange Rates

	(1)	(2)	(3)	(4)	(5)
$\mathcal{H}_i$	−1.000***	−1.058***	−1.023***	−1.278***	−0.858**
	(0.275)	(0.299)	(0.298)	(0.352)	(0.361)
$\mathcal{H}_i \times I_{us}$	−0.631***	−0.643***	−0.651***	−0.648***	−0.650***
	(0.216)	(0.221)	(0.217)	(0.219)	(0.219)
$\mathcal{H}_i \times I_i$	−0.281	−0.419	−0.449	−0.445	−0.353
	(0.277)	(0.289)	(0.299)	(0.297)	(0.283)
$\mathcal{H}_i \times I_i \times L_\alpha$		1.886***	1.843***	2.246***	2.051***
		(0.551)	(0.579)	(0.433)	(0.432)
# *Observations*	14,981	14,981	14,981	14,981	14,981
Other Regressors	✓	✓	✓	✓	✓
Time fe	✓	✓	✓	✓	✓
Country fe			✓		✓
Controls				✓	✓

Standard errors (in parentheses) are clustered at the country level.

Different Thresholds α



Controlling for Dollar Network Effects

	(1)	(2)	(3)	(4)
$\mathcal{H}_i^{us} \times I_{us}$	−0.409	−0.354	−0.397	−0.340
	(0.272)	(0.277)	(0.282)	(0.286)
$\mathcal{H}_i \times I_{us}$	−0.474**	−0.465**	−0.486**	−0.426**
	(0.211)	(0.217)	(0.206)	(0.211)
$\mathcal{H}_i^{us} \times I_i \times L_\alpha$	2.206*	2.132*	2.421**	2.152*
	(1.129)	(1.153)	(1.191)	(1.196)
$\mathcal{H}_i \times I_{i,t} \times L_\alpha$	1.945***	1.953***	2.040***	1.946***
	(0.601)	(0.610)	(0.645)	(0.638)
# Observations	14,957	14,957	14,957	14,957
Other Regressors	✓	✓	✓	✓
Time fe	✓	✓	✓	✓
Country fe		✓		✓
Controls			✓	✓

Standard errors (in parentheses) are clustered at the country level.

Controlling for Pegged Currencies

	(1)	(2)	(3)	(4)	(5)
$\mathcal{H}_i$	−1.000***	−1.058***	−1.023***	−2.446***	−2.078***
	(0.275)	(0.299)	(0.298)	(0.649)	(0.644)
$\mathcal{H}_i \times I_{us}$	−0.631***	−0.643***	−0.651***	−1.182***	−1.208***
	(0.216)	(0.221)	(0.217)	(0.452)	(0.449)
$\mathcal{H}_i \times I_i$	−0.281	−0.419	−0.449	−0.780	−0.641
	(0.277)	(0.289)	(0.299)	(0.551)	(0.511)
$\mathcal{H}_{i,t} \times I_{i,t} \times L_\alpha$		1.886***	1.843***	2.627***	2.494***
		(0.551)	(0.579)	(0.715)	(0.726)
# Observations	14,981	14,981	14,981	14,981	14,981
Other Regressors	✓	✓	✓	✓	✓
Time fe	✓	✓	✓	✓	✓
Country fe			✓		✓
Controls				✓	✓

Standard errors (in parentheses) are clustered at the country level.

CONCLUSIONS

We study the role of financial network effects on the determination of exchange rates.

We build on the model of Gabaix & Maggiori (2015) and extend it to a multi-country set-up with heterogeneous intermediation capacity and country size.

We shed light on economic quantities that capture cross-sectional and time-series variation in intermediation capacity: *gross banking intermediation*.

We find evidence of higher-order network effects matters for determination of exchange rates.

Appendix

Reporting Countries

1983	Austria, Bahamas, Belgium, Canada, Cayman Islands, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, Netherlands Antilles, Spain, Sweden, Switzerland, UK, US
1997	Australia, Portugal
2000	Taiwan, Turkey
2001	Guernsey, India, Isle of Man, Jersey
2002	Bermuda, Brazil, Chile, Panama
2003	Greece, Macau, Mexico
2005	South Korea
2007	Malaysia
2008	Cyprus
2009	South Africa
2010	Curacao, Indonesia
2014	Norway
2015	China
2016	Philippines
2017	Saudi Arabia

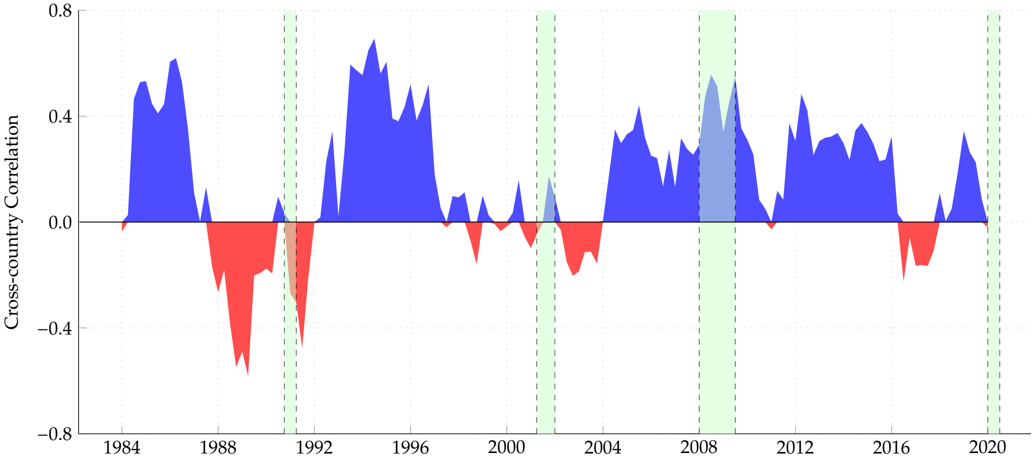
Go back

Counterparty Countries

1984	Austria, Australia, Belgium, Canada, Denmark, Germany, Hong Kong, Ireland, Italy, Japan, Liechtenstein, Netherlands, Norway, Nauru, New Zealand, Portugal, Singapore, Spain, South Africa, Sweden, Switzerland, UK, US
1990	Kuwait, Saudi Arabia, Tuvalu
1992	Kiribati
1995	United Arab Emirates
1996	Czech Republic, France, Greece, Indonesia, Malaysia, Mexico, Poland, Taiwan
1997	Hungary, India
1998	Andorra, Finland, Greenland, Thailand, Vatican City
1999	Euro Area, San Marino
2000	Bahrain, Philippines, Turkey
2001	Guernsey, Isle of Man, Jersey
2002	South Korea, Slovakia
2004	Argentina, Bulgaria, Brazil, Chile, Colombia, Croatia, Egypt, Iceland, Israel, Jordan, Kazakhstan, Kenya, Lithuania, Latvia, Malta, Morocco, Oman, Peru, Pakistan, Palestinian Authority, Qatar, Russia, Slovenia, Tunisia
2005	China, Romania
2006	Montenegro
2010	Ukraine
2011	Botswana, Serbia, Sri Lanka, Uganda, Vietnam, Zambia

Go back

First-Order Connections vs. Trade Centrality



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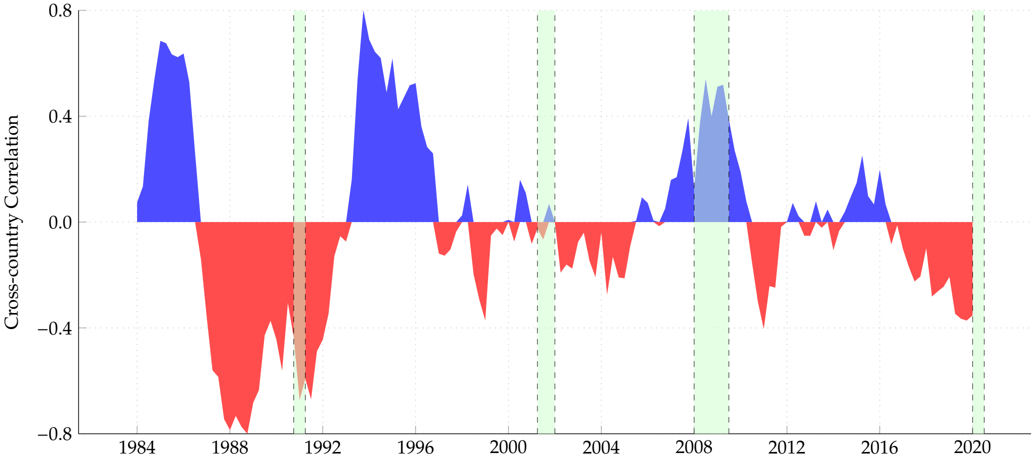
Higher-Order Connections vs. Trade Centrality



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