The Micro Origins of International Business Cycle Comovement[1]

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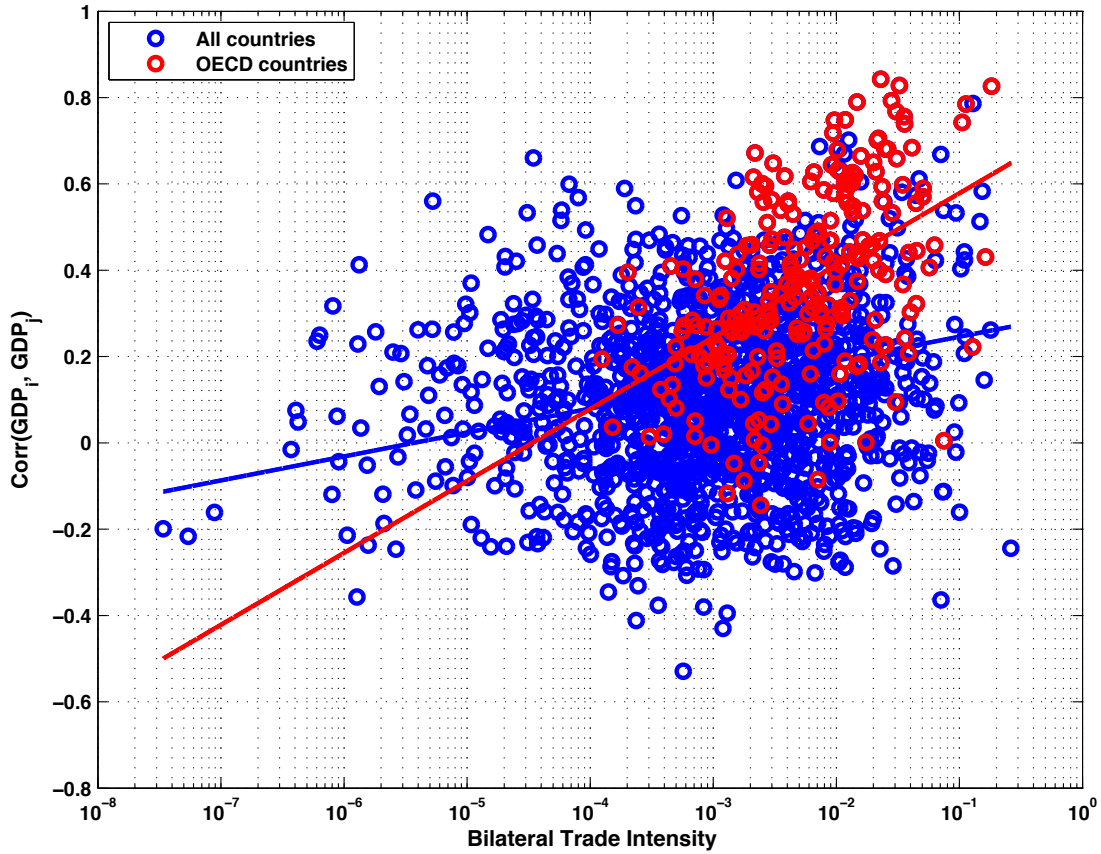
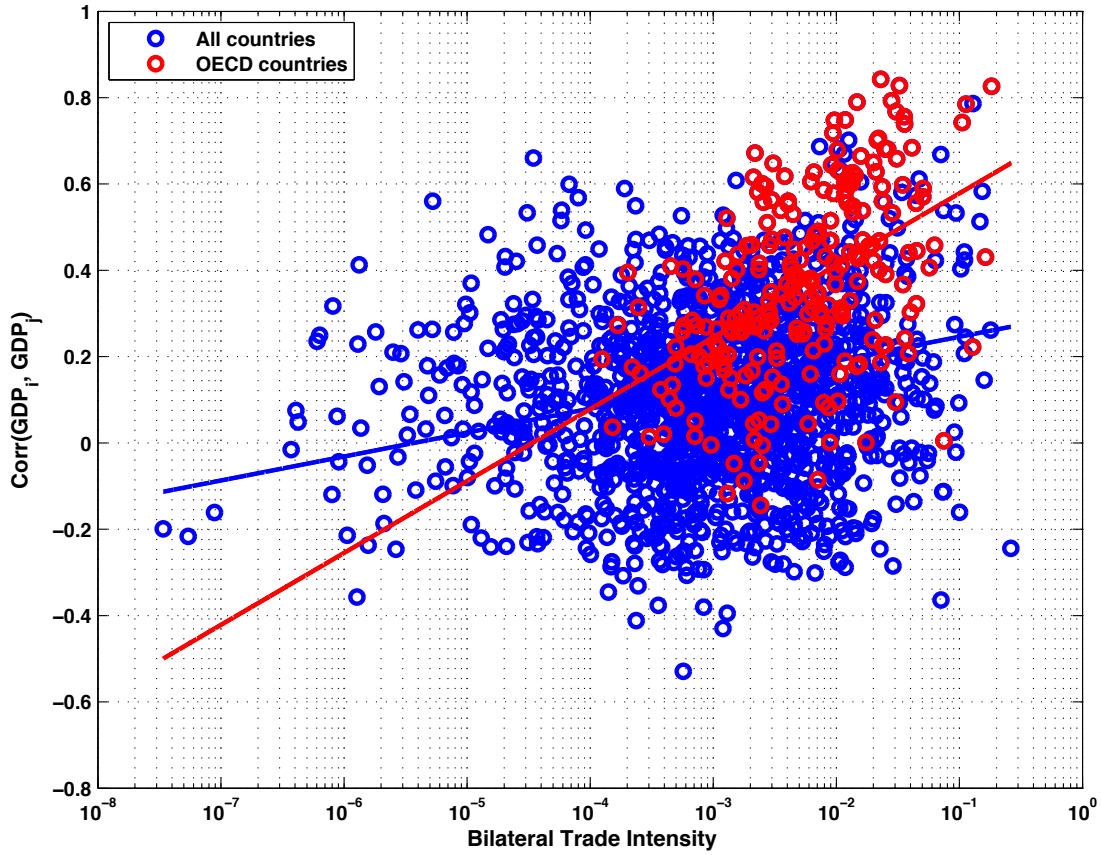
International Business Cycle Comovement and Trade



- Frankel and Rose (1998), repeatedly confirmed since then
- Comovement also correlated with multinational linkages (Kleinert et al, 2015)

International Business Cycle Comovement and Trade



- Key unresolved questions:
  - transmission through linkages or common shocks? (Imbs, 2004)
  - micro-underpinnings of the relationship? "Trade-comovement puzzle," (Kose and Yi, 2006, Johnson, 2014)

The Role of Firms

- The micro origins of aggregate fluctuations
  - Gabaix (2011): skewness of firm-size distribution and idiosyncratic shocks ("granularity")
  - Acemoglu et al. (2012): input-output linkages and networks
  - di Giovanni et al. (2014): empirical evidence of micro shocks driving aggregate volatility

- How important are firms' international linkages in explaining international comovement?
- Which linkages play the greatest role?

This Paper

- A firm-level view of international business cycle comovement
- Census of French firms, 1993–2007
  - Value added/sales
  - Bilateral import, export, *and* multinational linkages
- Documents the importance of directly connected firms for aggregate activity and international comovements:
  1. Estimates the impact of direct connectedness on firm-level correlation with foreign GDP
  2. Aggregates up to establish whether the firm-level changes in correlation amount to an effect on business cycle comovement
- Main results: Directly connected firms represent less than 10% of French firms, 56% of aggregate value added and about 70% of international comovements

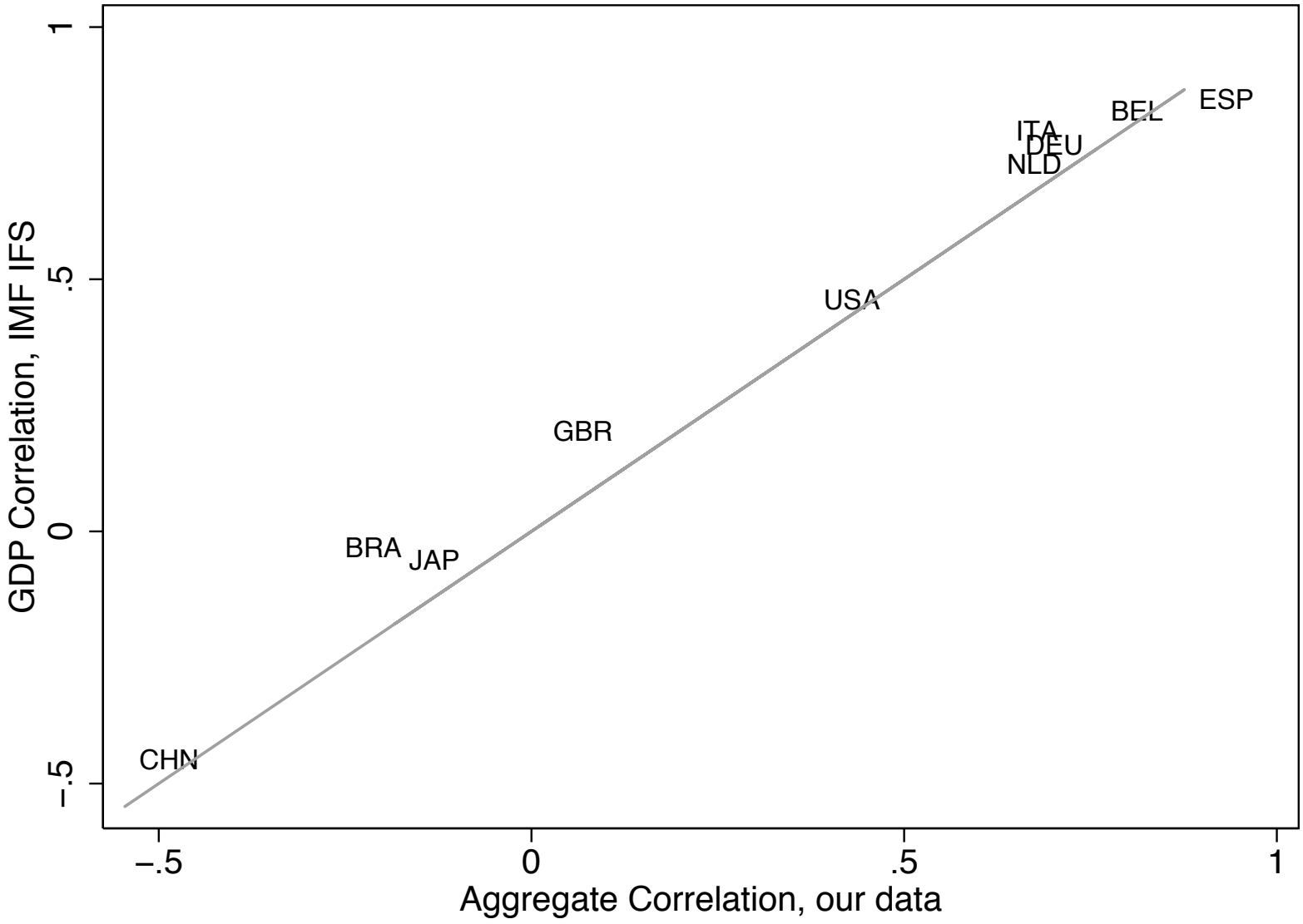
Related Literature

- IRBC and International Comovements
  - Empirical: Frankel and Rose (1998), Imbs (2004), Clark and van Wincoop (2001), Kalemli-Ozcan et al. (2001), Morgan et al. (2004), Imbs (2006), Kalemli-Ozcan et al. (2013)...
  - Theory: BKK (1995), Burstein et al. (2008), Arkolakis and Ramanarayanan (2009), Ghironi and Melitz (2005), Alessandria and Choi (2007), Kose and Yi (2006), Johnson (2014)
- Literature on micro origins of macro fluctuations
  - Gabaix (2011), Acemoglu et al. (2012), di Giovanni and Levchenko (2012), Carvalho and Gabaix (2013), Carvalho and Grassi (2015), di Giovanni et al (2014), Atalay (2014)
- Business cycle comovement at the firm level
  - Kleinert, Martin, and Toubal (2015), Kurz and Senses (2015), Cravino and Levchenko (2016), Boehm, Flaaen, and Pandalai-Nayar (2015)

Data Description

- Merge three large datasets:
  - Fiscal administration: firm tax forms from FICUS/FARE: value added, sales
  - Customs: partner-country exports and imports
  - *Liaisons Financieres* Database: multinational ownership
- Study comovement with 10 of France's largest trading partners over 1993–2007
  - Replace Switzerland with Brazil to include another major non-European trading partner

Bilateral Correlations: Our Data vs. Standard Sources



Summary Statistics for Whole Economy

	No. firms	Value Added		
		Mean	Median	Share in total
All Firms	998,531	1,165	211	1.00
Importers	189,863	3,516	515	0.72
Exporters	200,775	3,219	477	0.71
Affiliates of foreign multinationals	30,654	7,061	1,335	0.25
Firms with foreign affiliates	1,786	65,829	2,279	0.14

Notes: valued added is reported in thousands of euros. Importers/exporters account for 93% of manufacturing value added.

Connectedness By Country

Country	Directly Connected			Not Directly Connected		
	No. firms	Combined share	Mean $\rho(\gamma_{ft}, \gamma_{\mathcal{C}t})$	No. firms	Combined share	Mean $\rho(\gamma_{ft}, \gamma_{\mathcal{C}t})$
Belgium	113,472	0.626	0.047	853,812	0.374	0.007
Brazil	19,962	0.385	-0.013	947,322	0.615	-0.035
China	46,930	0.489	-0.064	920,354	0.511	-0.066
Germany	108,657	0.627	0.039	858,627	0.373	-0.006
Italy	105,522	0.607	0.065	861,762	0.393	0.027
Japan	39,500	0.478	-0.042	927,784	0.522	-0.059
Netherlands	82,369	0.590	0.065	884,915	0.410	0.013
Spain	93,180	0.586	0.029	874,104	0.414	0.001
United Kingdom	84,373	0.604	0.046	882,911	0.396	0.021
United States	80,826	0.604	0.063	886,458	0.396	0.044
Average	77,479	0.560	0.024	889,805	0.440	-0.005

"Conceptual Framework"

- Correlation between France and country $\mathcal{C}$:

$$\rho\left(\gamma_{Ft}, \gamma_{\mathcal{C}t}\right) = \frac{\text{Cov}\left(\gamma_{Ft}, \gamma_{\mathcal{C}t}\right)}{\sigma_F \sigma_{\mathcal{C}}} \tag{1}$$

- Aggregate growth rate:

$$\gamma_{Ft} = \sum_f w_{ft-1} \gamma_{ft} \tag{2}$$

Focus on the intensive margin (88% of aggregate comovements) ▸ Extensive Margin

- Plugging (2) into (1), aggregate correlation can be written as:

$$\rho\left(\gamma_{Ft}, \gamma_{\mathcal{C}t}\right) = \sum_f w_{ft-1} \frac{\sigma_f}{\sigma_F} \rho\left(\gamma_{ft}, \gamma_{\mathcal{C}t}\right) \tag{3}$$

Micro Evidence I

- Estimation equation

$$\rho\left(\gamma_{ft}, \gamma_{\mathcal{C}t}\right) = \beta \mathbf{DIRECT}_{f,\mathcal{C}} + \delta_f + \delta_{\mathcal{C}} + \eta_{f,\mathcal{C}}$$

where

$$\mathbf{DIRECT}_{f,\mathcal{C}} = [EX_{f,\mathcal{C}} \quad IM_{f,\mathcal{C}} \quad AFF_{f,\mathcal{C}} \quad HQ_{f,\mathcal{C}}]$$

- Refine the interpretation of macro results
  - β Comovements through the transmission of shocks (Frankel and Rose, 1998)
  - $\delta_{\mathcal{C}}$ Connected countries are more similar, thus subject to common shocks (Imbs, 2004)
- (Augmented specification: Accounts for indirect international connections through IO linkages)

Main Estimation Results

	(1) Baseline	(2) Baseline	(3) Baseline	(4) Baseline	(5) Baseline	(6) Sales	(7) MFG
Dep. Var: $\rho(\gamma_{ft}, \gamma_{\mathcal{C}t})$							
Importer	0.029^a	0.025^a	0.013^a	0.013^a	0.012^a	0.018^a	0.011^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Exporter	0.035^a	0.020^a	0.005^a	0.005^a	0.006^a	0.011^a	0.005^a
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
French Multinational	0.023^b	0.021^b	0.009	0.009	0.009	0.017^c	0.002
	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.013)
Affiliate of a Foreign MNE	0.028^a	0.028^a	0.010^a	0.010^a	0.009^a	0.014^a	0.011^a
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Observations	8,363,760	8,363,760	8,363,760	8,363,440	8,363,750	8,928,330	1,234,760
Adjusted R^2	0.001	0.281	0.287	0.288	0.289	0.285	0.285
Firm FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	No	No	Yes	Yes
Country×Region FE	No	No	No	Yes	No	No	No
Country×Sector FE	No	No	No	No	Yes	No	No
# of Xing links	403,180	403,180	403,180	403,092	403,180	418,915	202,454
# of Ming links	573,347	573,347	573,347	573,222	573,347	593,338	216,471
# of Affiliates	25,385	25,385	25,385	25,382	25,385	27,786	7,115
# of HQ links	3,046	3,046	3,046	3,043	3,046	3,626	815
# of Firm FEs		836,376	836,376	836,344	836,375	892,833	123,476
# of Country FEs			10			10	10
# of Country×Region FEs				960			
# of Country×Sector FEs					1,090		

- (Somewhat weaker) evidence of a positive impact of indirect connections

From Micro to Macro

1. Contribution of directly connected firms

$$\rho\left(\gamma_{At}, \gamma_{Ct}\right) = \frac{\sigma_{I_C}}{\sigma_A}\rho\left(\sum_{f \in I_C} w_{ft-1}\gamma_{ft}, \gamma_{Ct}\right) + \frac{\sigma_{I_C^c}}{\sigma_A}\rho\left(\sum_{f \in I_C^c} w_{ft-1}\gamma_{ft}, \gamma_{Ct}\right)$$

Aggregate Contribution of Directly Connected Firms

Country	Average ρ_A (observed)	Direct component	Indirect component
Belgium	0.758	0.519	0.239
Brazil	-0.269	-0.191	-0.078
China	-0.545	-0.370	-0.175
Germany	0.643	0.396	0.247
Italy	0.630	0.399	0.232
Japan	-0.183	-0.163	-0.021
Netherlands	0.618	0.425	0.193
Spain	0.876	0.543	0.332
United Kingdom	0.010	0.078	-0.069
United States	0.372	0.317	0.055
Average	0.291	0.195	0.096
NB: Manufacturing			
Average	0.484	0.408	0.076

From Micro to Macro

1. Contribution of directly connected firms

$$\rho\left(\gamma_{At},\gamma_{\mathcal{C}t}\right)=\frac{\sigma_{I_{\mathcal{C}}}}{\sigma_A}\rho\left(\sum_{f\in I_{\mathcal{C}}}w_{ft-1}\gamma_{ft},\gamma_{\mathcal{C}t}\right)+\frac{\sigma_{I_{\mathcal{C}}^c}}{\sigma_A}\rho\left(\sum_{f\in I_{\mathcal{C}}^c}w_{ft-1}\gamma_{ft},\gamma_{\mathcal{C}t}\right)$$

2. Change in the aggregate correlation

$$\widehat{\Delta\rho}\left(\gamma_{At},\gamma_{\mathcal{C}t}\right)=\sum_f w_{ft-1}\frac{\sigma_f}{\sigma_A}\widehat{\Delta\rho}\left(\gamma_{ft},\gamma_{\mathcal{C}t}\right)$$

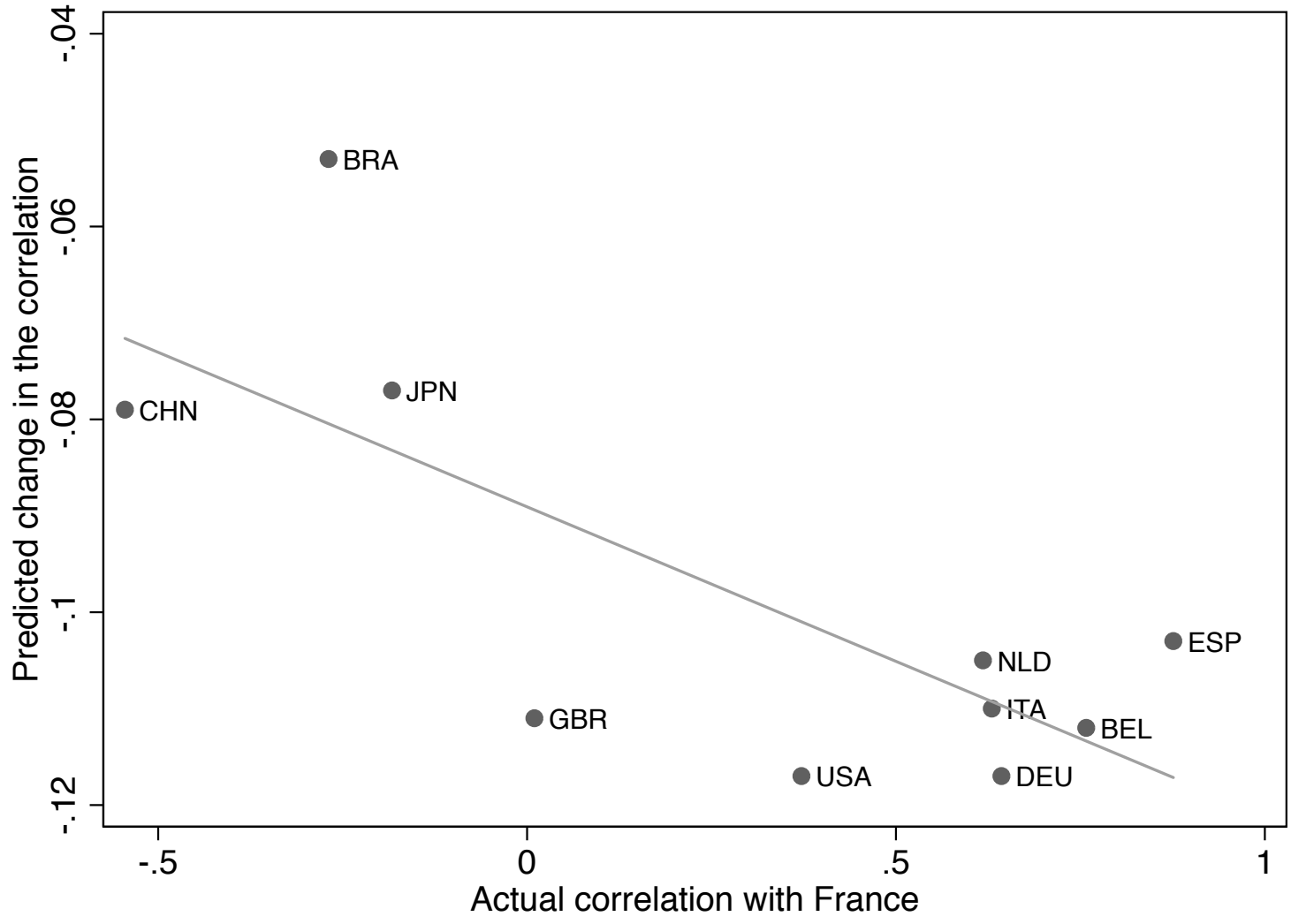
with

$$\begin{aligned}\widehat{\Delta\rho}\left(\gamma_{ft},\gamma_{\mathcal{C}t}\right) &= -\widehat{\beta}_1\mathbb{1}\left(EX_{f,\mathcal{C}}=1\right)-\widehat{\beta}_2\mathbb{1}\left(IM_{f,\mathcal{C}}=1\right)\\ &\quad -\widehat{\beta}_3\mathbb{1}\left(AFF_{f,\mathcal{C}}=1\right)-\widehat{\beta}_4\mathbb{1}\left(HQ_{f,\mathcal{C}}=1\right)\end{aligned}$$

Aggregate Effects of Closing the Economy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Total Change		Sever Trade		Sever MNEs		Equal Weights	
Country	ρ_A	$\Delta\rho_A$	$s.e.(\Delta\rho_A)$	$\Delta\rho_A$	$s.e.(\Delta\rho_A)$	$\Delta\rho_A$	$s.e.(\Delta\rho_A)$	$\Delta\rho_A$	$s.e.(\Delta\rho_A)$
Belgium	0.758	-0.112	0.016	-0.105	0.010	-0.007	0.013	-0.035	0.002
Brazil	-0.269	-0.053	0.011	-0.049	0.006	-0.004	0.009	-0.005	0.000
China	-0.545	-0.079	0.015	-0.075	0.007	-0.005	0.013	-0.014	0.001
Germany	0.643	-0.117	0.019	-0.106	0.010	-0.011	0.016	-0.035	0.002
Italy	0.630	-0.110	0.019	-0.101	0.010	-0.009	0.016	-0.033	0.002
Japan	-0.183	-0.077	0.011	-0.073	0.008	-0.004	0.009	-0.011	0.001
Netherlands	0.618	-0.105	0.014	-0.095	0.009	-0.010	0.011	-0.025	0.002
Spain	0.876	-0.103	0.019	-0.095	0.009	-0.008	0.017	-0.028	0.002
United Kingdom	0.010	-0.111	0.019	-0.099	0.009	-0.012	0.016	-0.027	0.002
United States	0.372	-0.117	0.019	-0.101	0.010	-0.016	0.016	-0.025	0.002
Average	0.291	-0.098		-0.090		-0.009		-0.024	
NB: Manufacturing									
Average	0.484	-0.103		-0.099		-0.004		-0.040	

Aggregate Effects of Closing the Economy



Zooming in: the top 100 Firms

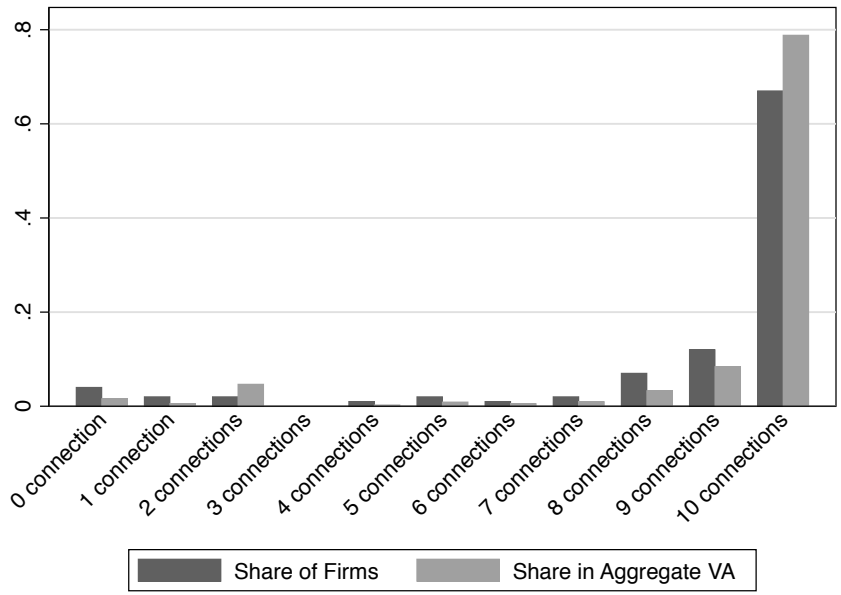
Share of the top 100 in aggregate:	
Value added	0.219
Exports	0.220
Imports	0.183
Value added of foreign MNEs' affiliates	0.152
Value added of firms with foreign affiliates	0.828

The Importance of the Directly Connected Firms

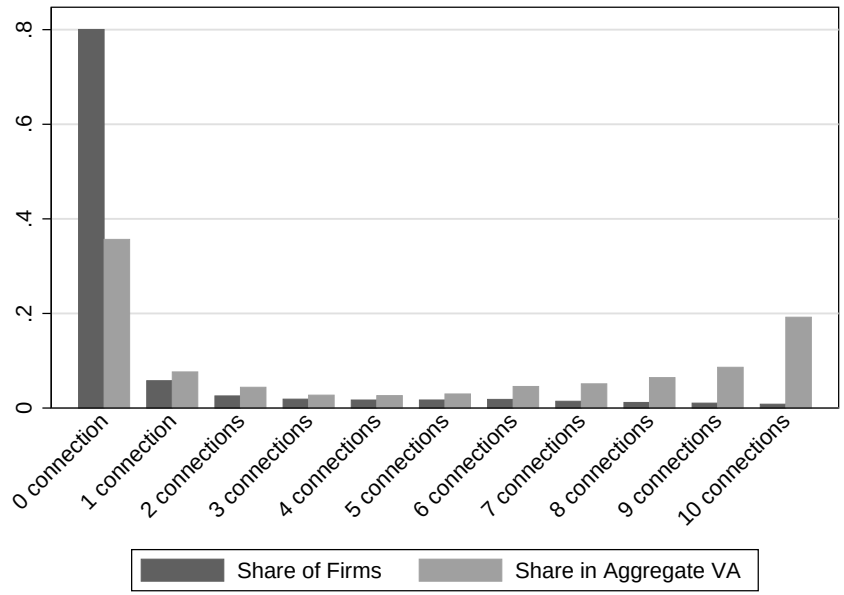
	Top 100		Non-Top 100	
Country	Directly connected	Not directly connected	Directly connected	Not directly connected
Belgium	0.915	0.085	0.544	0.456
Brazil	0.780	0.220	0.272	0.728
China	0.901	0.099	0.372	0.628
Germany	0.915	0.085	0.545	0.455
Italy	0.918	0.082	0.519	0.481
Japan	0.904	0.096	0.357	0.643
Netherlands	0.912	0.088	0.498	0.502
Spain	0.898	0.102	0.498	0.502
United Kingdom	0.933	0.067	0.511	0.489
United States	0.967	0.033	0.501	0.499
Average	0.904	0.096	0.4617	0.538

Numbers of Markets Served

Top 100



Not Top 100



- Contribute significantly to aggregate comovements
- Create a "common component" between many of France's partners

Conclusion

- Comovement from micro to macro
- At the micro level, firms that are linked to a foreign country comove more with that country
- At the macro level, they are important in the aggregate French economy
- Potential for a substantial aggregate effect
- Aggregate effect is even stronger if indirect connections through IO are taken into account
- Still don't understand: general equilibrium effects; types of shocks being transmitted...

Intensive and Extensive Margins

$$\tilde{\gamma}_{At} \approx \ln \sum_{f \in I_t} x_{ft} - \ln \sum_{f \in I_{t-1}} x_{ft-1}$$

$$= \ln \frac{\sum_{f \in I_{t/t-1}} x_{ft}}{\sum_{f \in I_{t/t-1}} x_{ft-1}} - \left(\ln \frac{\sum_{f \in I_{t/t-1}} x_{ft}}{\sum_{f \in I_t} x_{ft}} - \ln \frac{\sum_{f \in I_{t/t-1}} x_{ft-1}}{\sum_{f \in I_{t-1}} x_{ft-1}} \right)$$

$$= \underbrace{\gamma_{At}}_{\textit{Intensive margin}} - \underbrace{\ln \frac{\pi_{t,t}}{\pi_{t,t-1}}}_{\textit{Extensive margin}}$$

Focus mostly on the intensive margin ◂ Back to framework

Correlation Decomposition: Intensive and Extensive Margins

Using:

$$\tilde{\gamma}_{At} = \gamma_{At} - \ln \frac{\pi_{t,t}}{\pi_{t,t-1}}$$

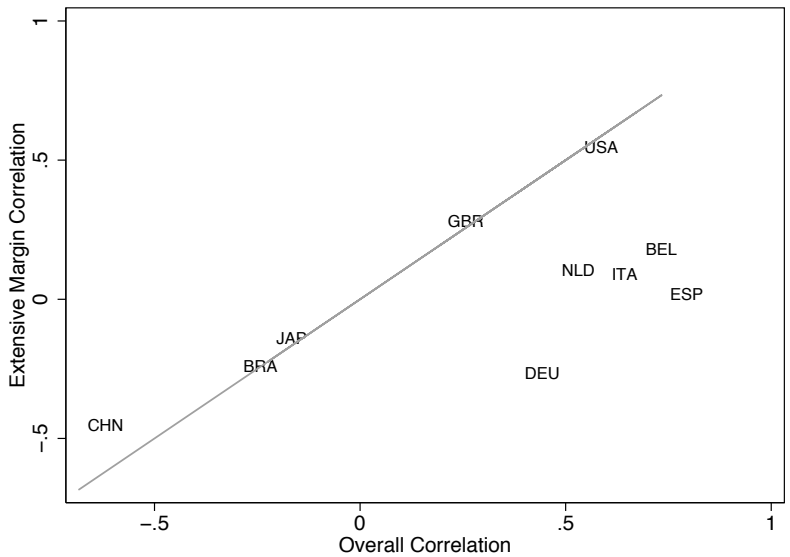
it comes:

$$\rho\left(\tilde{\gamma}_{At}, \gamma_{Ct}\right) = \frac{\sigma_A}{\tilde{\sigma}_A}\rho\left(\gamma_{At}, \gamma_{Ct}\right) + \frac{\sigma_\pi}{\tilde{\sigma}_A}\rho\left(\ln \frac{\pi_{t,t}}{\pi_{t,t-1}}, \gamma_{Ct}\right)$$

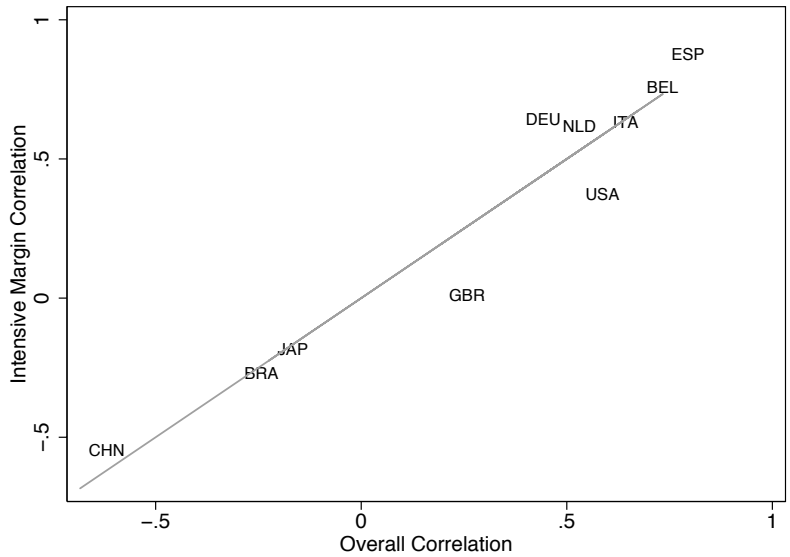
◂ Back to framework

Bilateral Correlations: Extensive and Intensive Margins

Extensive



Intensive



On average, intensive component accounts for 88% of aggregate comovement ◂ Back to framework