Shaping the World Economy in the Age of Global Value Chains

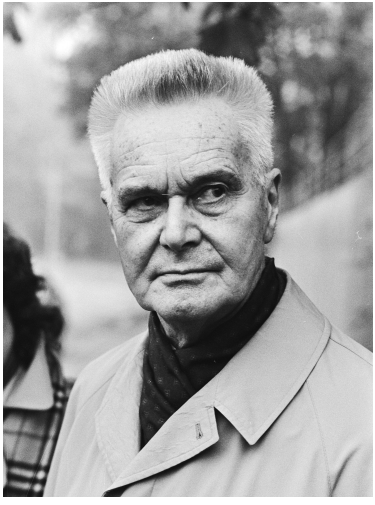
Pol Antràs (Harvard University)

Tinbergen Lecture

2024 Royal Dutch Economic Association's Nederlandse Economendag

October 25, 2024

Tinbergen and International Trade



- Tinbergen wrote extensively about the global economy
  - embraced neoclassical theories of trade
  - but also showed concern about consequences of trade for inequality and for national security
- Perhaps most famously, in 1962, he was the first economist to run a **gravity equation** for trade flows

264 *Appendix VI*

The trade flow equation can be written, in its simplest form, as follows:

$$E_{ij} = a_0 Y_i^{a_1} Y_j^{a_2} D_{ij}^{a_3} \quad (1)$$

Shaping the World Economy: Suggestions for an International Economic Policy (1962)

Road Map

1. Broad Introduction to Global Value Chains
2. Brief Overview of Recent Work: Challenges and Solutions
3. Some Avenues for Future Work
4. Thoughts on policies *shaping the world economy* in the age of GVCs ('Deglobalization')

WARNING: Some of the material relates to technical matters... but I will only cover it at a high level

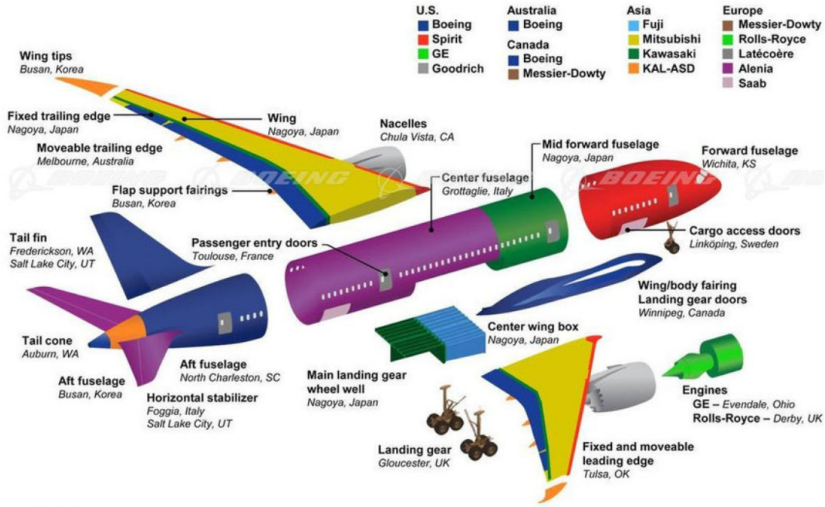
Background

- Humans have traded at long distances since time immemorial (see Barjamovic et al., QJE, 2019)
- At a broad level, we understand why since (at least) 1817
- But modern workhorse models in the trade field abstract from salient features of the modern world economy
- Since (roughly) the early 1980s, a combination of forces (technology, policy, politics) led to a fast globalization of production processes across borders

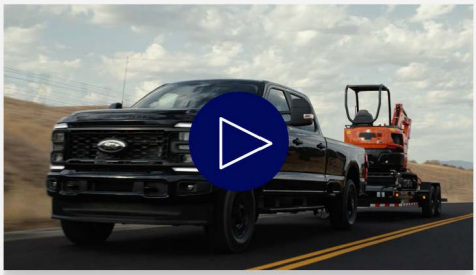
Global Value Chains: Spiders and Snakes

A Spider

A Spider: Boeing's Dreamliner



A Web of Spiders: Ford



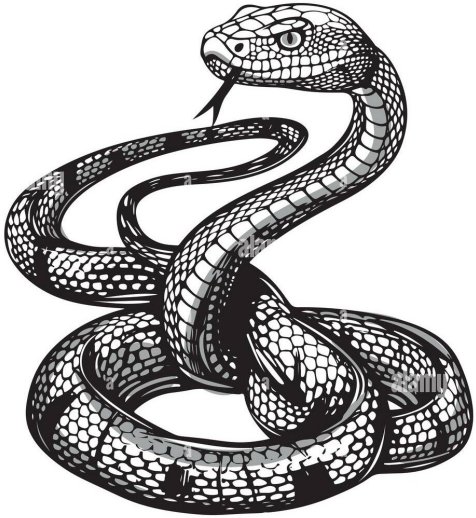
100% COMMITTED TO BEING 100% ASSEMBLED IN AMERICA*

Ford F-Series® are 100% assembled in America, including in states like Michigan, Kentucky and Ohio.

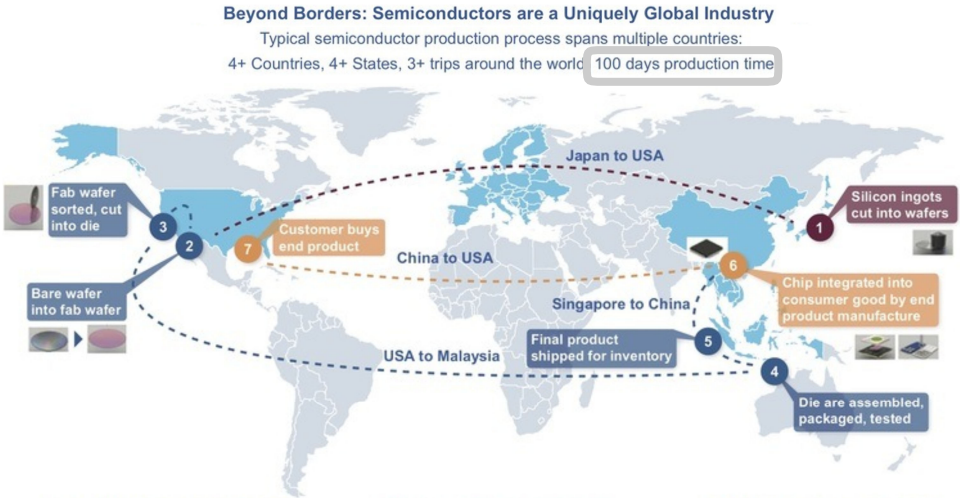
*Of foreign and domestic parts

- Only about 55% of the value of F-150s is US value added
- Only about 40% of Ford vehicles are assembled in the US

A Snake



A Snake: Manufacturing of Semiconductors



A Hybrid ("Sniker"): Ford Fiesta

Taking Stock

A New Perspective on International Trade Flows

- It's not wine for cloth anymore
- More and more, what we observe in Customs forms are slices of global value chains
- Can we treat these slices as independently determined from other related slices?
  - Ratio of Dreamliner wings (Nagoya, Japan) to wing tips (Busan, Korea) must be one!
- This is not just about general equilibrium or industry equilibrium interdependencies!

Very Active Area of Research

(see my 2022 Handbook Chapter with Davin Chor)

- Much progress on the empirical front (but still significant challenges/limitations)
  - Macro measurement: Input-Output analysis (kudos to the good folks in Groningen!)
  - Micro measurement: Firm-level studies
- Some progress on the theoretical front (but still significant challenges/limitations)
  - Macro modeling: Roundabout models; Input-Output analysis
  - Micro modeling: Firm-Level analysis
- Policy analysis still in its infancy

Unifying Themes of **My** Recent Work on GVCs

- I have largely focused on firm-level studies in line with the 21th century trade literature
  - Aggregate trade flows = sum of trade decisions by heterogeneous producers
  - Seminal work of Melitz (2003) on exporting
- But firm 'location' strategies are much more complex when firms can export, but they can also import and set up offshore production plants (GVCs)
- Furthermore, there are other distinctive features of GVCs
  - prevalence of input trade; customization; search and matching frictions; imperfect contracting
- **Key Question:** What novel lessons can be learn from analyzing, estimating and quantifying multi-country models of GVCs?

Some Recent Work of Mine

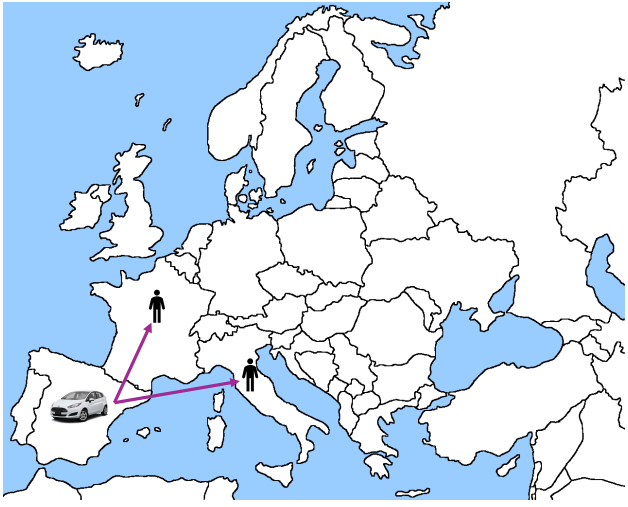
- Spiders: Antràs, Fort and Tintelnot or AFT (AER, 2017)
- Snakes: Antràs and de Gortari or AdG (ECMA, 2020)
- "Snikers": Antràs, Fadeev, Fort and Tintelnot or AFFT (REStat, 2024)
- Trade Policy: Antràs, Fort, Gutiérrez and Tintelnot or AFGT (JPE:Macro, 2024)
- Role of Production Length and Interest Rates: Antràs (WP, 2023)

Theoretical Challenges And Some Progress

Theoretical Challenges (I): Global Sourcing

- In canonical models of exporting (Melitz' 03), firms feature constant marginal costs
  - Easy to handle various margins of trade and easy to aggregate analytically
  - Each firm makes J simple $\{0, 1\}$ decisions, where J are potential export markets

Firm-Level Exporting



Firm-Level Exporting According to ChatGPT

ChatGPT 4o

Share

Could you please help come up with a graph that illustrates how a firm from Spain exports to France and Italy? Maybe you could supersede it in a map of Europe, with arrows going from the firm in Spain to France and Italy.

Here is the map of Europe showing Spain, France, and Italy, with arrows representing export routes from a firm in Spain to both France and Italy. Let me know if you'd like any adjustments!

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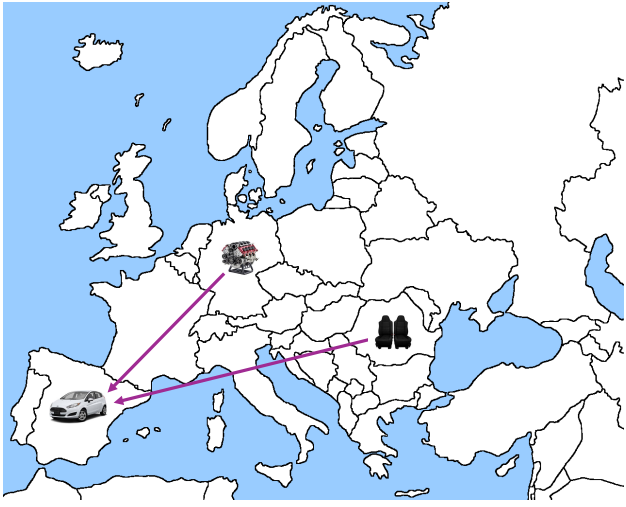
- But global sourcing (i.e., importing) naturally affects the marginal cost of the firm!

Firm-Level Global Sourcing



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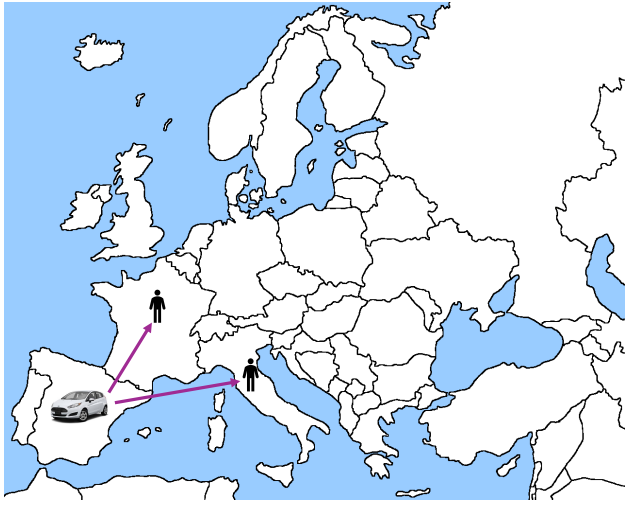
- In canonical models of exporting (Melitz' 03), firms feature constant marginal costs
  - Easy to handle various margins of trade and easy to aggregate analytically
  - Each firm makes J simple $\{0, 1\}$ decisions, where J are potential export markets
- But global sourcing (i.e., importing) naturally affects the marginal cost of the firm!
- Import entry decisions are thus interdependent across markets
  - Global sourcing strategy is the solution of a combinatorial optimization problem with dimensionality 2^J
- Interdependencies across markets also complicate firm's intensive margin decisions

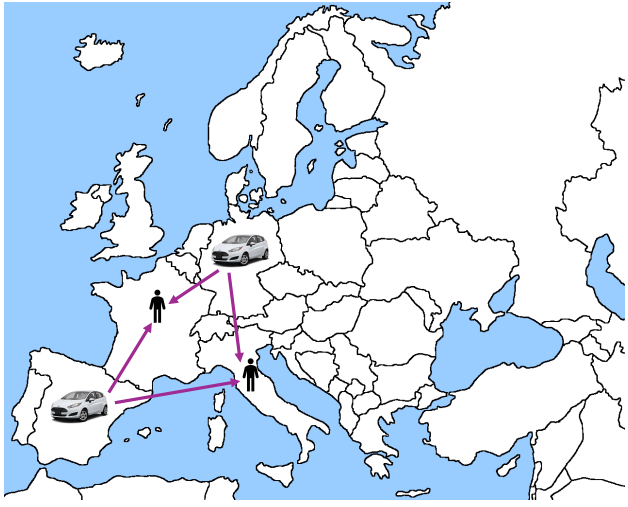
Theoretical Challenges (II): Export-Platform FDI

- Even shutting down global sourcing, when firms choose a global assembly strategy (e.g., Ford), location decisions become complex
- Two sources of interdependencies
  - Cannibalization effects (entry decisions are substitutes)
  - **Firm-level** rather than plant-level export strategies (entry decisions are complements)
- Regardless, assembly and export strategies are now combinatorial optimization problems each of dimensionality 2^J

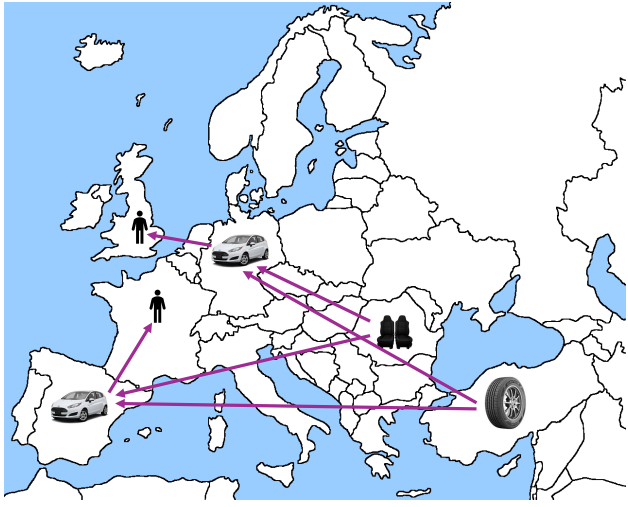
Firm-Level Export-Platform FDI: Cannibalization



Firm-Level Export-Platform FDI: Cannibalization



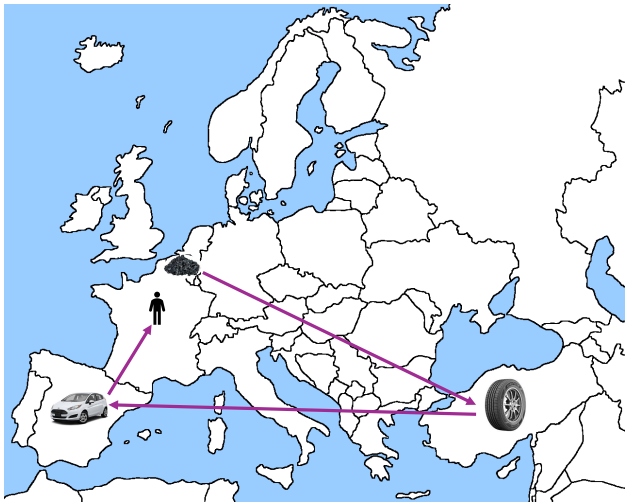
Firm-Level Export-Platform FDI: Complementarity



Theoretical Challenges (III): Sequential GVCs

- Consider optimal location of production for the different stages in a sequential GVC
- Without trade frictions $\approx$ standard multi-country global sourcing model
- With trade costs, matters become trickier
- Location of a stage takes into account upstream and downstream locations
  - Where is the good coming from? Where is it going to?
  - Need to solve jointly for the optimal path of production
- Even under constant returns to scale, firms face a J^N combinatorial problem for each destination of consumption

Firm-Level Sequential GVCs



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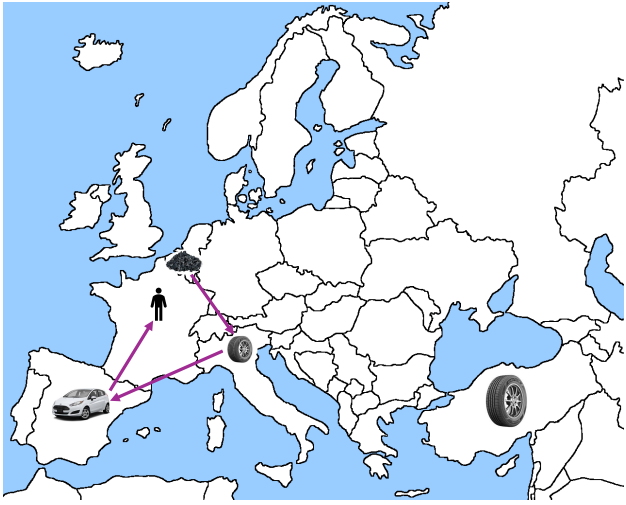


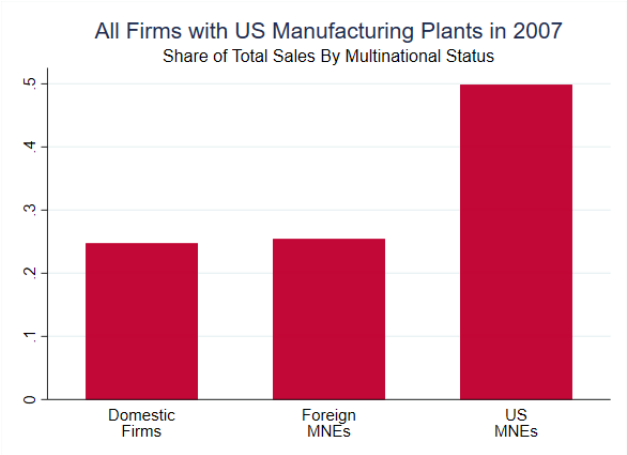
How to Tackle these Problems: Some Progress

- Under 'standard' assumptions, global sourcing and global assembly entry decisions are either complements or substitutes
  - Spiders: can apply monotone comparative static techniques to characterize solution and devise iterative algorithms for estimation (see AFT, 2017)
  - 'Snikers': same is true if both global sourcing and global assembly strategies are complements (see AFFT, 2023)
  - Other approaches: linear programming à la Koopmans, machine learning
- Path problem in sequential GVCs with CRS can be solved via dynamic programming
  - can characterize effects of trade costs and estimate models of 'snakes' (see AdG, 2020)
- Once the entry decision is solved, discrete-choice modeling techniques (Eaton and Kortum, 2002) can be invoked to characterize the intensive margin decisions of firms
- Finally, straightforward to aggregate firm-level decisions for macro counterfactuals

Some Theoretical Lessons

- Initial core productivity differences get magnified by endogenous global production choices

Multinational Enterprises (MNEs) Dominate Aggregate Activity



- Only 1,550 out of 246,000 firms with US manufacturing are US multinationals
  - but they account for 50% of US manufacturing sales, and foreign MNEs another 25%

MNEs Dominate Trade by US Manufacturers

	Panel A: Import Statistics				Panel B: Export Statistics			
	Share of Aggregate		No. of Countries		Share of Aggregate		No. of Countries	
Firm Type	Importers	Imports	Avg	Median	Exporters	Exports	Avg	Median
Domestic	0.48	0.17	4	3	0.52	0.18	8	4
Foreign MNEs	0.03	0.40	12	8	0.03	0.27	19	10
US MNEs	0.02	0.43	21	17	0.02	0.54	40	35

Panel A presents the share of US importers and import value, and the average and median number of countries from which firms import by firm type. Panel B presents comparable statistics for US exports. Sample is all firms with US manufacturing plants that import from 2+ countries (left panel) or export to 2+ countries (right panel).

- MNEs account for 83% of US imports and 82% of exports by US manufacturers

Some Theoretical Lessons

- Initial core productivity differences get magnified by endogenous global production choices
- Import competition shocks (e.g., the China shock) applying to inputs operate very differently than when applying to final goods
  - Negative aggregate manufacturing employment effects mask heterogeneous effects

A China Shock with Global Sourcing (AFT, 2017)

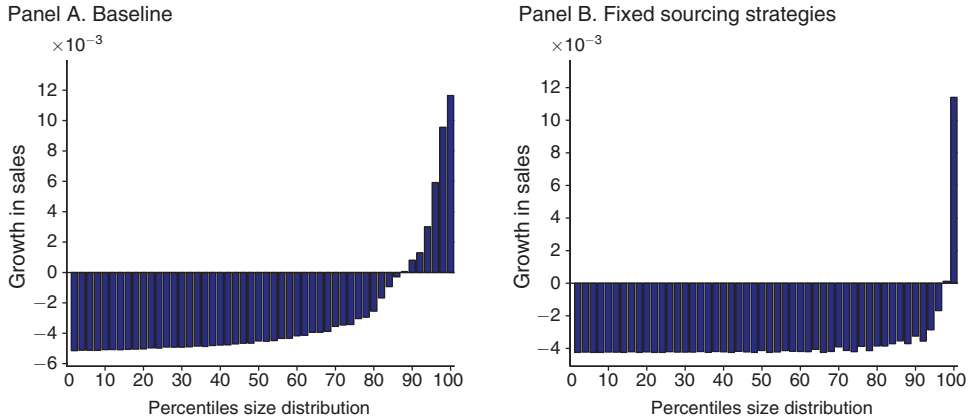
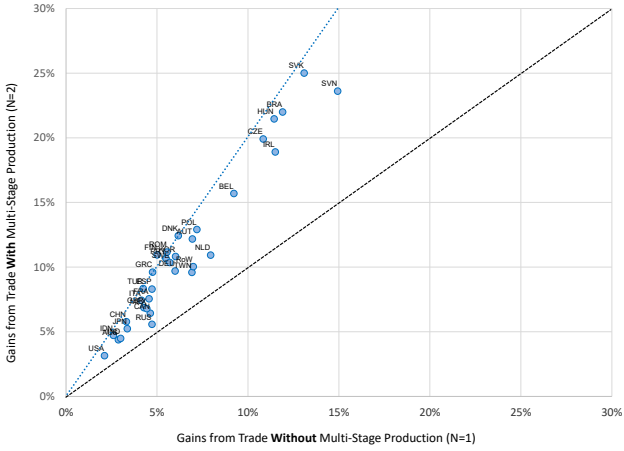


FIGURE 5. CHANGES IN THE SIZE OF FIRMS

Some Theoretical Lessons

- Initial core productivity differences get magnified by endogenous global production choices
- Import competition shocks (e.g., the China shock) applying to inputs operate very differently than when applying to final goods
  - Negative aggregate manufacturing employment effects mask heterogeneous effects
- Aggregate gains from trade (and negative real income implications of trade wars) are significantly higher in a world with GVCs than in traditional models
  - Autarky means giving up on use of any foreign value added (not just foreign consumer goods)

Gains from Trade are 60% Larger with Two Stages than with One Stage



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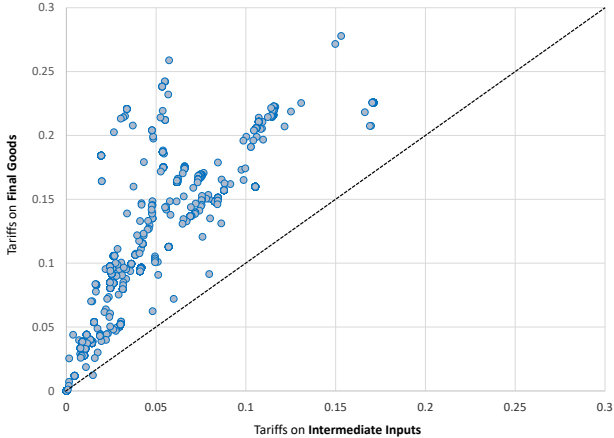
  - Autarky means giving up on use of any foreign value added (not just foreign consumer goods)
- Import tariffs on intermediate inputs are less desirable than on final goods (rationale for observed tariff escalation) - see AFGT (2024)
  - Note: increasing returns to scale are essential for this result ($\neq$ Diamond-Mirrlees)

Tariff Escalation



Source: Simple averages of country-pair tariffs by UN-BEC good types for the year 2007 from Shapiro (2020)

Empirical Challenges And Some Progress

How Do We Measure Global Value Chains?

Macro Approaches

- Challenge: International trade flow data is recorded on a gross output (sales) basis
- Solution: Construction of World Input Output Tables (e.g., WIOD project)
  - combines International Trade Statistics + Input-Output Tables + Assumptions

Structure of the World-Input Output Database

			Use by country-industries							Final use by countries			Total use
			Country 1			…	Country M			Country 1	…	Country M	
			Industry 1	…	Industry N	…	Industry 1	…	Industry N		…		
Supply from country-industries	Country 1	Industry 1											
		…											
		Industry N											
	……												
	Country M	Industry 1											
		…											
		Industry N											
Value added by labour and capital													
Gross output													

Figure 1. Schematic Outline of a World Input–Output Table (WIOT)

Figure: Timmer et al. (2015)

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Firm-Level Approaches

- Challenge: typically have firm-level information in only one country (Census + Customs)
- Solution #1: work with what we have and focus on segments of GVCs
- Solution #2: merge datasets (but still at a very primitive stage)

Example of Solution #1: Antràs, Fort and Tintelnot (AER, 2017)

Focus on Data from the US

- 2007 data from the U.S. Census Bureau
  - Economic Censuses
  - Import transactions data
- Sample is all manufacturing firms (around 250,000 firms)
  - Include firms with non-manufacturing activity
  - 23% of employment and 38% of sales
  - 65% of (non-mining) imports
  - A quarter of these firms imports
- Structural Estimation
  - Limit analysis to countries with 200+ U.S. importers
  - 66 countries and the U.S.

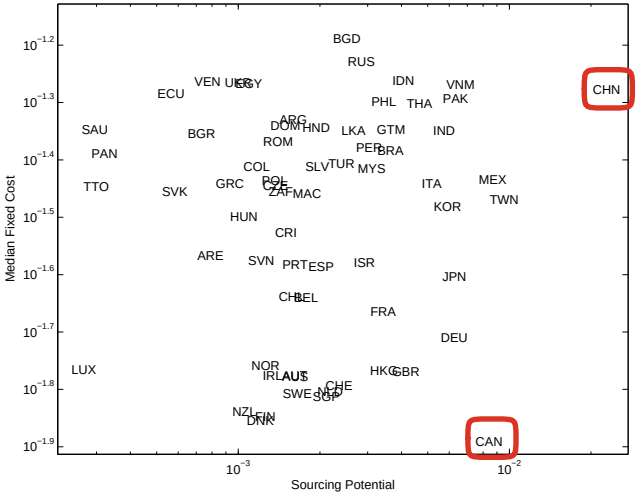
Some Firm-level Import Statistics

- Number of imported products (HS10) per source country and number of source countries per imported product

	Products Per Country			Countries Per Product		
	Firm-level			Firm-level		
	Mean	Median	Max	Mean	Median	Max
Mean	2.78	2.18	7.21	1.11	1.00	1.61
Median	2.00	2.00	2.00	1.03	1.00	1.00
95%tile	8.23	5.00	25.00	1.78	1.00	4.00

- How diversified were sourcing strategies in 2007? Not much!
- But some large importers are quite diversified (Chung, Harvard PhD thesis 2017)

Structural Estimation: Sourcing Potential vs. Fixed Cost Estimates



Example of Solution #2: Antràs, Fadeev, Fort and Tintelnot (2024)

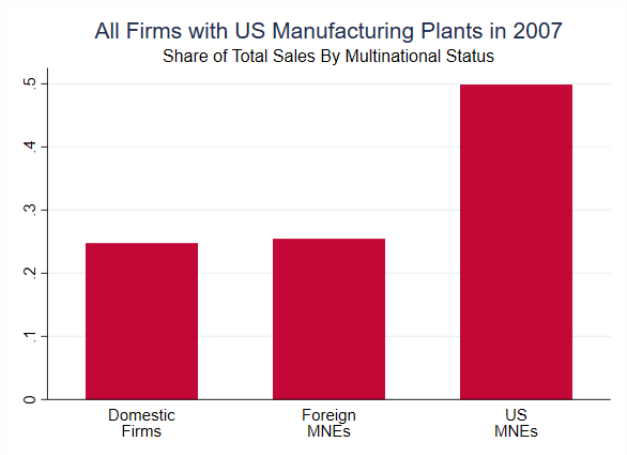
Newly Linked 2007 US Census-BEA Data

- Data from the US Census Bureau
  - Longitudinal Business Database: universe of private, non-farm employer establishments
  - All Economic Censuses: establishment sales
  - Longitudinal Foreign Trade Transactions: imports and exports (we exclude oil)
  - Company Organization Survey (COS): firm ownership information
- Bureau of Economic Analysis data on foreign direct investment
  - BEA US Direct Investment Abroad (outward FDI, BE-11)
  - BEA Foreign Direct Investment in the United States (inward FDI, BE-12)
- Combine data via EINs and name and address matching
  - Census generally maps more EINs and activity to a unique firm
  - Use COS to distinguish US versus majority-owned foreign firms

New Firm Definitions Using the Combined Data

- US MNE:
  - US firm with majority-owned foreign affiliates
  - We focus on firms with majority-owned foreign manufacturing affiliates (*FMAs*)
- Foreign MNE:
  - Majority-owned by a foreign firm
- We focus on firms with one or more manufacturing plants in the United States

Multinational Enterprises (MNEs) Dominate Aggregate Activity



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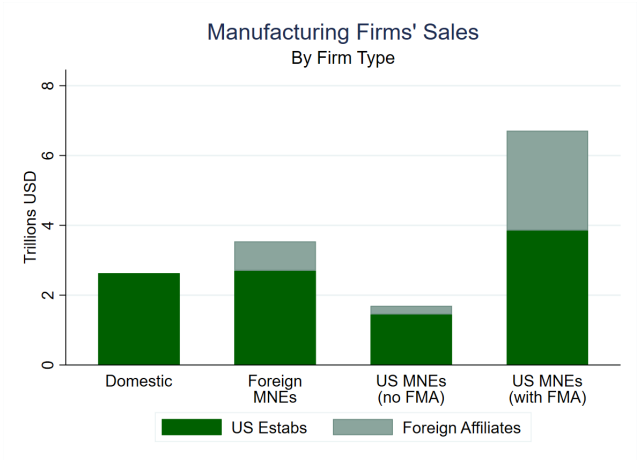
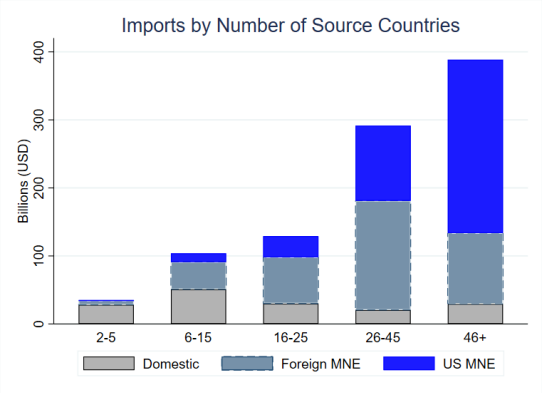
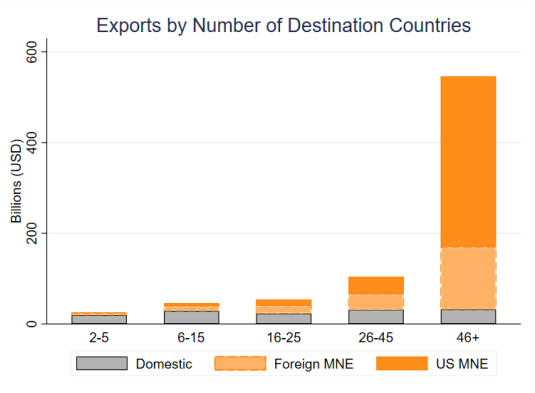
Total Sales by Firms with US Manufacturing Plants by Firm Type



- These FMAs produce almost as much abroad as their parents in the US
  - In fact, US MNEs' foreign affiliate sales are four times larger than their US exports

US Trade Flows by Traders' Extensive Margin of Countries

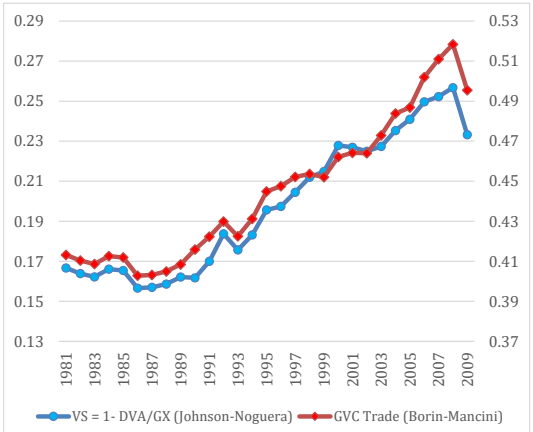




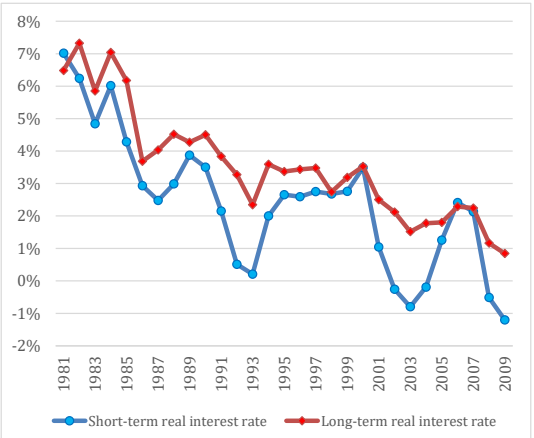
- MNEs have larger extensive and intensive margins of trade, even controlling for US size
- US MNEs more likely to import & export to countries in regions in which they have affiliates (rationale in AFFT, 2023)

Interest Rates and Global Value Chains: Antràs (2023)

Two Salient Trends in World Economy



Rising GVC Participation



Declining Real Interest Rates

The Paper in One Slide

- How do interest rates shape international specialization and GVCs?
- **'Austrian' perspective:** I develop a stylized model of sequential production with N goods/stages in which the time length of each good/stage is endogenously determined
- Letting the production process *mature* increases labor productivity, but it comes at the cost of higher working capital needs for firms
- Fragmenting production allows firms to better minimize costs, but it entails an additional time lag between production and final consumption

Summary

Summary

- Multinational firms are dominant players in domestic employment, output, and trade
- MNEs' input-sourcing, exporting, and global assembly decisions are interrelated
- This interdependence affects firms' responses to policy and other shocks
  - Joint sourcing, exporting, and assembly decisions are missing from most models
  - Potential to reverse standard and 'intuitive' predictions of effects of certain policies

Some Future Avenues for Research

- Current models of GVCs (generally) introduce scale economies too crudely
- Most overhead costs are sunk in nature
- Sunk costs are key for understanding the response of global economy to shocks (e.g., US-China trade war)
- Market structure model as monopolistic competition, but oligopolistic competition seems much more realistic in many sectors (ASML)
- Treat with caution counterfactual exercises based on quantitative models featuring CRS and industry-level I-O links

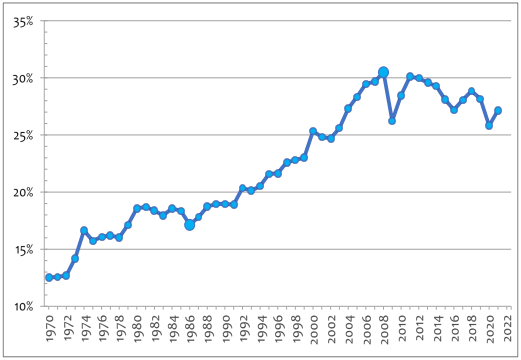
Thoughts on Policy and on Deglobalization

Some Thoughts on Policy and on Deglobalization

- The world economy does not (yet) appear to be de-globalizing (it 'slowbalized')

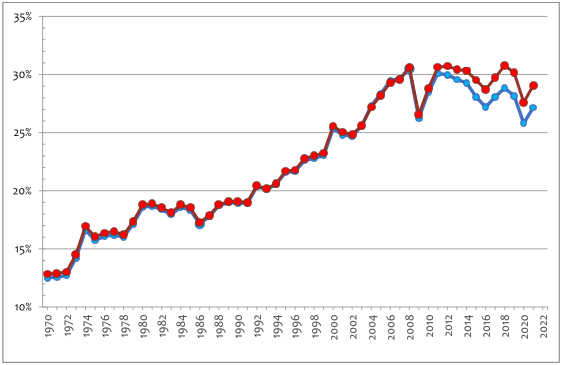
Slowbalization

Chart 1. World Trade over World GDP (1970-2021)



Source: World Bank's World Development Indicators (link)

Chart 1'. World Trade over World GDP (1970-2021) excluding China



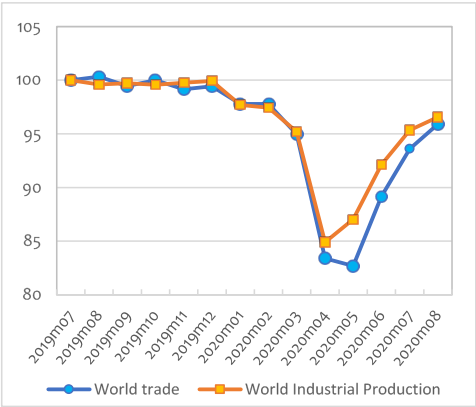
Source: World Bank's World Development Indicators (link)

Some Thoughts on Policy and on Deglobalization

- The world economy does not (yet) appear to be de-globalizing (it 'slowbalized')
- Global trade was remarkably resilient in the face of COVID

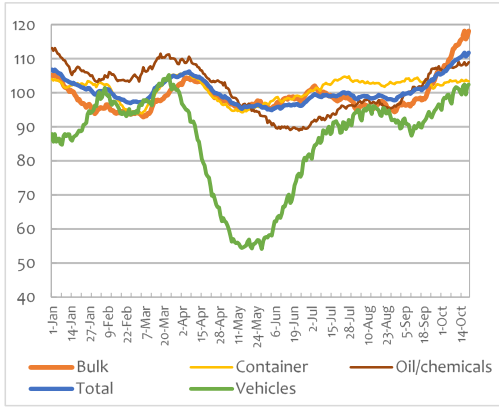
COVID and World Trade

Panel A. World Trade and World Industrial Production
(Index July 2019 = 100)



Source: CPB World Trade Monitor (link)

Panel B. Estimated Metric Tons of World Exports
(30-day moving average in ratio to 2017-19 average)



Source: Cerdeiro, Komaromi, Liu and Saeed (2020); AIS data collected by MarineTraffic (link)

Some Thoughts on Policy and on Deglobalization

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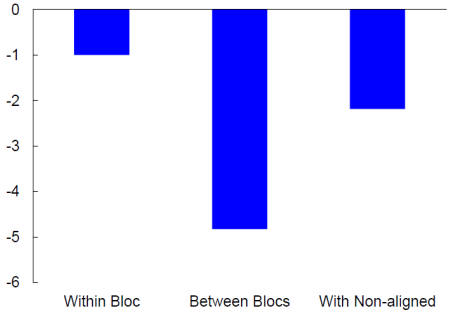
Geopolitics and World Trade

Geopolitical considerations are already affecting trade and investment

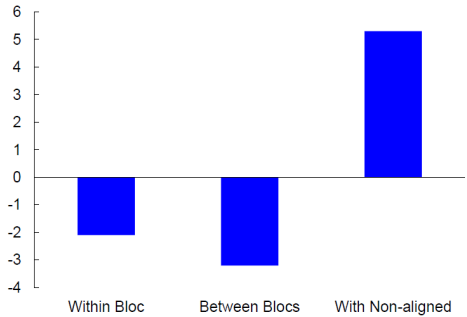
Change in trade growth post war

(percentage points)



Change in FDI shares post war

(percentage points)



Sources: fDi Markets; Trade Data Monitor; and IMF staff calculations.

Note: In the right chart, bilateral quarterly growth rates are computed as the difference in log bilateral trade, which are then aggregated using bilateral nominal trade as weights. The chart on the left plots the change in the number of FDI (measured as a share of the total number of FDI) between 2022Q2-2023Q2 and 2018Q1-2022Q1 within and between blocs and with non-aligned countries. In both charts, the hypothetical Western bloc includes US, Europe, Canada, Australia and New Zealand. The hypothetical Eastern bloc comprises Belarus, China, Mali, Nicaragua, Russia, and Syria. The rest of the countries are considered "Non-aligned."

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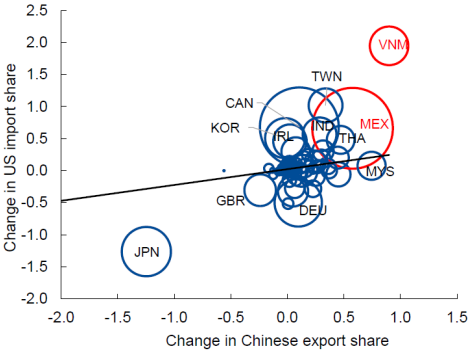
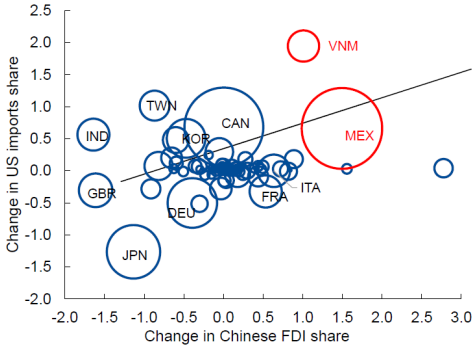
Geopolitics and World Trade

Countries gaining market share in US imports received more FDI and exports from China since 2017

Change in US import shares vs Chinese export shares
(percentage point)



Change in US import shares vs FDI from China
(percentage point)



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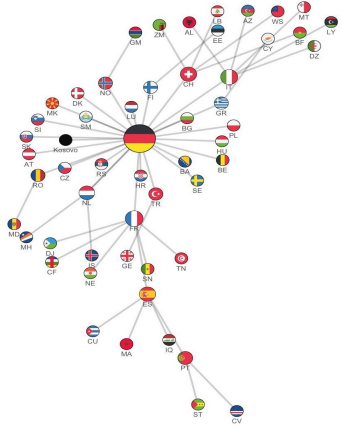
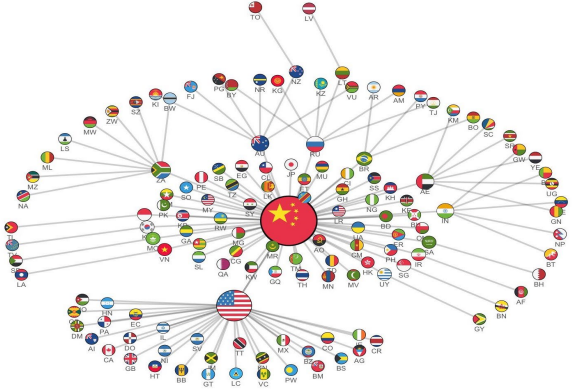
Countries connected to their primary trading partner in 2020

Exports + imports. Data: International Monetary Fund. Flags were not available for countries in black.





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- Diversification or increased resilience would be very costly
- Debt overhang and future interest rates

HARTELIJK DANK!