

Interdependence, Sectoral Linkages, and the Costs and Benefits of Negotiating Free-Trade Agreements

Shubhi Agarwal
University of Florida

Hamid Firooz
University of Rochester

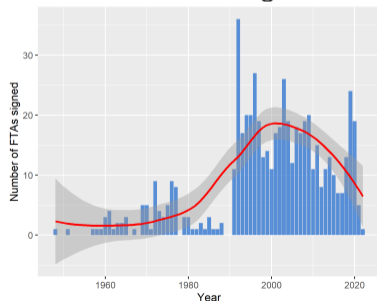
Gunnar Heins
University of Florida

EEA Meetings 2024
August 26, 2024

Introduction

- ▶ The last decades have seen a steep rise in regional free-trade agreements (FTAs)
- ▶ Controversial Trend:
 - ▶ Lower trade barriers between involved parties
 - ▶ But effectively weakening of the most-favored nation principle
 - ▶ Further: Only few signatories are low-income countries (< 13%)

Figure: Number of FTAs signed over time



Notes: The figure plots the total number of newly signed FTAs in each year. The shaded area refers to the smoothed values from a local polynomial regression.

Motivation

- ▶ What is the **main reason** for this trend?
 - ▶ Greater benefits of trade (e.g. due to lower transport costs) or FTAs?
 - ▶ Facilitated Negotiations?
 - ▶ More complex relationships between countries (networks, intermediate inputs)?
 - ▶ Complementarities between agreements?
- ▶ And: What are the **consequences** of being left out?
 - ▶ Do countries that already signed many FTAs still have incentives to sign FTAs with outsiders (e.g. developing countries)?

Motivation

- ▶ To answer these questions: Develop a **structural model** of negotiating trade agreements that accounts for
 - ▶ Benefits and welfare implications of FTAs
 - ▶ Cross-country and cross-sectoral linkages
 - ▶ Potential differences in the ease at which countries negotiate with each other
- ▶ **Main challenge:** Dimensionality of the problem
- ▶ Here: A country can sign an FTA with 43 other countries, resulting in about 9 quadrillion (2^{43}) country-pair combinations.

This Paper

- ▶ We quantify the costs and benefits of signing free-trade agreements
 - ▶ Gains from tariff reductions
 - ▶ Non-tariff related welfare gains
 - ▶ Cost of negotiating/maintaining an FTA
- ▶ Use a large-scale application of Caliendo and Parro (2015) to measure the impact of 60,000 factual and counterfactual FTAs
- ▶ Develop a quantitative model in which countries endogenously decide on signing FTAs
 - ▶ Overcome the dimensionality of the problem via a modified version of Jia (2008) & Arkolakis et al. (2021):
- ▶ Main Findings:
 1. Significant heterogeneity in the cost/ease of negotiating FTAs across country pairs
 2. Recent rise of FTAs driven by
 - ▶ Increasing importance of sectoral linkages
 - ▶ Complementarities in the ease of trade negotiations
 - ▶ Trend towards reductions in non-tariff barriers

Literature

- 1. Impact of tariffs and free-trade agreements:** Trefler (2004), Subramanian and Wei (2007) Caliendo and Parro (2015), De Loecker et al. (2016), Amiti et al. (2019), Fajgelbaum et al. (2020)
 - ▶ **Contribution:** Quantify the welfare consequences of all factual and about 60,000 counterfactual FTAs
- 2. Political Economy of trade and tariffs:** Venables (1987), Grossman and Helpman (1994), Bagwell and Staiger (1999), Broda, Limao, and Weinstein (2008), Bagwell and Staiger (2010), Ossa (2011, 2014)
 - ▶ **Contribution:** Focus on FTAs, introduce and estimate negotiation costs
- 3. Solution Methods for large discrete-choice problems:** Jia (2008), Antras, Fort, Tintelnot (2017), Morales, Sheu, Zahler (2019), Arkolakis, Eckert, Shi (2021), Liu (2023)
 - ▶ **Contribution:** Extend Jia (2008) to a setting in which a player's action can either increase or lower the marginal benefit of others' actions

QUANTITATIVE MODEL

The Quantitative Model

- ▶ N countries and J sectors
- ▶ **Preferences:** Households who consume C_n^j final goods from sector j obtain utility:

$$u(C_n) = \prod_{j=1}^J (C_n^j)^{\alpha_n^j}, \quad C_n^j = \left[\int (r_n^j(\omega^j))^{(\sigma^j-1)/\sigma^j} d\omega^j \right]^{\sigma^j/(\sigma^j-1)} \quad (1)$$

$r_n^j(\omega^j)$: Quantity of variety ω^j

- ▶ **Technology:** Continuum of intermediate varieties $\omega^j \in [0, 1]$ produced in each sector j
- ▶ Country n produces ω^j with the following technology:

$$q_n^j(\omega^j) = z_n^j(\omega^j) \left[l_n^j(\omega^j) \right]^{\gamma_n^j} \prod_{k=1}^J \left[m_n^{k,j}(\omega^j) \right]^{\gamma_n^{k,j}} \quad (2)$$

z_n^j : Productivity

l_n^j : Labor input

$m_n^{k,j}$: Intermediate inputs

$\gamma_n^{k,j}$: Share of materials from sector k used in the production of ω^j

The Quantitative Model

- ▶ **Perfect Competition:** In each country n and sector j , varieties ω^j are bought from the lowest-cost producer across the world
- ▶ **Trade costs** for shipping goods from country i to n in sector j consist of both an iceberg component d_{ni}^j and tariffs τ_{ni}^j :

$$\kappa_{ni}^j = (1 + \tau_{ni}^j) \cdot d_{ni}^j \quad (3)$$

- ▶ **Productivity distribution** in country i in sector j follows a Fréchet distribution with location parameter λ_i^j and scale parameter θ^j
 - ▶ → The fraction of country n 's expenditure spent on intermediates from i equals

$$\pi_{ni}^j = \frac{\lambda_i^j [c_i^j \kappa_{ni}^j]^{-\theta^j}}{\sum_{h=1}^N \lambda_h^j [c_h^j \kappa_{nh}^j]^{-\theta^j}} \quad (4)$$

- ▶ We solve the model in changes using “exact hat algebra” (Dekle, Eaton & Kortum (2008))

The Quantitative Model

- ▶ In each period, countries can negotiate free trade agreements between each other
- ▶ To sign an agreement, countries face a **negotiation cost** s_{int}
 - ▶ Reduced-form function capturing e.g. the ease of negotiations or cost of drafting/maintaining FTAs
- ▶ Allow s_{int} to vary by country-pair, over time, and with past FTAs

$$s_{int} = \gamma_t^{(0)} + \gamma^{(d)} \cdot \text{Distance}_{in} + \gamma^{(b)} \cdot \text{Border}_{in} + \gamma^{(l)} \cdot \text{Lang}_{in} \\ + \gamma^{(g1)} \cdot \text{GDP}_{it} + \gamma^{(g2)} \cdot \text{GDP}_{nt} + \gamma^{(f)} \sum_{i' \neq i} \text{FTA}_{i'nt} + \epsilon_{int}$$

Lang_{in} : Common language

GDP_i : Country i 's gross domestic product

$\sum_{i' \neq i} \text{FTA}_{i'nt}$: Number of other signed FTAs

- ▶ We assume that cost s_{int} has to be **paid in each period** for every country with which an FTA was agreed on.
 - ▶ Countries sign FTAs for which $\Delta\text{Welfare} > s_{int}$ for both countries

FTAs over time

- ▶ **Main challenge:** FTAs are interdependent
 - ▶ Signing an FTA with country 1 alters
 1. The marginal benefit ΔW_{ni} of other agreements
 2. The negotiation cost s_{ni}

→ Need to determine each country's decision on all FTAs simultaneously

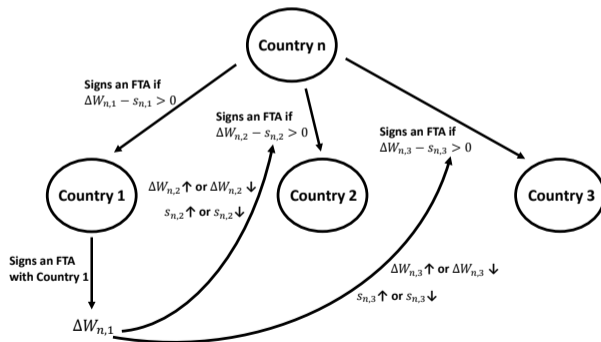


Figure: Example: Interdependence in Negotiating FTAs

Data

- ▶ Sample of 43 countries and a constructed Rest of the World
 - ▶ Selection mainly driven by data availability
 - ▶ Years 1988 - 2020

- ▶ Six main pieces of information:
 1. Trade flows
 - ▶ UN Comtrade
 2. Tariffs
 - ▶ WITS (World Bank)
 3. Domestic output
 - ▶ OECD Inter-Country Input-Output (ICIO) Tables
 4. Value added
 - ▶ OECD Inter-Country Input-Output (ICIO) Tables
 5. Country-specific input-output tables
 - ▶ OECD Inter-Country Input-Output (ICIO) Tables
 6. Date, type and signatories of free-trade agreements
 - ▶ WTO's Regional Trade Agreements Database

ESTIMATION

Structural Estimation

- ▶ In order to run **counterfactuals**: Estimate the parameters γ of the negotiation cost s_{int}

$$s_{int} = \gamma_t^{(0)} + \gamma^{(d)} \cdot \text{Distance}_{in} + \gamma^{(b)} \cdot \text{Border}_{in} + \gamma^{(l)} \cdot \text{Lang}_{in} \\ + \gamma^{(g1)} \cdot \text{GDP}_{it} + \gamma^{(g2)} \cdot \text{GDP}_{nt} + \gamma^{(f)} \sum_{i' \neq i} \text{FTA}_{i'nt} + \epsilon_{int}$$

- ▶ **Assumption:** Country n would sign an FTA with country i at time t if the welfare gain \hat{W}_{nt} exceeds the negotiation cost s_{int}
 - ▶ conditional on other signed FTAs
- ▶ **Definition:** D_{int} is a dummy variable that equals 1 if there is an FTA between countries n and i in place at time t
- ▶ Under this notation, can write the decision of a country as **fixed-point problem**

$$D_{int} = 1 \left\{ \underbrace{\hat{W}_{nt} | (\Delta D_{int} = 1, \mathbf{D})}_{\text{Welfare Gain from FTA with country } i} - s_{int}(\mathbf{D}) > 0 \right\} \quad (5)$$

Structural Estimation

- ▶ Two common **solution algorithms** for such a problem:
 1. When FTAs are complements, i.e. when an FTA increases the net benefit of signing an FTA with another country
 - ▶ Jia (2008)
 2. When FTAs are substitutes
 - ▶ Arkolakis, Eckert, Shi (2021)
- ▶ **Problem:** Ex ante unclear if FTAs are complements or substitutes
 - ▶ In addition: May differ by country pair

Structural Estimation

Modified Algorithm - Sketch:

1. Start with a guess of γ (ideally: start with a case in which all FTAs are complements)
2. For country 1, compute how each agreement affects the marginal benefit of other agreements
 - ▶ If an agreement i is not complementary to all other agreements, set D_{i1t} to 1
3. Find the optimal choice D^* for all other agreements via Jia (2008)
4. Repeat Step 2 for $D_{i1t} = 0$ and pick the optimal D_{i1t}
5. Repeat Steps 2-4 for all other countries
6. Check if $D_{int} = D_{nit} = 1$. Set all other elements of D to 0.
7. Check if the predicted moments match the empirical ones. If not, adjust γ until a match is achieved.

Structural Estimation

- ▶ We estimate the parameters of the cost function via the **simulated method of moments (SMM)**:
 - ▶ Solve the model for a given set of parameters repeatedly.
 - ▶ find the parameters that allow the model to match a set of targeted FTA-related moments
- ▶ Main Targeted Moments:
 1. Fraction of country pairs with an FTA in place
 2. Avg. Fraction of FTAs signed with neighbors
 3. Avg. Fraction of FTAs signed with close countries
 4. Avg. Fraction of FTAs signed with large countries
 5. Number of countries that signed more than M agreements (M : Median)

ESTIMATES AND COUNTERFACTUALS

Parameter Estimates

- ▶ Parameter Estimates are largely intuitive:
 - ▶ Common Language facilitates negotiations
 - ▶ Harder to reach an agreement with more distant and with larger countries
 - ▶ Past experience in signing FTAs with other countries lowers negotiation cost
 - ▶ Higher negotiation cost in the 1990s

Table: Structural Negotiation Cost Estimates

	(1)
Avg. Negotiation Cost	0.2403
Common Language	-0.0527
Distance (in logs)	0.0565
GDP (in logs)	0.0279
$\sum_{i' \neq i} FTA_{i'nt}$	-0.0057
Additional Cost (1990s)	0.0340

Notes: All estimates reported in this table are multiplied by 1,000.

Parameter Estimates

Table: Country Pairs with highest and lowest negotiation cost

Country 1	Country 2	\tilde{s}_{int}
Malaysia	Brunei	.0071822
Singapore	Malaysia	.0111777
Sweden	Finland	.0147775
Austria	Hungary	.0166852
Colombia	Costa Rica	.0340745
France	Switzerland	.0479158
⋮	⋮	⋮
Viet Nam	USA	.3876046
Thailand	USA	.3893984
Peru	China	.3899287
Indonesia	USA	.3905938
Chile	China	.3941878
Malaysia	USA	.3954859

Parameter Estimates

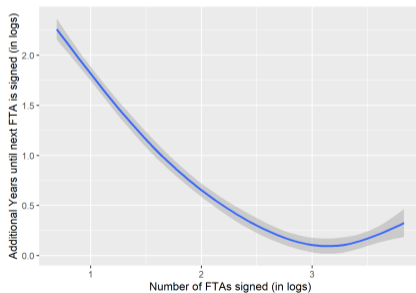
Table: Partner Countries with highest and lowest Negotiation Cost

Country	Partner with lowest \tilde{s}_{int}	Partner with highest \tilde{s}_{int}
Australia	New Zealand	China
Canada	Iceland	China
Chile	Argentina	China
China	Brunei Darussalam	USA
Colombia	Costa Rica	China
Denmark	Norway	USA
Finland	Sweden	USA
France	Switzerland	China
Germany	Netherlands	China
Hungary	Austria	USA
India	Brunei Darussalam	Brazil
Japan	Brunei Darussalam	USA
Mexico	Costa Rica	China
Peru	Costa Rica	China
Russian Federation	Finland	USA
Singapore	Malaysia	USA
Spain	Portugal	China
Switzerland	Austria	China
USA	Canada	China

Parameter Estimates

- ▶ Our results imply that FTAs are predominantly complements
- ▶ Consistent with the data:
 - ▶ A country is more likely to sign an additional FTA if it has already signed more FTAs with others in the past (see Baier et al. (2014)):

Figure: Frequency of FTA signings based on history



Notes: Figure plots the number of additional years a country takes until it signs an FTA (in logs) against the number of FTAs it has signed in the past (in logs).

Parameter Estimates

- ▶ Our results imply that FTAs are predominantly complements
- ▶ Intuitively, this implies that
 1. Past agreements lower the negotiation cost s_{int} : $\gamma^{(f)} < 0$
 2. Past agreements increase the marginal welfare benefit of other FTAs or affect it only little
- ▶ Why would this be the case?
 - ▶ Learning-by-doing / Economies of Scale
 - ▶ Texts of FTAs are often very similar, or match word-by-word
 - ▶ Fixed cost associated with the requirement of setting up ways to enforce rules, e.g. related to product standards or rules of origin
 - ▶ Sectoral linkages prevent strong substitution effects

Counterfactual Results

- ▶ Based on our estimates: Perform a range of counterfactuals

Main Result 1: Sectoral Linkages

- ▶ Without sectoral linkages, 12.9% fewer FTAs would be signed
 - ▶ Why? Sectoral/IO-Linkages strongly magnify the predicted welfare benefit of many FTAs (Caliendo and Parro (2015))

Table: Counterfactuals - The Importance of Sectoral Linkages

No Sectoral Linkages	
	Counterfactual Change
Number of signed FTAs	-12.93%

Counterfactual Results

Main Result 2: Interdependence

- ▶ Complementarities matter:
 - ▶ If the negotiation cost was independent of past FTAs, countries would sign 25.4% fewer FTAs

Table: Counterfactuals - The Importance of Interdependence

Reducing complementarities by 50%:	
Number of signed FTAs	-25.40%
Signing FTA with the U.S.:	
Number of signed FTAs with other countries	+11.61%

Counterfactual Results

Main Result 3: Changes over time

- ▶ Rise in FTAs over time primarily consistent with rising importance of non-tariff related benefits of FTAs and declining negotiation costs over time

Table: Counterfactuals - Changes over time

Reverting non-tariff related benefits of FTAs & negotiation costs back to 1990s levels:	
	Counterfactual Change
Number of signed FTAs	-49.76%
Same cost for large and small countries: $\gamma^{(g)} = 0$	
Avg. change in signed FTAs over all years (Large versus small countries)	+10.56%
No common language differences:	
Avg. change in signed FTAs over all years (Different versus same language countries)	+5.01%

Conclusions

- ▶ We quantify the costs and benefits of signing free-trade agreements
- ▶ Use a large-scale application of Caliendo and Parro (2015) to measure the impact of 60,000 factual and counterfactual FTAs
- ▶ Develop a quantitative model in which countries endogenously sign FTAs
 - ▶ Overcome the dimensionality of the problem via a modified version of Jia (2008):
- ▶ Main Findings:
 1. Significant heterogeneity in the cost/ease of negotiating FTAs across country pairs
 2. Most FTAs tend to be complements
 3. Recent rise of FTAs driven by rising importance of non-tariff related benefits of FTAs and declining negotiation costs
 - ▶ Magnified by increasing importance of sectoral linkages and complementarities