REVISITING THE EFFECTS OF PREFERENTIAL TRADE AGREEMENTS

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Preferential Trade Agreements (PTAs)

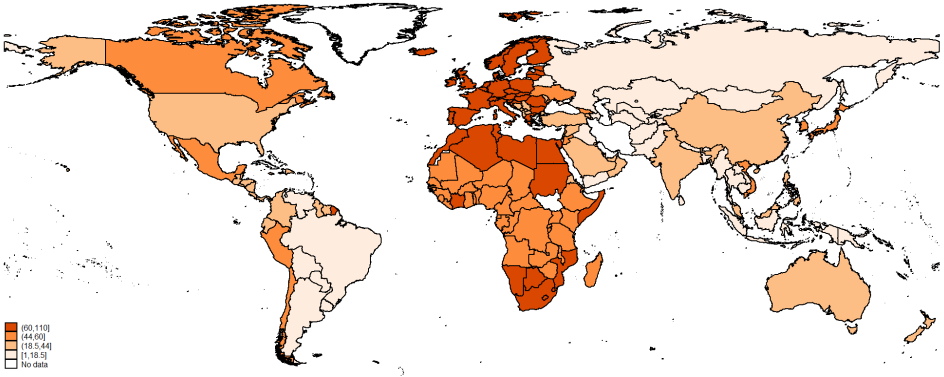


Figure: Total Number of Bilateral PTA Connections, 1949-2020

▸▸ Notified to the WTO ▸▸ Not Notified to the WTO ▸▸ Number of PTA Pairs per Year

Research Question

What are the effects of PTAs on trade between members?

1. PTAs and trade are jointly determined by geography, size, and past trade

   ⇒ Reduce biases associated with selection into PTAs

2. PTA effects are heterogeneous

   ⇒ Uncover differences between natural and non-natural trading partners

3. PTA effects are dynamic

   ⇒ Estimate anticipation, short, medium and long-run effects

Preview of the Results

- In the long run, PTAs increase bilateral trade by 48% for all types of country pairs
- In the short run, the effects vary across types of country pairs
  - Natural trading partners do not react in anticipation
  - For non-natural one thrid of the effect is realized in anticipation
- Research designs which do not account for selection overestimate the effects of PTAs
- Use the estimates to make policy-relevant general equilibrium predictions

Structural estimation: Anderson and van Wincoop (2003), Baier and Bergstrand (2007), Egger et al. (2011), Egger, Larch and Yotov (2020)

- Reduce selection bias
- Estimate effects without relying on functional form assumptions

Non-parametric estimation: Egger et al. (2008), Baier and Bergstrand (2009), Egger and Tarlea (2021)

- Deal with biases related to economic size
- Account for past trade and past PTAs
- Uncover cross-sectional heterogeneity and estimate dynamic effects

Economic determinants of PTAs: Magee (2003), Baier and Bergstrand (2004). Egger and Larch (2008)

Outline

Data Construction

Design and Empirical Strategy

Results

DATA CONSTRUCTION

Economic size affects trade volume and the assignment of PTAs

Market Share

$$\frac{X_{ij}}{E_j}$$

Normalized Market Share (Santamaría et al., 2020)

$$s_{ij} = \frac{X_{ij}/E_j}{Y_i/E}$$

where X_{ij} are the sales from origin i to destination j; $E_j = \sum_i X_{ij}$ is the total expenditure of j; $Y_i = \sum_j X_{ij}$ is the total income of i; and $E = \sum_j E_j$ is the world’s total expenditure

	$(X_{ij}/E_j)^{1960}$	$(Y_i/E)^{1960}$	s_{ij}^{1960}
Israel-USA	0.16%	0.21%	0.76
USA-Israel	28.06%	22.03%	1.27

Data Construction

1. Combine all international and domestic trade datasets
   ⇒ Additionally gain almost one million "missing" observations

   ⏩ Sources ⏩ Metadata

2. Trade data is systematically missing
   ⇒ Partially reconstruct the matrix of bilateral trade flows

   ⏩ Model ⏩ Cross-Validation ⏩ Comparison

3. Data on domestic trade unavailable before 1980s
   ⇒ Use modified trade outcomes without domestic trade

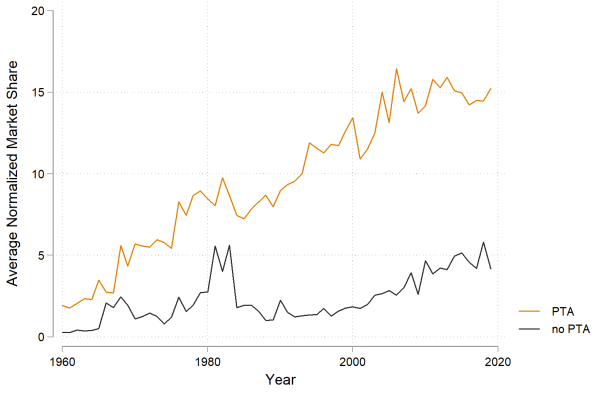
   ⏩ Distributions ⏩ Regressions ⏩ Linear Fit

4. PTA dataset
   ⇒ Construct treatment variable and extract PTA characteristics

   ⏩ Agreement Dynamics ⏩ PTA Characteristics

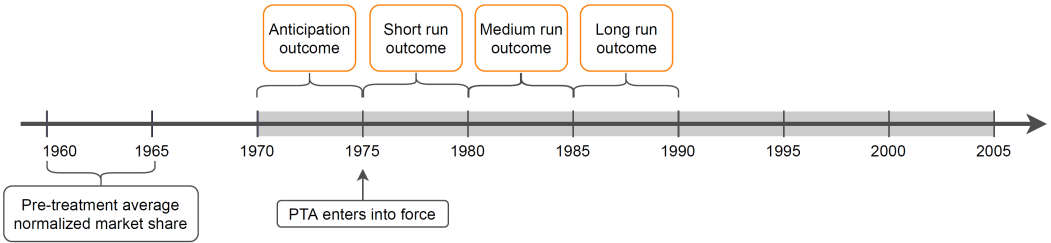
Final Dataset

	Cross-section	Percent	Panel	Percent	Mean Share
No PTA	36,812	83.87	2,465,521	93.63	2.55
PTA	7,078	16.13	167,879	6.37	17.69
Both	43,890		2,633,400		3.51



DESIGN AND EMPIRICAL STRATEGY

Staggered Treatment Design: Example



- Treatment: pairs with a PTA entering into force between 1970 and 2005
- Control: pair which never had a PTA
- Mean implementation period: 8 years
- Mean negotiation period: 4.5 years

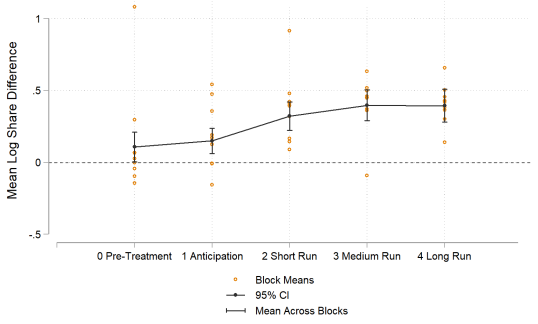
Empirical Strategy: Imbens and Rubin (2015)

1. **Design** ⏩ Framework ⏩ Assumptions
   - Estimate the probability of having a PTA ⏩ Logit Estimation ⏩ Estimated Probability
   - Trim the dataset ⏩ Algorithm
   - Block on the estimated probability ⏩ Algorithm ⏩ Constructed Blocks
2. **Diagnostics**
   - Covariates and PTA characteristics across blocks ⏩ Pair Characteristics ⏩ PTA Characteristics
   - Covariate balance and PTA characteristics within blocks ⏩ Pair Characteristics ⏩ PTA Characteristics ⏩ Growth Rates
3. **Analysis**
   - Regression adjustment within each block ⏩ Details
   - Estimating sampling variance ⏩ Details

RESULTS

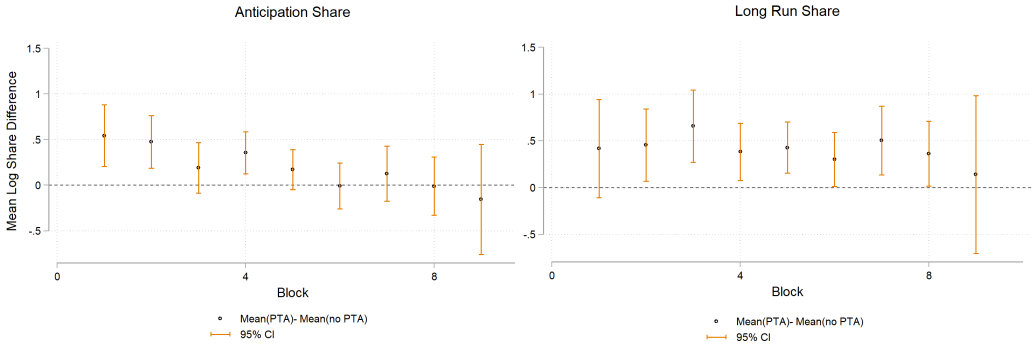
Average Effects

	Anticipation [t-5; t=0)	Short Run (t=0; t+5]	Medium Run (t+5; t+10]	Long Run (t+10; t+15]
Coefficient	0.15	0.32	0.39	0.39
Std. Err.	0.054	0.061	0.065	0.069
Percent	16%	37%	48%	48%



- Effects of PTAs kick in gradually, with one-third realizing in anticipation

Heterogeneous Effects



- Only non-natural partners increase trade in anticipation
- In the long run natural and non-natural partners have the same increase

Comparison to Alternative Research Designs

Simulation Results Simulation Setup

Conclusions

Causal inference framework: estimate dynamic heterogeneous effects of PTAs

- In the long run trade increases by 48%
- In the short run effects are heterogeneous across country pairs
  - Natural trading partners do not react in anticipation
  - Non-natural trading partners increase trade by 16%
- Research designs which do not account for selection overestimate the effects of PTAs

GE model: use the estimates to make policy-relevant predictions

Model | RCEP | LR: Welfare | LR: Trade | SR: Welfare | SR: Trade | Additional

Appendix

Preferential Trade Agreements Notified to the WTO

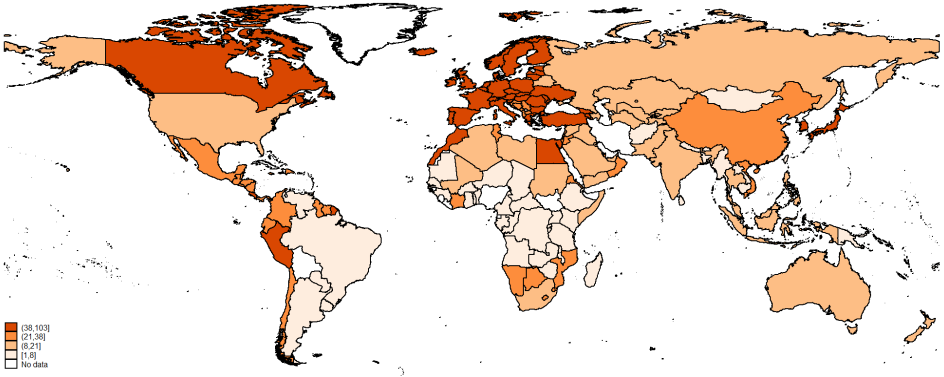


Figure: Total Number of Bilateral PTA Connections for WTO-Notified Agreements, 1949-2020

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Preferential Trade Agreements Not Notified to the WTO

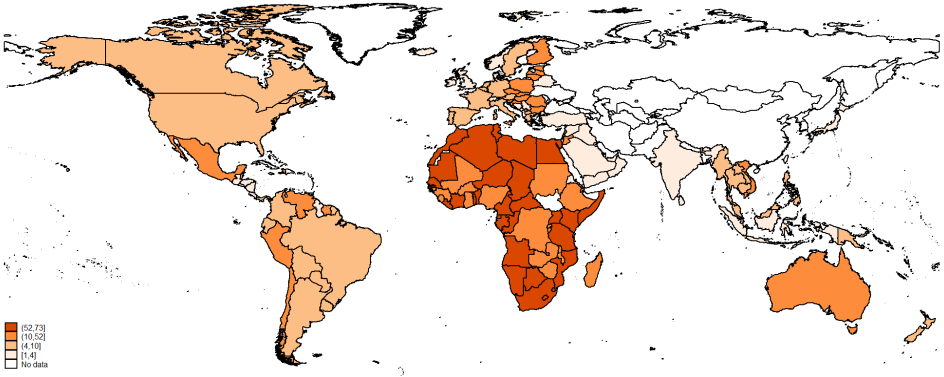

Figure: Total Number of Bilateral PTA Connections for Agreements Not Notified to the WTO, 1949-2020

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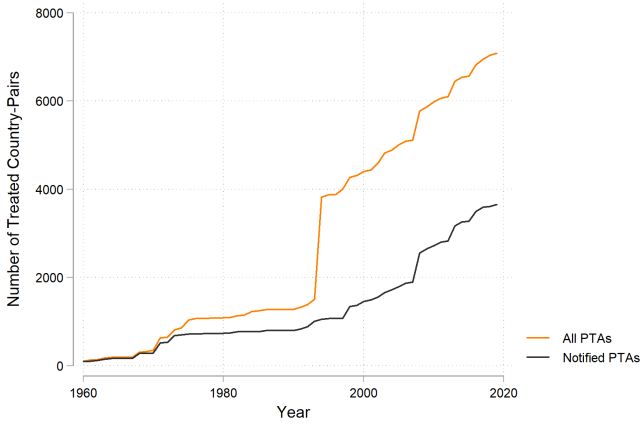
Number of Treated Pairs per Year



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Data Sources

1. **Trade data**:
   - WTO structural gravity database
   - USITC International Trade and Production Database for Estimation (ITPD-E)
   - IMF Direction of Trade Database (DOTS)
   - World Trade Flows (WTF)
   - CEPII Gravity Dataset
   - UNIDO Industrial Statistics (INDSTAT)
2. **Geographical, cultural and historical characteristics**:
   - CEPII Gravity Dataset
   - NASA's Earth Observing System Data and Information System (EOSDIS)
3. **PTA dataset**:
   - Design of Trade Agreements (DESTA)

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Metadata for raw bilateral trade datasets

Name	Countries	Pair	Years	Observations	Balance	Missing
ITPDE-E	237	43,623	2000-2016	714,951	No	0
WTO	229	48,711	1980-2016	972,692	No	0
IMF	218	47,030	1948-2017	2,710,148	No	0
WTF	263	50,456	1984-2015	750,556	No	0
NBER	201	23,750	1962-2000	926,250	Yes	499,365
						UN exporter: 2,843,970
						UN importer: 2,731,663
CEPII	248	61,034	1948-2019	3,661,898	No	BACI: 3,056,279
						IMF exporter: 2,770,880
						IMF importer: 2,687,346

Metadata for raw domestic trade datasets

Name	Countries	Years	Observations
ITPD-E	115	2000-2014	1,356
WTO	160	1980-2016	3,645
TradeProd	180	1980-2006	4,514
INDSTAT	137	1980-2016	3,349

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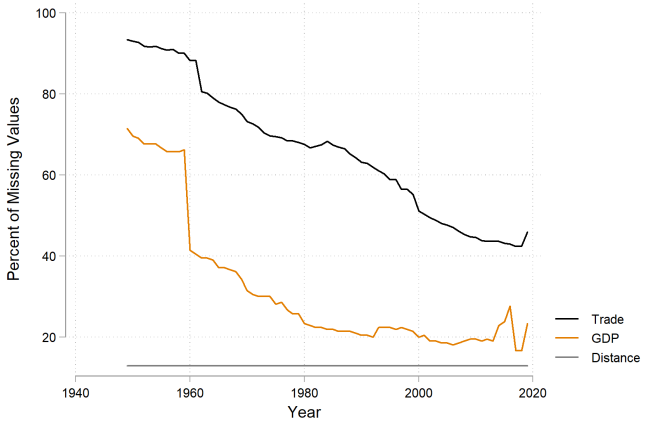
Proportion of Observations Missing Per Year



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Patterns

- 35,411 missing observations for active PTAs (21.09% of all country-pairs with active PTAs)
- 45,742 missing observations of the type X.X
- 21,259 missing observations of the type X..X
- 11,621 missing observations of the type X...X
- 4,664 missing observations for neighbouring countries

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- Flexible form of log-linearized empirical gravity model

$$\log(X_{ijt}) = \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \sum_{q=2}^{4} \gamma_{qt} Dist_{ij} \times \delta_t + \beta_3 Colony_{ij} + \beta_4 Comcol_{ij} + \beta_5 Language_{ij} + \beta_6 Contiguity_{ij} + \beta_7 Legal_{ij} + \beta_8 GATT_{it} + \beta_9 GATT_{jt} + \beta_{10} EU_{it} + \beta_{11} EU_{jt} + \beta_{12} PTA_{ijt} + \beta_{13} NumPTA_{it} + \beta_{14} NumPTA_{jt} + \beta_{15} Landlock_{ij} + \beta_{16} SIDS_{ij} + \beta_{17} SameReg_{ij} + \beta_{18} \log(Pop_{it}) + \beta_{19} \log(Pop_{jt}) + \varepsilon_{ijt}$$

- Estimate using available information in a flexible model with 266 parameters and predict trade

	Missing	Total	Percent Missing
Trade	1,613,663	2,633,400	61.28
Predicted Trade	1,185,396	2,633,400	45.01

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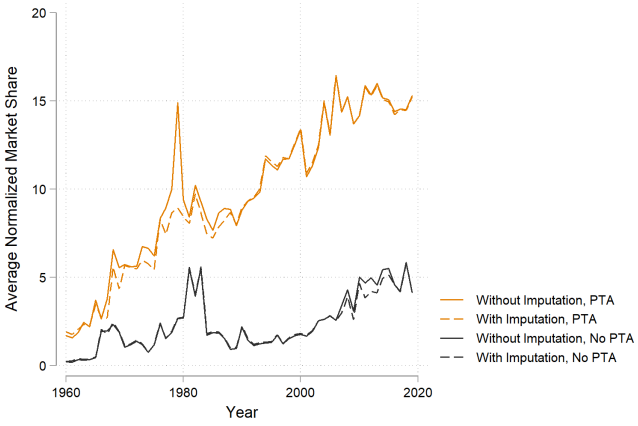
Shares With and Without Imputation



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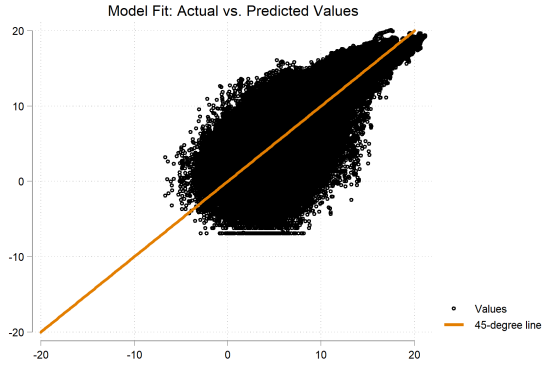
Cross-Validation and Model Fit



Adjusted R-Squared	10-fold CV RMSE	Mean	Initial N	Predicted N
0.62	2.5	6.65	1,019,737	593,443

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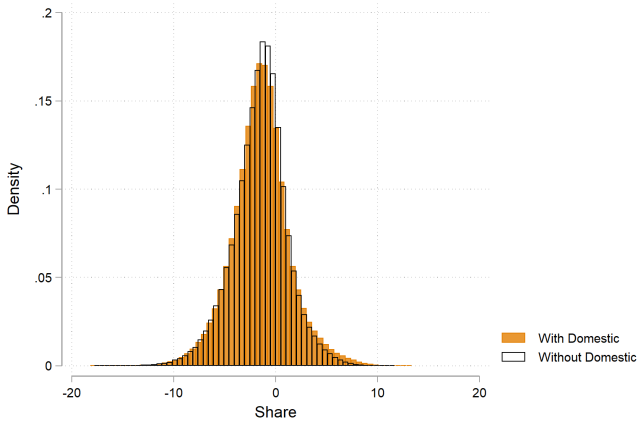
Shares With and Without Domestic Trade



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Shares With and Without Domestic Trade

$$s_{ijt} = \alpha + \beta \tilde{s}_{ijt} + \varepsilon_{ijt}; \quad s_{ijt} = \alpha + \beta \tilde{s}_{ijt} + \boldsymbol{\gamma X} + \eta_{ijt}$$

	Univariate	Multivariate
$\tilde{s}_{ij}$	0.99***	0.97***
PTA		-0.01*
ln(GDP origin)		-0.02***
ln(GDP destination)		-0.08***
ln(Pop origin)		-0.11***
ln(Pop destination)		-0.6***
ln(Dist)		-0.06***
ln(Area origin)		-0.04***
ln(Area destnation)		-0.02***
Landlock origin		0.25***
Landlock destination		0.16***
Same country		0.08***
Colony		0.04***
Common language		-0.01**
Contiguity		0.05***
Intercept	-0.006***	3.93***
Number of obs.	636,957	549,031
Adj. R-squared	0.95	0.82

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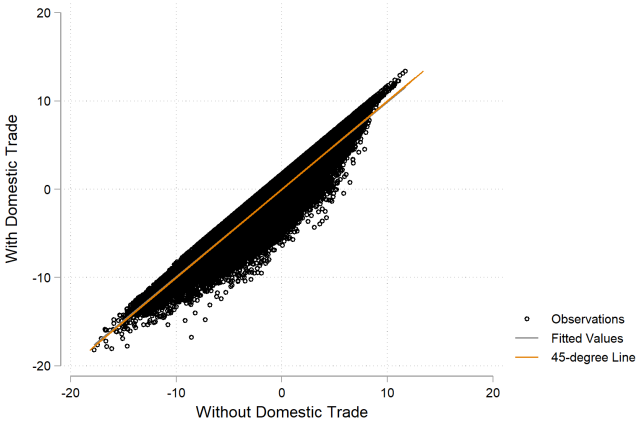
Shares With and Without Domestic Trade



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- Superseding Agreements
  - Example: Andean Group (Cartagena Agreement 1969, Quito Protocol 1988, Trujillo Protocol 1997, Sucre Protocol 2003)
- Overlapping Agreements
  - Colombia and Peru are both in Andean Group (Bolivia, Colombia, Ecuador, and Peru) and in Pacific Alliance (Chile, Colombia, Mexico and Peru)
- Accessions
  - Example: Venezuela joined Andean Community in 1973
- Withdrawals
  - Example: Venezuela withdrew from Andean Community in 2006
  - Withdrawals are rare, and most of the times are related to restructuring (eg. joining EC and thus withdrawing former agreements, while joining those that EC has)

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Withdrawals and Accessions

I code *real* withdrawals if countries stop having any type of formal PTA:

- Brazil-Venezuela from 2006 to 2012: Venezuela exited Andean Community to join MERCOSUR, but was not a member until 2012
- Eritrea with Angola, Lesotho, Mozambique, Namibia, Tanzania when the latter exited COMESA
- Georgia with Belarus, Kyrgyzstan, Tajikistan when Georgia exited CIS
- The rest of the 486 country pairs which formally withdrew from PTAs had another PTA in place

Accessions

- Only for non-overlapping agreements
- Entry into force is coded as the year of accession
- There are 852 of such country pairs over the whole period

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Resulting PTA Characteristics

Indicator		Number of observations	Percentage
Type	FTA	4,065	57.08
	CU	3,057	342.92
Participation	Base Treaty	6,291	88.58
	Accession	811	11.42
Notification	Notified	3,427	48.42
	Not Notified	3,651	51.58
National Treatment	Yes	4,820	67.75
	No	2,294	32.25
Composition	Bilateral	262	3.68
	Plurilateral	3,220	45.21
	Plurilateral and 3rd country	1,192	16.74
	Region-Region	1,637	22.99
	Accession to a PTA	566	7.95
	Inheritance accession	245	3.44
Region	Africa	2,740	38.47
	Americas	382	5.36
	Asia	250	3.51
	Europe	778	10.92
	Oceania	114	1.60
	Intercontinental	2,858	40.13

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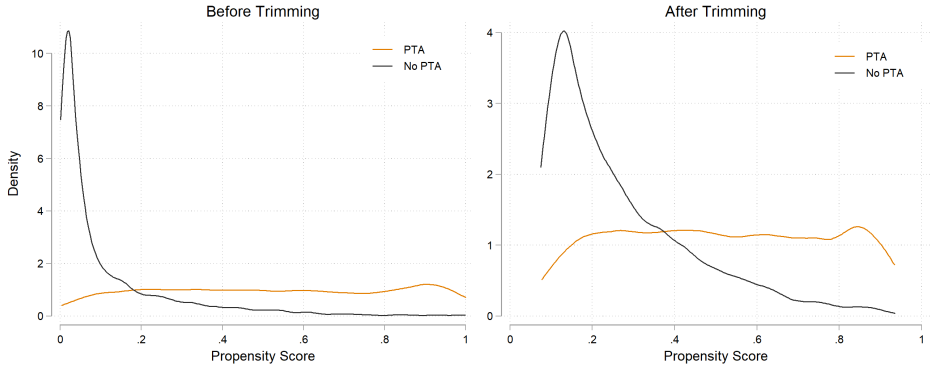
Propensity Score Estimation



- Optimal cutoff = 0.083

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- Potential outcomes at time $T = \{A, S, M, L\}$: $s_{ij}^T(0)$ and $s_{ij}^T(1)$
- PTA effects is the percentage change in average normalized market shares

$$\tau_{ij}^T = \ln \frac{s_{ij}^T(1)}{s_{ij}^T(0)}$$

- Realized (observed) outcomes:

$$s_{ij}^{T,obs} = \begin{cases} s_{ij}^T(0), & \text{if } \text{PTA}_{ij} = 0 \\ s_{ij}^T(1), & \text{if } \text{PTA}_{ij} = 1 \end{cases}$$

- If treatment assignment is probabilistic and unconfounded the average effect of PTAs on members estimated as:

$$\hat{\tau}^T = \mathbb{E}(\ln s_{ij}^{T,obs} | \text{PTA}_{ij} = 1, Z_{ij} = z) - \mathbb{E}(\ln s_{ij}^{T,obs} | \text{PTA}_{ij} = 0, Z_{ij} = z)$$

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1. **Unconfoundedness** (Rubin, 1990)

$$\text{PTA}_{ij} \perp \left(s_{ij}^{T}(0), s_{ij}^{T}(1) \right) | Z_{ij}$$

2. **Overlap** (probabilistic assignment) (Rosenbaum and Rubin, 1983)

$$0 < e(z) < 1$$

where $e(z) = \mathbb{E}\left(\text{PTA}_{ij} | Z_{ij} = z\right) = Pr\left(\text{PTA}_{ij} = 1 | Z_{ij} = z\right)$ is the propensity score

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Logit Estimation Results

	Raw Sample		Trimmed Sample	
	Coefficient	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
Pre-treatment Share	0.08***	(0.02)	0.07***	(0.02)
Distance	-1.96**	(0.05)	-2.07***	(0.07)
Remoteness	-5.26***	(0.30)	-5.23***	(0.35)
Small Island	-0.94***	(0.08)	-0.96***	(0.09)
Common Language	0.64***	(0.07)	0.67***	(0.07)
EU Membership	0.91***	(0.06)	0.90***	(0.09)
Landlocked	0.46***	(0.05)	0.55***	(0.06)
Common Colonizer	0.58***	(0.09)	0.69***	(0.09)
Colonial Relationship	-0.63**	(0.19)	-0.81***	(0.21)
GATT Membership	0.22***	(0.06)	0.12	(0.07)
Legal System	0.14*	(0.05)	0.13*	(0.06)
Pre-treatment PTAs	0.11	(0.07)	0.09	(0.07)
Intercept	62.02***	(2.69)	62.72***	(3.37)
N treated	3,200		2,612	
N control	13,392		4,673	
N Total	16,592		7,285	
Pseudo R-squared	0.39		0.19	

⏩ Back

Trimming: Crump, Hotz, Imbens and Mitnik (2008)

1. Estimate the propensity score $\hat{e}(x : T, Z)$
2. Calculate the optimal trimming threshold
3. Drop observations on both sides of the interval [0,1] defined by the threshold
4. Drop observations outside the common support of the propensity score

⏩ Back

1. The algorithm relies on comparing average values of the log odds ratios by treatment status, where the estimated log odds ratio is

$$\hat{l}(z) = \ln\left(\frac{\hat{e}(z)}{1-\hat{e}(z)}\right)$$

2. Start with a single block, $J = 1$. Calculate the t-statistic for the test of the null hypothesis that the average value for the estimated propensity score for the treated is the same as for the controls within the same block
3. The current block will be viewed as adequate if the t-statistic is sufficiently small. If not, split at the median
4. Repeat until all blocks are adequate or until there are too few observations in the resulting blocks

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Constructing Blocks

	B1	B2	B3	B4	B5	B6	B7	B8	B9
Inferior of PS	0.08	0.125	0.1875	0.25	0.375	0.5	0.625	0.75	0.875
N Control	1,008	1,028	657	873	524	312	153	81	24
N Treated	115	186	180	387	405	380	352	360	247
N Total	1,123	1,214	837	1,260	929	692	505	441	271

- Data-dependent procedure for selecting both the number of blocks and their boundaries (Becker and Ichino, 2002)
- Constructing blocks such that treatment and control have similar probability of having a PTA

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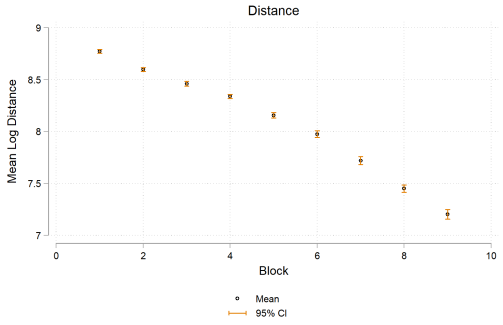
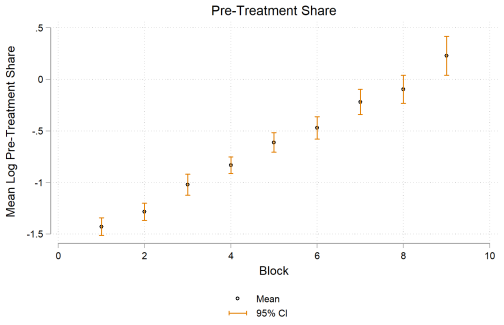
Across Blocks: Natural vs. Non-Natural Trading Partners





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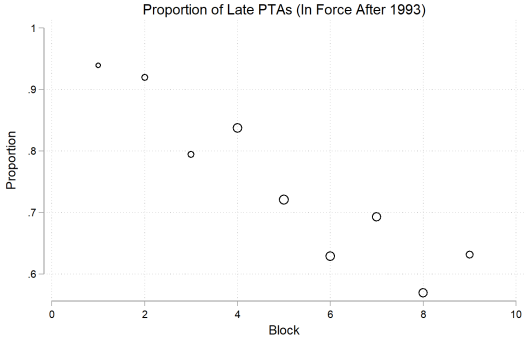
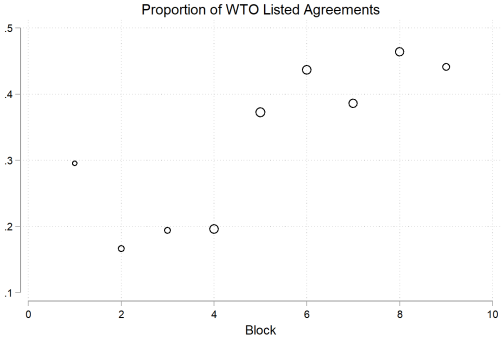
Across Blocks: PTA Characteristics





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Balancing Test of Covariates by Block: Mean(PTA) - Mean(No PTA)

	B1	B2	B3	B4	B5	B6	B7	B8	B9
Pre-treatment Share	0.25*	0.08	-0.07	-0.15*	0.03	0.01	0.03	-0.22	0.80**
	(0.14)	(0.11)	(0.12)	(0.08)	(0.09)	(0.11)	(0.13)	(0.17)	(0.33)
Distance	0.0003	-0.09***	-0.04	-0.09***	-0.02	-0.009	0.23***	0.11**	0.53***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)	(0.08)
Remoteness	-0.001	0.012*	0.02*	0.005	-0.0009	-0.0009	-0.03**	-0.02*	-0.05***
	(0.007)	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)	(0.009)	(0.009)	(0.01)
Small Island	0.03	0.03	-0.01	0.03*	-0.005	0.0008	-0.11***	0.03	-0.21***
	(0.03)	(0.03)	(0.02)	(0.18)	(0.02)	(0.02)	(0.03)	(0.02)	(0.04)
Common Language	0.17***	0.03	0.06	0.11***	0.13***	0.16***	0.17***	0.17**	0.21**
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.04)	(0.04)	(0.06)	(0.11)
EU Membership	0.02	0.01	0.07**	-0.03*	-0.05*	0.02	0.04	0.01	0.06
	(0.03)	(0.02)	(0.02)	(0.01)	(0.03)	(0.03)	(0.03)	(0.04)	(0.09)
Landlocked	0.09*	-0.009	0.009	-0.13***	0.06*	-0.04	0.19***	0.17***	0.37***
	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.05)	(0.06)	(0.10)
Common Colonizer	-0.02	-0.04	-0.03	-0.02	-0.01	0.01	0.12***	0.03	0.3***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	(0.04)	(0.09)
Colonial Relationship	-0.02	-0.004	0.004	-0.01	0.03***	-0.001	-0.002	-0.02	-0.07***
	(0.01)	(0.009)	(0.01)	(0.007)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
GATT Membership	-0.07*	-0.02	-0.06*	-0.07**	-0.02	0.04	0.14***	0.27***	0.22**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.05)	(0.08)
Legal System	0.03	-0.07*	-0.07*	0.005	0.04	-0.01	0.15***	-0.06	0.05
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.05)	(0.06)	(0.11)
Pre-treatment PTAs	-0.08**	-0.1***	-0.07**	-0.03	-0.02	0.09***	0.13***	0.16***	0.35***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.05)	(0.06)	(0.1)

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The probability of having a customs union by block

	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9
Pre-Treatment NMS	0.126	-0.0917	0.00540	-0.0935	-0.0701	-0.0331	0.0603	-0.122	0.113
	(1.09)	(-1.19)	(0.06)	(-1.60)	(-1.03)	(-0.40)	(0.65)	(-1.30)	(0.88)
Distance	-2.975	0.740	-3.368	0.159	-1.393	-1.132	-0.668	-1.138	-1.729
	(-1.44)	(0.54)	(-1.69)	(0.18)	(-1.13)	(-0.80)	(-0.50)	(-1.09)	(-0.85)
Remoteness	-15.87**	-1.384	-10.82*	-0.124	-2.215	-2.900	-3.188	2.825	-3.767
	(-2.87)	(-0.39)	(-2.09)	(-0.05)	(-0.68)	(-0.77)	(-0.89)	(0.93)	(-0.69)
Small Island	-0.939	1.096	-1.836	-0.00403	-0.948	-0.0612	-0.700	-0.706	-2.821*
	(-0.90)	(1.57)	(-1.83)	(-0.01)	(-1.47)	(-0.08)	(-0.93)	(-1.13)	(-2.17)
Language	1.610*	-0.277	0.496	-0.515	0.160	-0.135	-0.190	0.864*	1.638*
	(2.12)	(-0.52)	(0.69)	(-1.57)	(0.37)	(-0.29)	(-0.36)	(1.97)	(2.05)
EU	0	0	0	0	-1.634*	-2.615**	-1.533	-2.336**	-0.401
	(.)	(.)	(.)	(.)	(-2.38)	(-3.16)	(-1.93)	(-3.15)	(-0.39)
Landlock	0.887	0.172	1.460**	-0.0174	1.478***	1.074*	1.426***	1.399***	1.559*
	(1.53)	(0.43)	(2.63)	(-0.06)	(4.07)	(2.52)	(3.31)	(3.64)	(2.46)
Common Colony	0.569	-0.659	1.277	-0.110	0.695	1.467**	1.367**	0.623	2.590**
	(0.70)	(-1.12)	(1.69)	(-0.30)	(1.51)	(2.65)	(2.64)	(1.22)	(2.96)
Colony Dependence	0	1.041	0	0	0	0	0.160	0	0
	(.)	(1.07)	(.)	(.)	(.)	(.)	(0.14)	(.)	(.)
GATT	-0.0195	0.00653	0.425	0.199	0.595**	1.026***	1.100***	1.862***	2.612***
	(-0.06)	(0.03)	(1.45)	(1.11)	(2.71)	(3.82)	(3.79)	(5.61)	(5.10)
Legal System	0.136	-0.417	0.0219	0.0507	0.0986	-0.158	0.817**	1.276***	-0.391
	(0.44)	(-1.76)	(0.08)	(0.31)	(0.51)	(-0.73)	(3.02)	(4.09)	(-0.98)
Total Number of PTAs	-2.425***	-1.133***	-0.932**	-0.295	-0.615**	0.408	-0.948**	-0.209	-0.939
	(-3.58)	(-3.36)	(-2.61)	(-1.50)	(-2.67)	(1.61)	(-3.05)	(-0.63)	(-1.90)
Constant	166.2*	4.235	122.9*	-1.388	29.14	32.56	31.69	-19.83	43.03
	(2.51)	(0.10)	(1.98)	(-0.05)	(0.75)	(0.74)	(0.77)	(-0.59)	(0.70)
N Observations	955	1133	743	1102	904	677	505	437	268
Pseudo R-Squared	0.089	0.037	0.047	0.013	0.134	0.163	0.231	0.315	0.398

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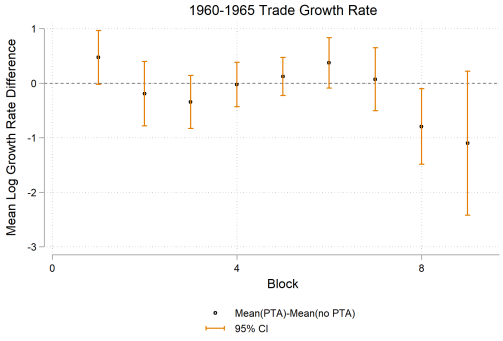
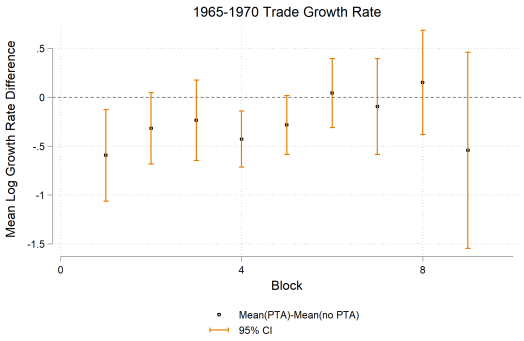
Balance of Trade Growth Rates





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1. Within each block and for each outcome at time $T = \{A, S, M, L\}$ the average treatment effect is estimated using linear regression

$$s_{ijt}^{T} = \alpha + \tau \text{PTA}_{ijt} + \delta \mathbf{Z}_{ij} + \gamma_t + \varepsilon_{ijt}$$

   where $\mathbf{Z}_{ij}$ is the covariate matrix; γ_t are year-into-force fixed effects

2. This leads to nine estimates of $\hat{\tau}$ for each T, one for each block

3. The average treatment effect on the treated is calculated as

$$\tau_{ATT} = \sum_{b=1}^{B} \frac{N_{tb}}{N_t} \hat{\tau}_b$$

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1. **Bootstrap**
   - For each $T = A, S, M, L$ and for each block, re-sample observations with replacement, run the regression, calculate the mean and the standard error at each iteration; perform this procedure one thousand times
2. **Re-sampling from the control distribution**
   - Ror each $T = A, S, M, L$ and for each block, sample observations from the control group while keeping the treatment observations fixed at every iteration, run the regression, calculate the mean and the standard error at each iteration; perform this procedure one thousand times

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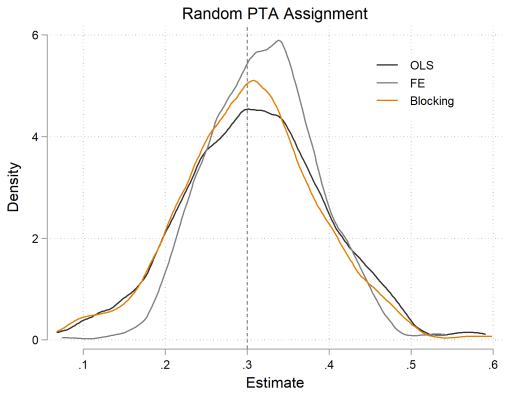
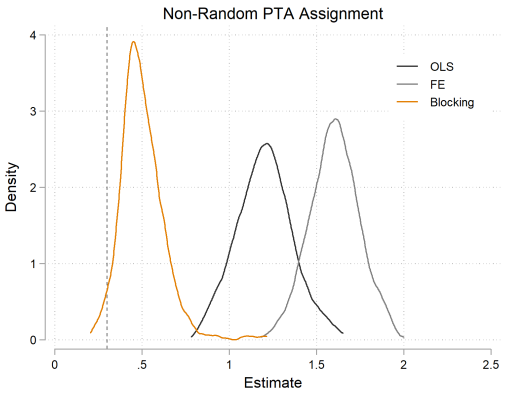
Numerical Simulation: Results





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Numerical Simulation: Details

- Create an economy using simple Armington structural gravity model
- Trade cost structure:

$$\tau_{ij} = t_{ij}\beta_{ij}$$

  where $\beta_{ii} = 1$ and $t_{ii} = 1$
- Use 'exact hat algebra' to simulate 500 datasets with 50 countries and 10 periods
- PTA: 10% reductions in trade policy costs β_{ij}
  1. Random PTA assignment
  2. Non-random PTA assignment

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- Standard one sector Armington CES: Costinot and Rodriguez-Clare (2014)
- $i = 1, ...N$ countries, each endowed with Q_i units of distinct good $i = 1, ...N$
- Representative agent with CES preferences:

$$C_j = \left(\sum_{i=1}^{N} \psi_{ij}^{(1-\sigma)/\sigma} C_{ij}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}$$

where C_{ij} is the demand for good i in country j; ψ_{ij} is an exogenous preference parameter, and $\sigma > 1$ is the elasticity of substitution of goods between different countries

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- Iceberg trade costs $\tau_{ij} > 1$, with $\tau_{ii} = 1$
- X_{ij} is the total value of country j's imports from i
- $E_j = \sum_{i=1}^{N} X_{ij}$ is country j's total expenditure
- Y_i is country i's total income
- Gravity equation:

$$X_{ij} = \frac{(Y_i \tau_{ij})^{-\varepsilon} \chi_{ij}}{\sum_{l=1}^{N} (Y_l \tau_{lj})^{-\varepsilon} \chi_{lj}} E_j \tag{1}$$

  where $\varepsilon = \sigma - 1$ is the trade elasticity
- Competitive equilibrium: $Y_i = E_i$ and $Y_i = \sum_{j=1}^{N} X_{ij}$

$$Y_i = \sum_{j=1}^{N} \frac{(Y_i \tau_{ij})^{-\varepsilon} \chi_{ij}}{\sum_{l=1}^{N} (Y_l \tau_{lj})^{-\varepsilon} \chi_{lj}} Y_j \tag{2}$$

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- Use 'Exact Hat Algebra': solve the system in changes
- $\lambda_{ij} = X_{ij} / \sum_l X_{lj}$ share of expenditure on good from i in j
- Since gravity holds in both initial and counterfactual equilibrium

$$\hat{\lambda}_{ij} = \frac{(\hat{Y}_i \hat{\tau}_{ij})^{-\varepsilon}}{\sum_{l=1}^{N} \lambda_{lj} (\hat{Y}_l \hat{\tau}_{lj})^{-\varepsilon}} \tag{3}$$

- To compute the changes in income level

$$\hat{Y}_i Y_i = \sum_{i=1}^{N} \frac{\lambda_{ij} (\hat{Y}_i \hat{\tau}_{ij})^{-\varepsilon} \hat{Y}_j Y_j}{\sum_{l=1}^{N} \lambda_{lj} (\hat{Y}_l \hat{\tau}_{lj})^{-\varepsilon}} \tag{4}$$

- Calculate changes in welfare

$$\hat{C}_j = \hat{\lambda}_{jj}^{-1/\varepsilon}$$

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Regional Comprehensive Economic Partnership (RCEP)

- Largest trade block in history
  - 30% of the world population
  - 30% of the world GDP
- Signed in November 2020
- Eliminates 90% of tariffs in 20 years

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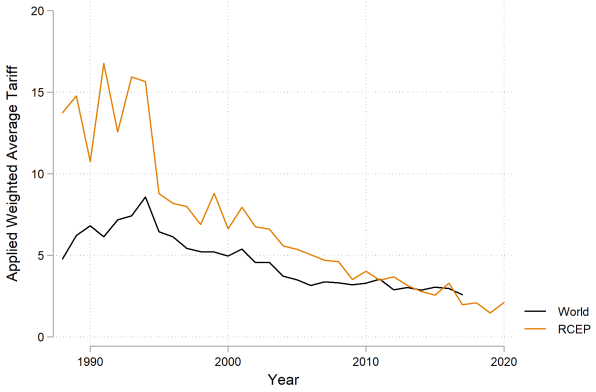
Average Applied Tariffs



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- Least restrictive data is for year 2015: 88 countries
- Counterfactual exercises:
  - **Long run**: 9.6% reduction in trade costs across all RCEP members
  - **Heterogeneity**: static exercises for anticipation and long run using block estimates
- Changes in iceberg trade costs

$$\underbrace{\text{Effect of PTAs on NMS}}_{\text{Average Estimate = 48\%}} = \underbrace{\text{Effect of PTA on Trade Cost}}_{\text{X}} \times \underbrace{\text{Effect of Trade Cost on Trade}}_{\text{Trade Elasticity, } \varepsilon=5}$$

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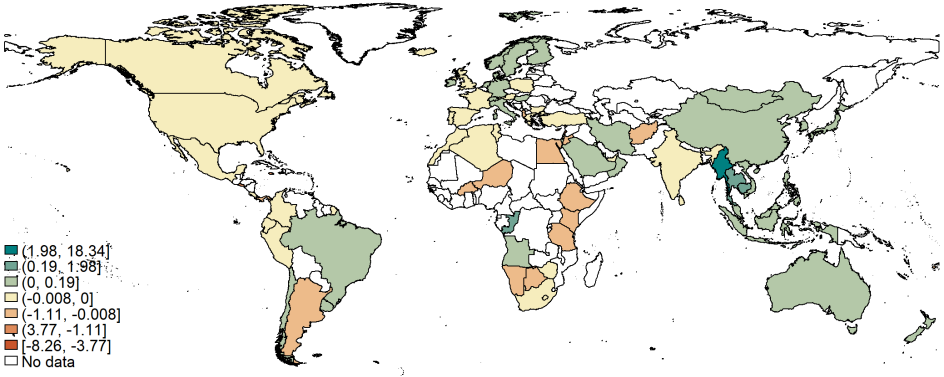

Figure: Changes in Real Consumption in the Long Run

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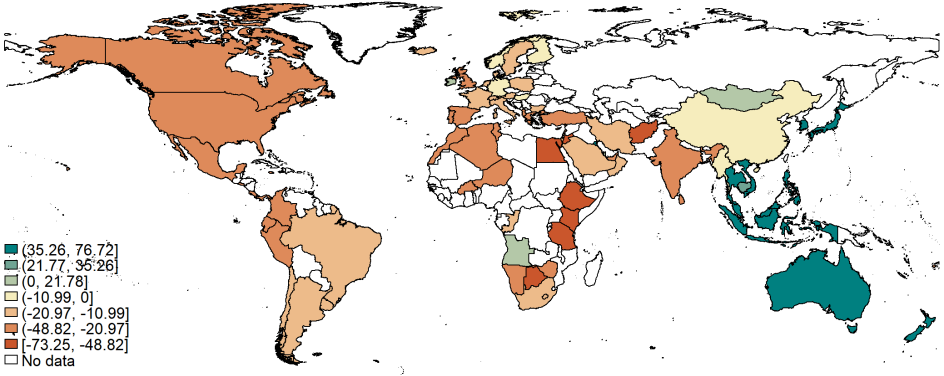

Figure: Changes in China's Normalized Market Shares in the Long Run

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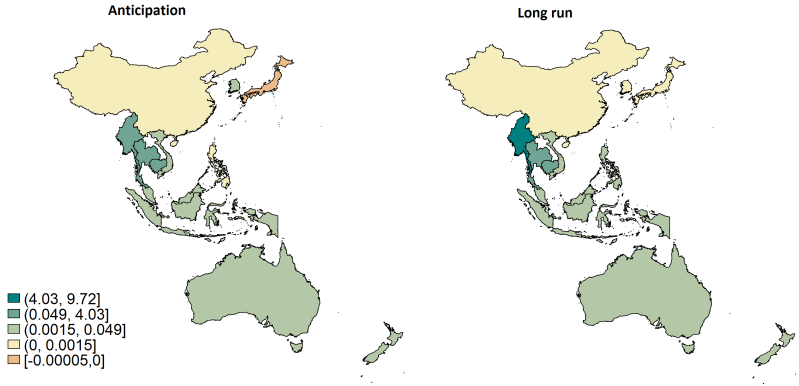

Figure: Changes in Real Consumption of RCEP Countries in Anticipation and Long Run

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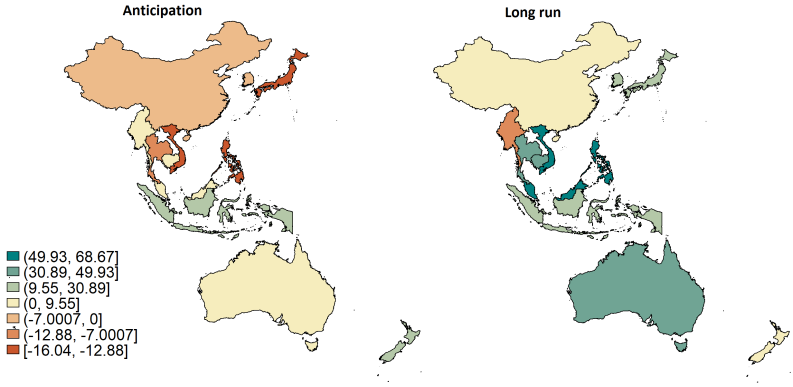

Figure: Changes in China's Normalized Market Shares with RCEP Countries in Anticipation and Long Run

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Other Exercises

- Decomposing the changes in real consumption into price and size effects
- Sensitivity analysis with respect to values of trade elasticity
- Comparison of GE effects with estimates obtained in the gravity model