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Multilateral Economic Integration and Agri-Food Global Value Chains

Dongin Kim and Sandro Steinbach

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email: dongin.kim@ndsu.edu

capts Center for Agricultural Policy and Trade Studies

Motivation

- The development of agri-food global value chains (GVCs) have reshaped how international trade functions.
  - ✓ The rise of offshoring via globalization efforts had created a complex agricultural production network (Lim, 2021).
  - ✓ The **intermediate inputs** constitute two-thirds of total world trade (Johnson and Noguera, 2012).
- The World Trade Organization (WTO) contributed to forming modern agri-food GVC by promoting international trade in a multilateral context.
- A question remains whether the multilateral trade liberalization via WTO is still effective.
  - ✓ **Is the WTO Passé?** (Bagwell et al., 2016; Dutt, 2020).

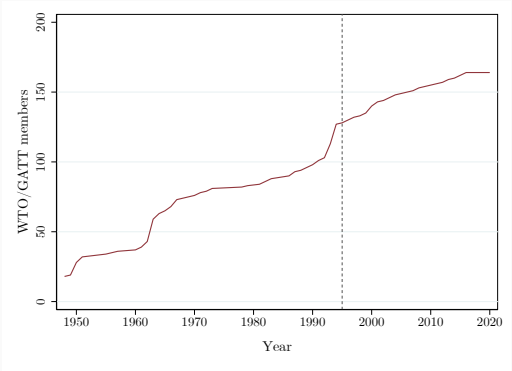
Motivation

- After Doha round of trade talks frozen, multilateralism is seen as a less preferred option (Baldwin, 2016).
- The regional trade agreements (RTAs) are more suited to the rise of offshoring and GVC as they go beyond the barriers the WTO addresses, such as IPR, labor standards, or investment measures (Baldwin, 2016).
  - ✓ This broader scope of RTAs seemed to reform the globalization regime (*from multilateralism to regionalism).
- A series of reversals in global economic integration in the last decade have slowly turned against globalization (Irwin, 2020):
  - ✓ US withdrawal from the Trans-Pacific Partnership
  - ✓ UK's exit from EU
  - ✓ Many renegotiation of existing trade agreements (Dutt, 2020)

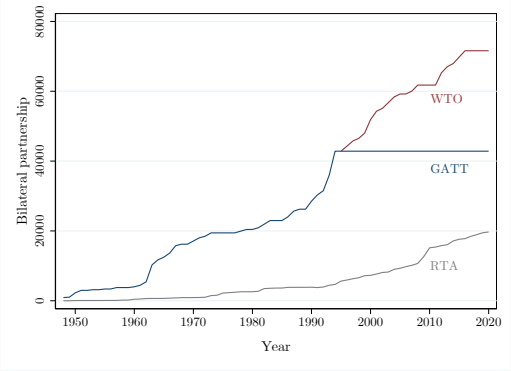
What We Do

- This study investigates how multilateralism developed over time in the agri-food GVC with the rise and fall of regionalism.
  - ✓ The study relies on a **three-way gravity** framework and **sector-level GVC flow** data covering from 1991 to 2020.
  - ✓ We examine the multilateral liberalization via WTO over time, accounting for the dynamics of the RTA developments.
  - ✓ **Event studies** are used to assess short- and long-run consequences.
  - ✓ Investigate **differential effects** across WTO membership type and economic development levels.

GATT/WTO and RTA Development



(a) Number of WTO members.



(b) Country pairs under policies.

GVC Definition

- A GVC includes “a series of stages involved in producing a product or service sold to consumers, with each stage **adding value**, and at least two stages being produced in **different countries**” (Antràs, 2020).
- We use a **macro approach** to decompose the value-added components of exports to define bilateral GVC flows (Borin and Mancini, 2019; Hummels et al., 2001, 1998; Koopman et al., 2014).
  - ✓ Domestic value-added (**DVA**): Value added in exports by domestic industries.
  - ✓ Foreign value-added (**FVA**): Value added in exports by foreign industries.→ ”**Backward** GVC participation”
  - ✓ Indirect value-added (**DVX**): Value added that is embodied in the exports of other countries.→ ”**Forward** GVC participation”

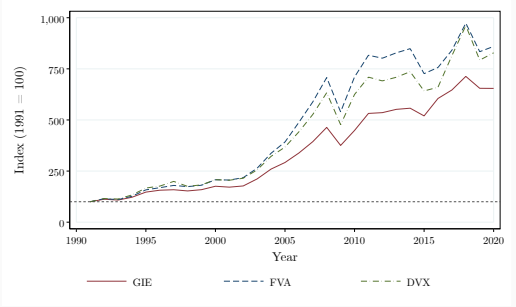
The matrix of the value-added content of trade

	Country 1	Country 2	Country 3	⋯	Country N	
Country 1	F^{11}	F^{12}	F^{13}	⋯	F^{1N}	DVX
Country 2	F^{21}	F^{22}	F^{23}	⋯	F^{2N}	
Country 3	F^{31}	F^{32}	F^{33}	⋯	F^{3N}	
⋯	⋯	⋯	⋯	⋯	⋯	
Country N	F^{N1}	F^{N2}	F^{N3}	⋯	F^{NN}	
	FVA					

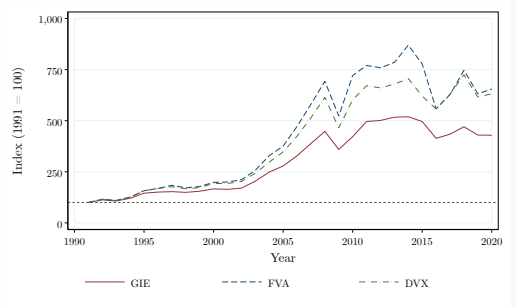
Note. F^{rs} is a matrix showing inter-sector flows between country r and country s.

- ✓ Total Value Added (**TVA**) = DVA + FVA
- ✓ Total Indirect Value Added (**TVX**) = DVA + DVX

Evolution of GVC Flows



(a) Agricultural Sector.



(b) Food Sector.

Note. Gross Industry Exports (GIE), calculated using multi-region input-output data for international trade components, can be compared to traditional export statistics.

Comparing with other sources (*Gross Exports).

Trade Liberalization and Agri-food GVC

- Because GVCs entail multiple border crossings, trade barriers have magnifying effects on GVC flows (Balié et al., 2019; Ferrantino, 2012; Greenville et al., 2017; Maskus et al., 2005).
- Accordingly, lowering these barriers becomes proportionately crucial for the facilitation of GVCs.
- No existing study exclusively assesses this aspect, as numerous studies concentrate on conventional trade flows (Anderson, 2010; Bureau et al., 2019; Grant and Boys, 2012; Honma, 2006).

Structural Gravity Framework

We rely on a multi-sector IO framework (Shepherd, 2022):

- Producers choose intermediates from the lowest-cost supplier, then sell their outputs domestically or in foreign markets.

$$\pi_{ij}^{kv} = \frac{\lambda_j^k \left[c_j^k \kappa_{ij}^{kv}\right]^{-\theta^k}}{\sum_{h=1}^{N} \lambda_h^k \left[c_h^k \kappa_{ih}^{kv}\right]^{-\theta^k}} \tag{1}$$

- π_{ij}^{kv} is the export share of i in j's imports for sector k and end use v.
- λ_j^k and θ^k denote the Fréchet distribution for Ricardian productivity.
- c_j^k is the cost of an input bundle and κ_{ij}^{kv} is the iceberg trade costs.

Empirical Specification

We add an explicit time subscript t to the GVC flow model, leading to the three-way gravity model:

$$X_{ijt}^{kv} = \exp\Big(\alpha_{it}^{kv} + \gamma_{jt}^{kv} + \delta_{ij}^{kv} + \beta_{\tau}\tau_{ijt}^{kv}\Big) \times \exp\Big(\sum_{n=1991}^{2020} \beta_n I(n)_{ij}\Big) \times \eta_{ijt}^{kv}\,, \tag{2}$$

- X_{ijt}^{kv} is GVC flows from country i to j in sector k for end use v in year t.
- α_{it}^{kv} and γ_{jt}^{kv} are the fixed effects capturing the inward and outward trade resistance terms.
- δ_{ij}^{kv} is the directional dyadic fixed effect.
- τ_{ijt}^{kv} is the vector of trade cost dummies (e.g., both are GATT/WTO members; RTA partners).
- $I(n)_{ij}$ is a dummy variable taking the value of one for international trade for each year T, and zero otherwise. $\rightarrow$ 'Globalization Measure' (Bergstrand et al., 2015).

Data

2023 Eora global supply chain database (Lenzen et al., 2013): Summary Statistics.

- A multi-region input-output (MRIO) sector-level table.
- About 16,000 sectors and 190 countries from **1991 to 2020**.
- We classified 26 aggregated sectors using the ISIC (Rev.3) system.
  - → Agriculture: 01 (*Agriculture*) & 02 (*Forestry*)
  - → Food: 15 (*Manufactured food and beverage*) & 16 (*tobacco products*)

Trade liberalization:

- GATT/WTO membership (World Trade Organization, 2023a).
- Economic integration agreement database (NSF-Kellogg Institute, 2023).
  - → All bilateral trade agreements until 2017.
  - → Complemented with the RTAs reported to WTO (World Trade Organization, 2023b).

Baseline Results

	TVA	TVX	TVA	TVX
(a) Agricultural Sector				
GATT/WTO	0.471***	0.369***	0.449***	0.364***
	(0.049)	(0.049)	(0.046)	(0.048)
RTA	-	-	0.076***	0.040**
			(0.016)	(0.018)
Observations	1,048,696	1,048,136	1,048,696	1,048,136
Pseudo *R*-squared	0.999	0.999	0.999	0.999
(b) Food Sector				
GATT/WTO	0.489***	0.442***	0.480***	0.425***
	(0.043)	(0.054)	(0.042)	(0.051)
RTA	-	-	0.040**	0.091***
			(0.016)	(0.016)
Observations	1,047,950	1,047,950	1,047,950	1,047,950
Pseudo *R*-squared	0.999	0.999	0.999	0.999

Table 1. GATT/WTO Effects on Agri-food GVC Flows.

- We transformed the semi-elasticity estimates using $(\exp(\beta) - 1) \times 100$.
- **Agriculture**: 56.7 % more TVA and 43.9 % more TVX between GATT/WTO members.
- **Processed food**: 61.6 % more TVA and 53.0 % more TVX between GATT/WTO members.

✓ RTA does not significantly influence GATT/WTO effects but is positively associated with GVC flows to a smaller degree.

Go to Gross Export Comparison.

Treatment Dynamics

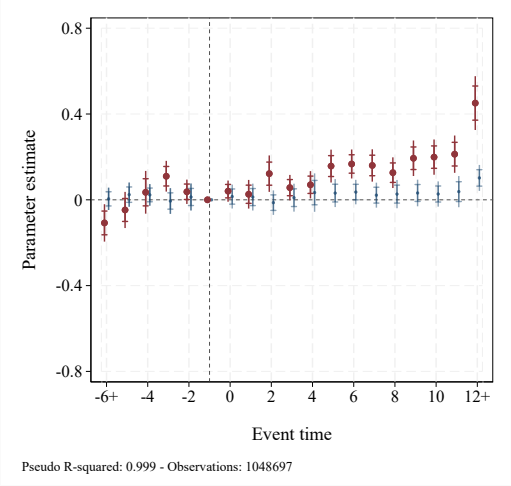
Understanding the dynamics of GVC flow adjustments to trade policy changes is vital (Anderson and Yotov, 2023; Egger et al., 2022).

- ✓ The treatment **anticipation** and a **delayed** response to trade policy changes.
- ✓ Both GATT/WTO and RTA may take time to manifest themselves due to rounds of negotiation, phase-in periods for tariff and non-tariff barrier reduction schedules, and granting periods for developing countries (Bagwell and Staiger, 1999; Burstein and Melitz, 2013; Flentø and Ponte, 2017)

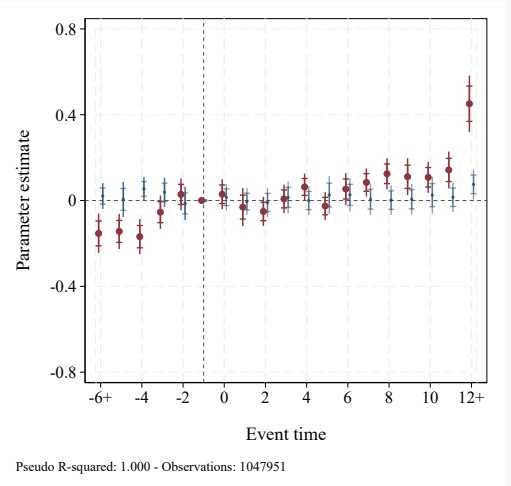
We rely on the following event study design:

$$X_{ijt}^{kv} = \exp\Big(\alpha_{it}^{kv} + \gamma_{jt}^{kv} + \delta_{ij}^{kv} + \sum_{r \neq 0} 1\left\{\tau_{ijt}^{kv} = r\right\} \beta_{\tau}^{r}\Big) \times \exp\Big(\sum_{n=1990}^{2020} \beta_n I(n)_{ij}\Big) \times \eta_{ijt}^{kv}\,, \tag{3}$$

Treatment Dynamics Results i

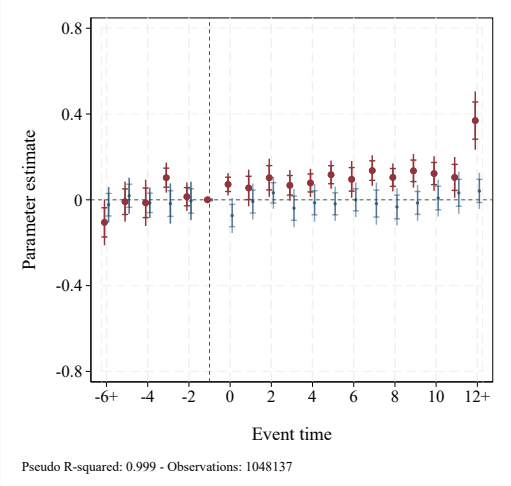


(a) Agricultural TVA.

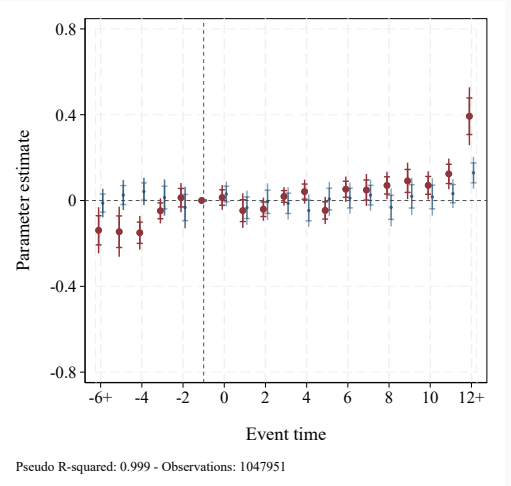


(b) Food TVA.

Treatment Dynamics Results ii



(c) Agricultural TVX.



(d) Food TVX.

Heterogeneity by GATT/WTO Membership

There is a potential heterogeneity of WTO effects when formal membership in the GATT is supplemented (Dutt, 2020; Grant and Boys, 2012; Tomz et al., 2007).

- We estimate Eq. 2 and Eq. 3 but allow for distinct WTO membership effects for the three sets of dyads in a single estimation:
  1. Both countries are formal GATT members
  2. One country is a formal GATT member.
  3. Both are newly joined the WTO.

Heterogeneity by GATT/WTO Membership

	Agricultural Sector		Food Sector	
	TVA	TVX	TVA	TVX
Both old (GATT)	0.055	0.192***	0.107**	0.271***
	(0.042)	(0.068)	(0.043)	(0.063)
Old & new	0.318***	0.272***	0.310***	0.294***
	(0.054)	(0.054)	(0.054)	(0.045)
Both new (WTO)	0.118	0.127	0.066	0.117*
	(0.098)	(0.096)	(0.099)	(0.067)
RTA	0.076***	0.041**	0.039**	0.090***
	(0.016)	(0.018)	(0.016)	(0.016)
Observations	1,048,696	1,048,136	1,047,950	1,047,950
Pseudo *R*-squared	0.999	0.999	0.999	0.999

Table 2. Differential Effects by GATT/WTO Membership Type.

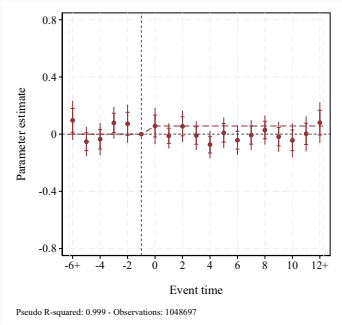
- There are substantial differential effects across membership types.
- During the last three decades (1991-2020):

✓ The agri-food GVC has developed the most between old and new members.

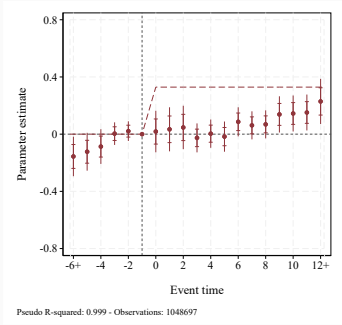
✓ No statistically significant evidence of the GVC development between new members.

Heterogeneity by GATT/WTO Membership

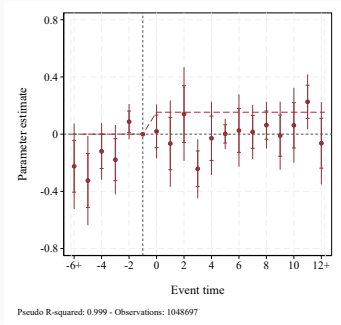
Figure. Agriculture TVA.



(a) Both old.



(b) Old & new.



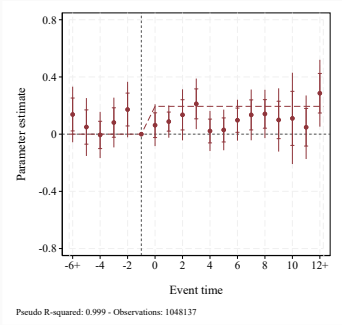
(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

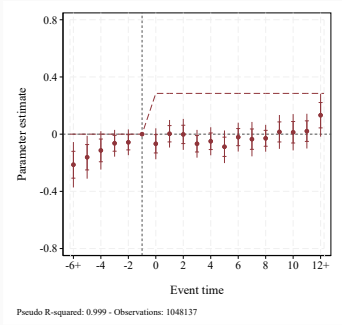
Pre-period adjusted.

Heterogeneity by GATT/WTO Membership

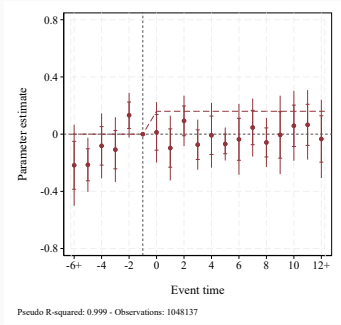
Figure. Agriculture TVX.



(a) Both old.



(b) Old & new.



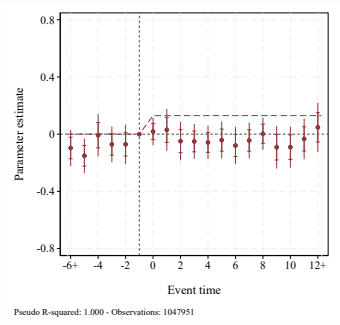
(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

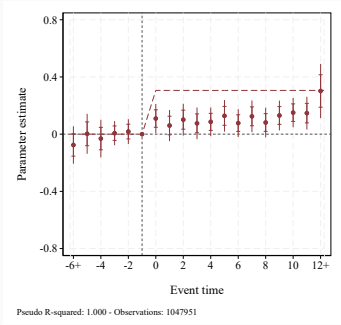
Pre-period adjusted.

Heterogeneity by GATT/WTO Membership

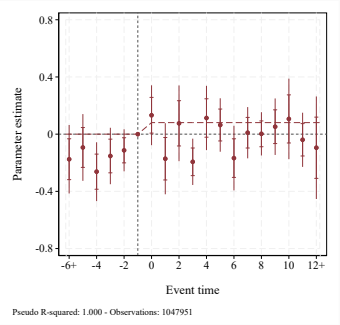
Figure. Food TVA.



(a) Both old.



(b) Old & new.



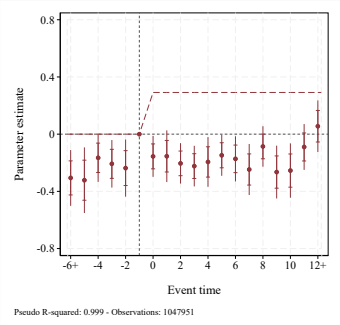
(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

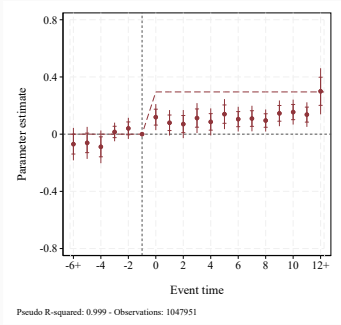
Pre-period adjusted.

Heterogeneity by GATT/WTO Membership

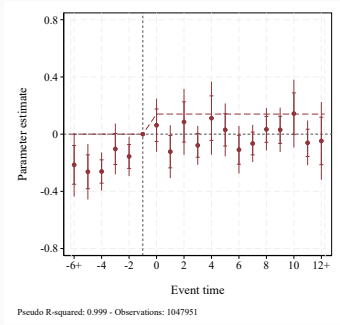
Figure. Food TVX.



(a) Both old.



(b) Old & new.



(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

Pre-period adjusted.

Heterogeneity by Economic Development Stage

There are asymmetric treatments between developed and developing countries in WTO and RTA (Flentø and Ponte, 2017; Subramanian and Wei, 2007; Tang and Wei, 2009).

- ✓ Development countries face immediate tariff reduction while developing countries are initially granted fewer obligations to liberalize tariff barriers in GATT/WTO (Subramanian and Wei, 2007).
- ✓ RTA often creates asymmetric treatment between countries in different development stages due to the unequal capability to standard harmonization, IPR, or environmental regulations (Disdier et al., 2014, 2008; Santeramo and Lamonaca, 2022)

→ We categorize transactions into four directions based on income classification: North and South.

Heterogeneity by Economic Development Stage

	Agricultural Sector		Food Sector	
	TVA	TVX	TVA	TVX
GATT/WTO				
– North-to-South	0.339***	0.325***	0.405***	0.439***
	(0.057)	(0.065)	(0.049)	(0.077)
– North-to-North	0.479***	0.338***	0.480***	0.405***
	(0.062)	(0.054)	(0.062)	(0.053)
– South-to-North	0.445***	0.370***	0.455***	0.459***
	(0.060)	(0.057)	(0.062)	(0.056)
– South-to-South	0.421***	0.395***	0.472***	0.461***
	(0.053)	(0.060)	(0.047)	(0.065)
RTA				
– North-to-South	0.091***	0.055**	0.050**	0.072***
	(0.024)	(0.028)	(0.021)	(0.023)
– North-to-North	0.013	0.023	-0.025	0.115***
	(0.025)	(0.029)	(0.030)	(0.024)
– South-to-North	0.159***	0.084***	0.092***	0.103***
	(0.030)	(0.026)	(0.031)	(0.025)
– South-to-South	0.039**	0.015	0.050**	0.081**
	(0.019)	(0.029)	(0.024)	(0.040)
Observations	1,026,080	1,026,263	1,026,080	1,026,080
Pseudo *R*-squared	0.999	0.999	0.999	0.999

Table 3. Differential Effects by Income Level.

- No evidence showing substantial differences across transactions by income class for GATT/WTO effects on agri-food GVC flows.
- RTA is more likely associated with positive agri-food GVC flows between developed and developing countries.

✓ RTA extends beyond mere tariff reduction; our findings provide evidence of its role in eliminating non-tariff barriers between North and South.

Conclusion

The WTO is not Passé for agri-food GVC.

- GATT/WTO positively correlates with recent agri-food GVC development.
- No evidence shows a shift in the agri-food GVC regime towards RTAs.
- WTO's impact increases over time, surpassing RTA's influence on agri-food GVC.

Heterogeneous WTO effects by membership types and income levels.

- The recent agri-food GVC development was more pronounced among WTO members when at least one trading partner holds formal GATT membership.
- WTO's multilateral liberalization leads to an even development regardless of income levels, while RTA effects are more prominent between North and South.

Q&A

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Appendix ii

Table A1. Summary Statistics.

	Mean	SD	Δ(1991/2020)	Min.	Max.
(a) Agricultural Sector					
TVA	12.50	457.00	0.21	0	101,210
TVX	8.39	296.00	0.17	0	56,923
(b) Food Sector					
TVA	12.90	804.00	0.18	0	597,204
TVX	13.50	890.00	0.20	0	612,959
(c) All Sectors					
TVA	12.90	804.00	0.18	0	597,204
TVX	13.50	890.00	0.20	0	612,959

Note. Δ(1991/2020) represents the annual growth rate. The units for the remaining statistics are scaled in million USD.

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Appendix ii

Table A2. WTO Effects on Agri-food Gross Export Flows.

	GIE	GIE
(a) Agricultural Sector		
WTO/GATT	0.401***	0.388***
	(0.065)	(0.065)
RTA		0.058**
		(0.023)
Observations	1,049,069	1,049,069
Pseudo *R*-squared	0.999	0.999
(b) Food Sector		
WTO/GATT	0.390***	0.385***
	(0.071)	(0.072)
RTA		0.033*
		(0.018)
Observations	1,049,069	1,049,069
Pseudo *R*-squared	0.999	0.999

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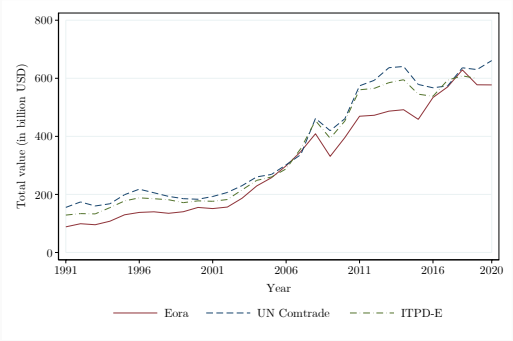
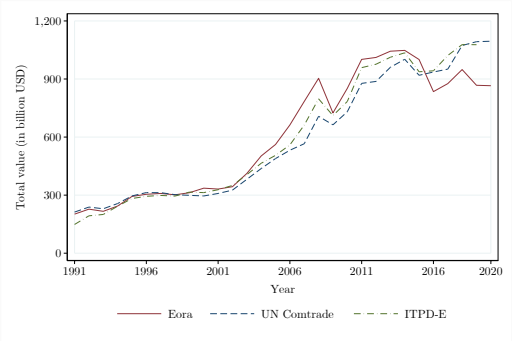
Appendix iii



(a) Agricultural Sector.



(b) Food Sector.

Note. The figure compares the gross exports based on the 2023 Eora database with UN Comtrade and ITPD-E.

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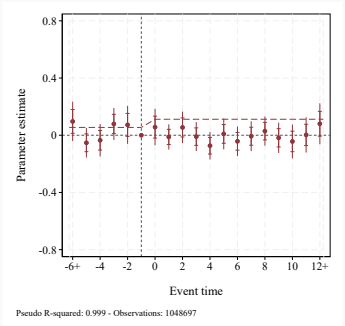
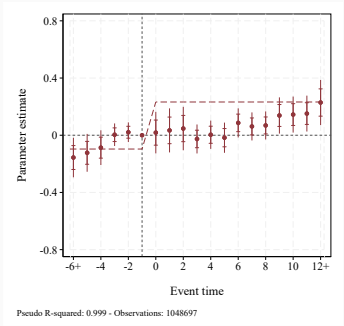
Appendix iv - 1

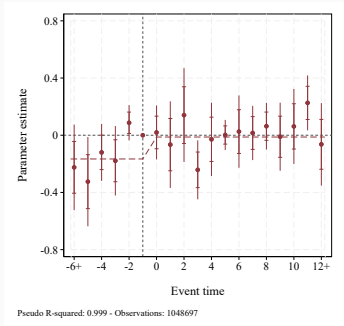
Figure. Agriculture TVA.



(a) Both old.



(b) Old & new.



(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

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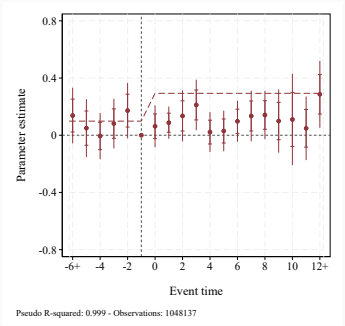
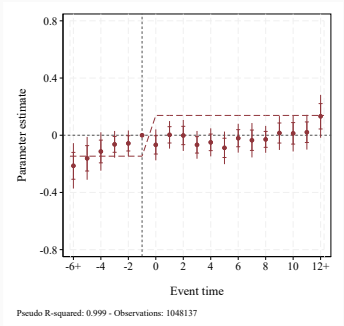
Appendix iv - 2

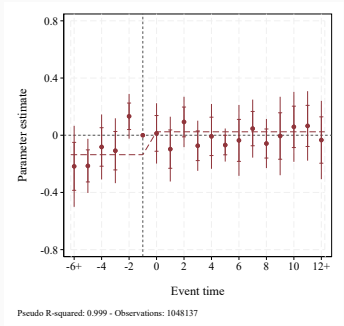
Figure. Agriculture TVX.



(a) Both old.



(b) Old & new.



(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

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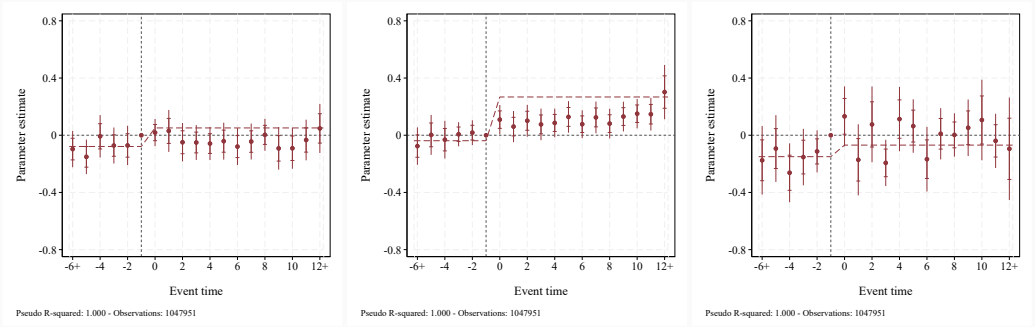
Appendix iv - 3

Figure. Food TVA.



(a) Both old. (b) Old & new. (c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

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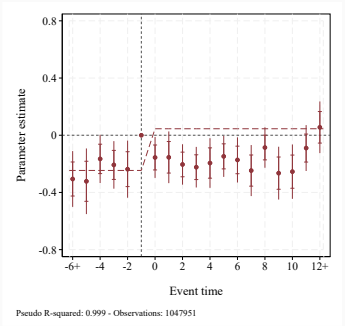
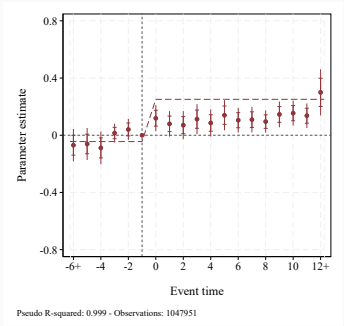
Appendix iv - 4

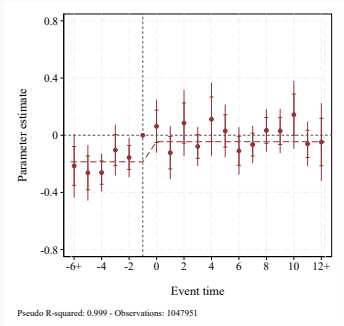
Figure. Food TVX.



(a) Both old.



(b) Old & new.



(c) Both new (WTO).

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients.

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