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International Agricultural Productivity, Trade and the Global Food Dollar

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Selected presentation for the International Agricultural Trade Research Consortium's (IATRC's) 2022 Annual Meeting: Transforming Global Value Chains, December 11-13, 2022, Clearwater Beach, FL.

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United States Department of Agriculture

International Agricultural Productivity, Trade and the Global Food Dollar

*IATRC Annual General Meetings
December 11-13, 2022*

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Overview

Background on ASTAR program and global food dollar (GFD)
→ U.S. food dollar (Canning et al., md) and GFD (Yi et al. 2021)

Production and trade data for agri-food value chains (AVCs)
→ Agri-food environmental economic data system (Ag-FEEDs)
→ International agricultural productivity accounts
→ Trade flows and costs

Preliminary findings: graphical observations and regressions

Next steps: re-export, services, supports, robustness controls

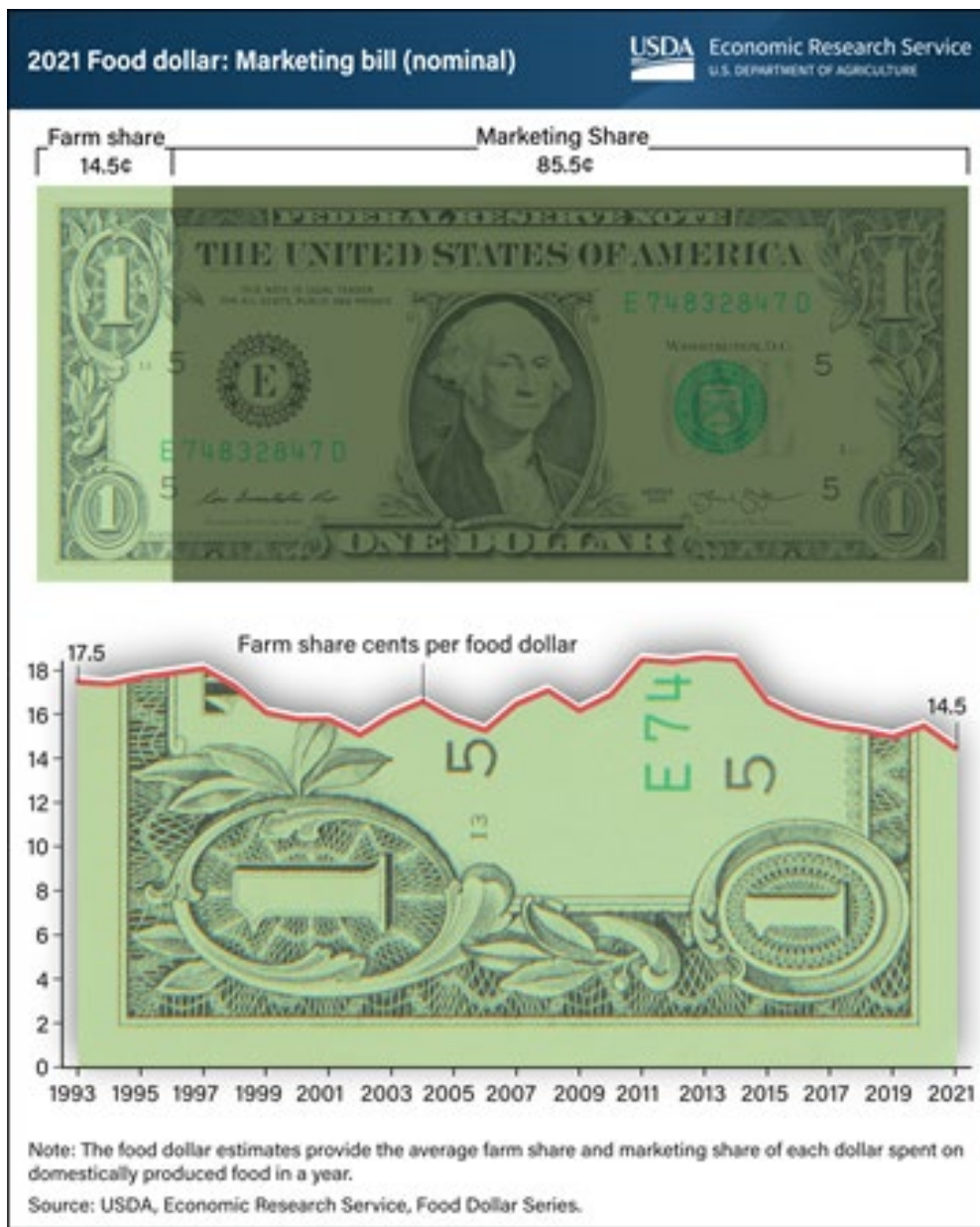


U.S. food dollar

Widely recognized metric
(USDA ERS, 11/28/2022)

AVC shares, Canning (2011)
→ Farm and marketing
(i.e., post-farmgate)

GFD and ASTAR program
expands approach
internationally
(Yi et al. 2021)



Global food dollar and ASTAR

Agri-food Systems Targeted Applied Research

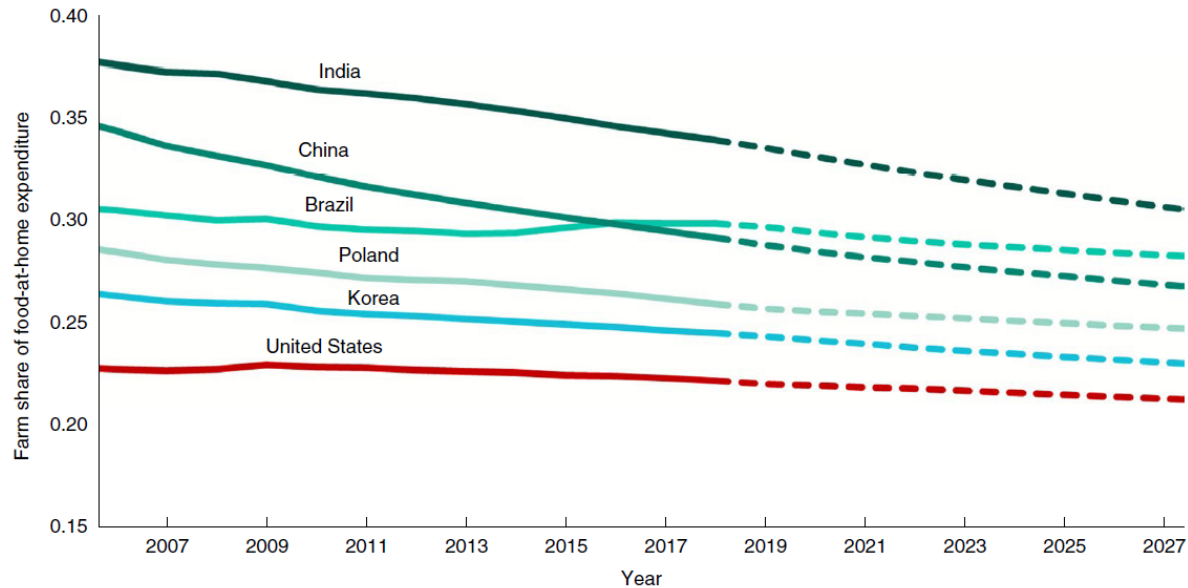


Fig. 4 | Farm share of at-home food expenditures for selected countries, 2005-2030. Farm shares for the period 2005-2018 (solid line) are calculated from the multivariate regression model (see Supplementary Information) using actual real GDP per capita for the years 2005-2018 (purchasing power parity adjusted, constant 2011 terms) and actual, inflation-adjusted agricultural land productivity for the years 2005-2016 (constant 2004-2006 terms). Agricultural productivity for the years 2017 and 2018 is assumed to grow at the average rate from 2005 to 2016. Projections of farm shares for the period 2019-2030 (dashed lines) are calculated from the econometric model (see Supplementary Information), using the OECD's GDP per capita long-term forecast (downloaded from <https://data.oecd.org/gdp/real-gdp-long-term-forecast.htm#indicator-char>) and the 2005-2016 average agricultural land productivity growth rate. In the regression model, the number of observations in each year is 64, 64, 64, 66, 64, 93, 81, 83, 87, 86 and 92 for the years 2005-2015, respectively.

(Source: Yi et al. 2021)



Agri-food value chains, productivity and trade

Value chain analysis is complex, agri-food sector *no exception*:

- Low-middle income countries, food security (Barrett et al. 2022)
- Globalization of agri-food systems and value chains evident

Sourcing and comparative advantage:

- Production environment and/or productivity
(e.g. climate, tech., soil quality, etc.)
- Trade flows and costs
(e.g., policy and transportation)



International agricultural productivity

USDA ERS data product established in 2013 (Fuglie & Rada)

Data sources (e.g., FAOSTAT), global coverage 1961 to 2020

Total factor productivity (TFP):

“Growth accounting” measure (e.g., Solow residual)

- Differenced annual rates, output (ΔY) – input (ΔX)
 - Inputs (land, labor, capital, materials)
 - Outputs (crops and animals)



International trade flows and costs

Trade flows data, net agri-food import/export (FAOSTAT):

- Agri-food products (USD)
- Live animals (USD)

Trade costs indexes (WTO), 42 countries, 2000-18:

- Net trade, imports, and exports, 5-part costs:
 1. Transport and travel cost
 2. Information and transaction cost
 3. ICT connectedness
 4. Trade policy and regulatory differences
 5. Governance quality



Building on the global food dollar (GFD)

Agri-food environmental economic data system (Ag-FEEDs):

- 61 countries, covers ~90% agri-food consumption
 - 4-step process to compile initial Ag-FEEDs (Yi et al., 2021)
 - +3 steps, append production and trade (flow and cost) data

Step 5: International Agricultural Productivity (USDA ERS IAP)

Output – crop and animal; TFP index (all years)

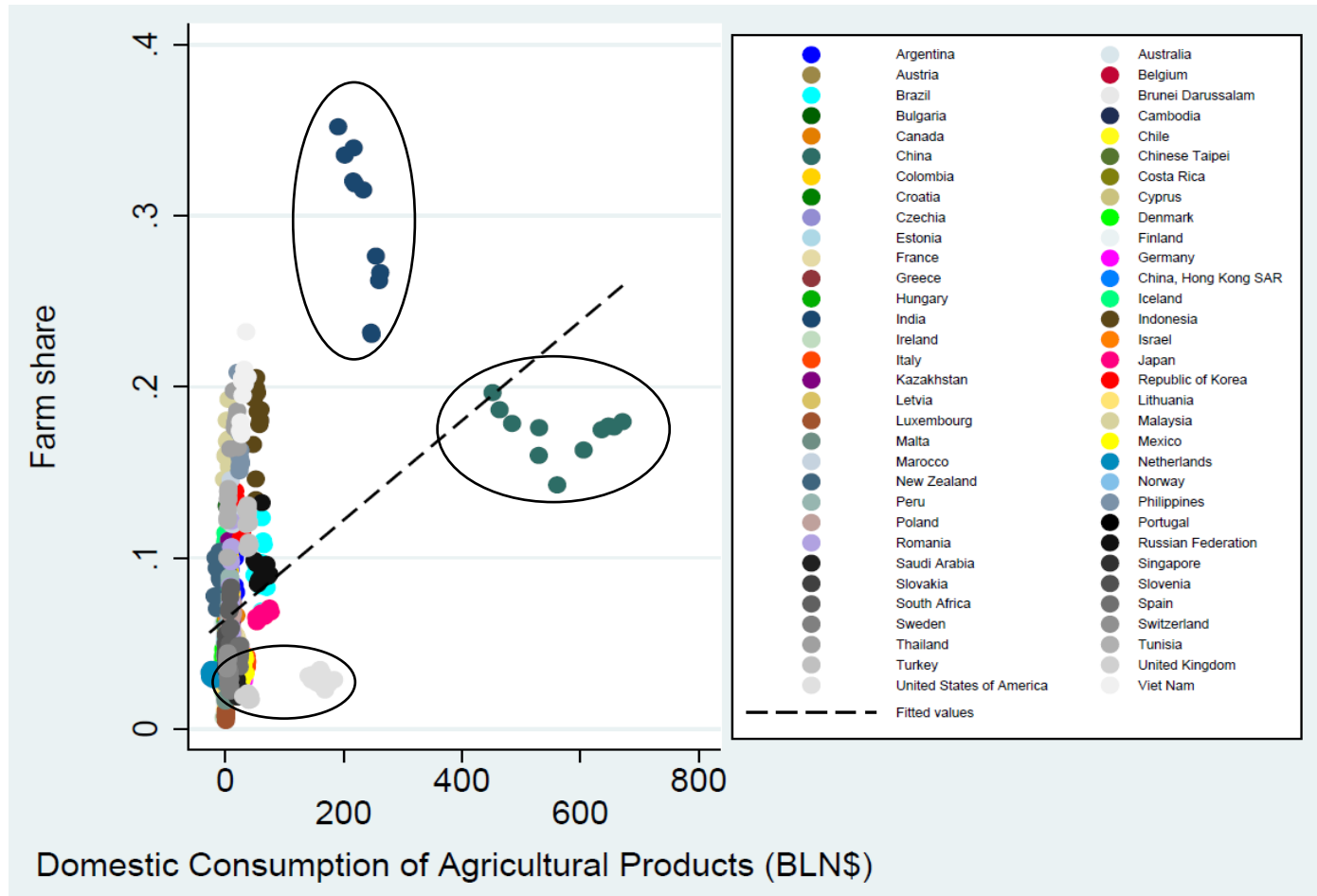
Step 6: Trade flow – net (exp.-imp.) crop and animal (all years)

Step 7: Trade cost index – net, imp., exp. (42 countries, 2000–18)



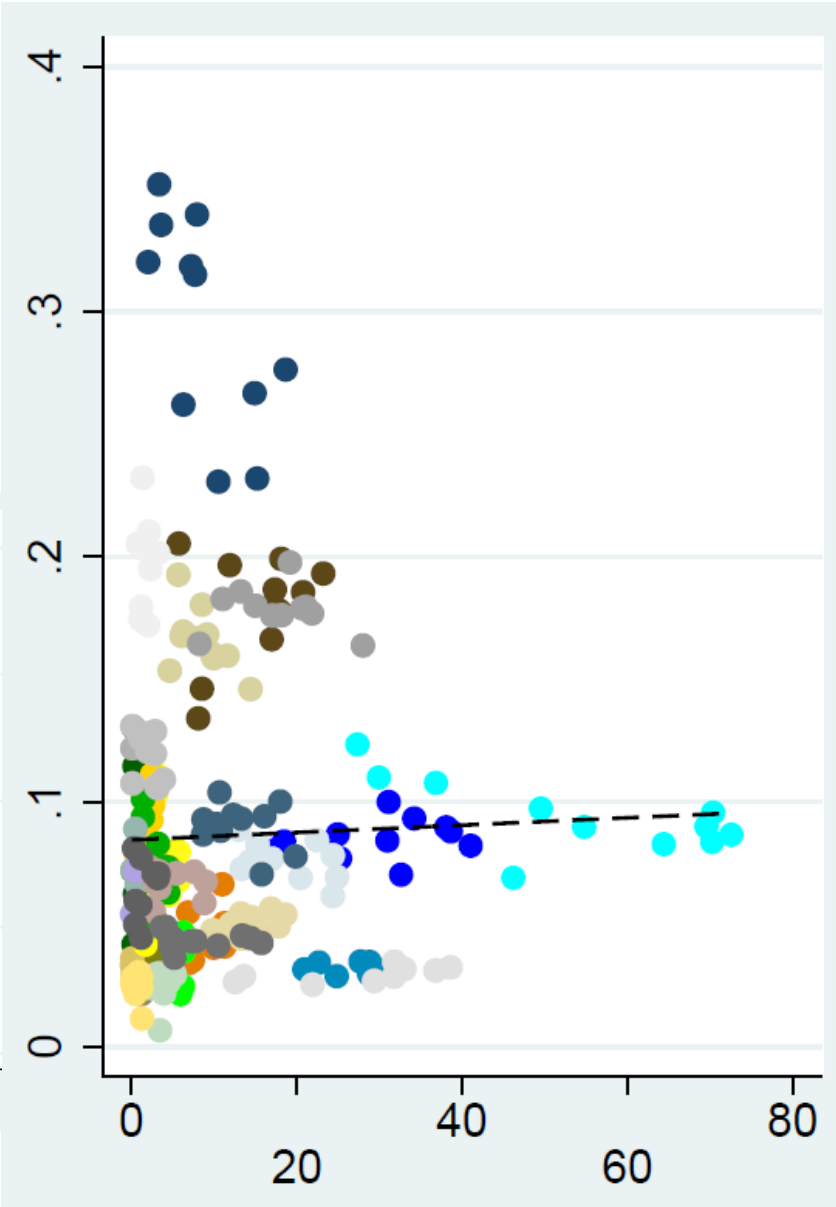
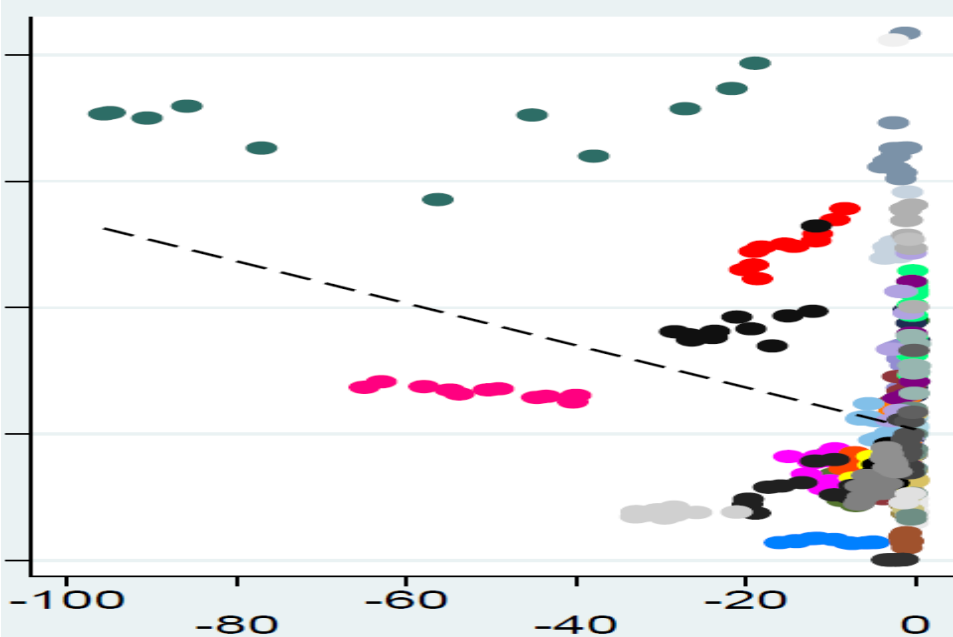
Graphical observation 1

Standouts: India (top), China (right), and US (bottom)

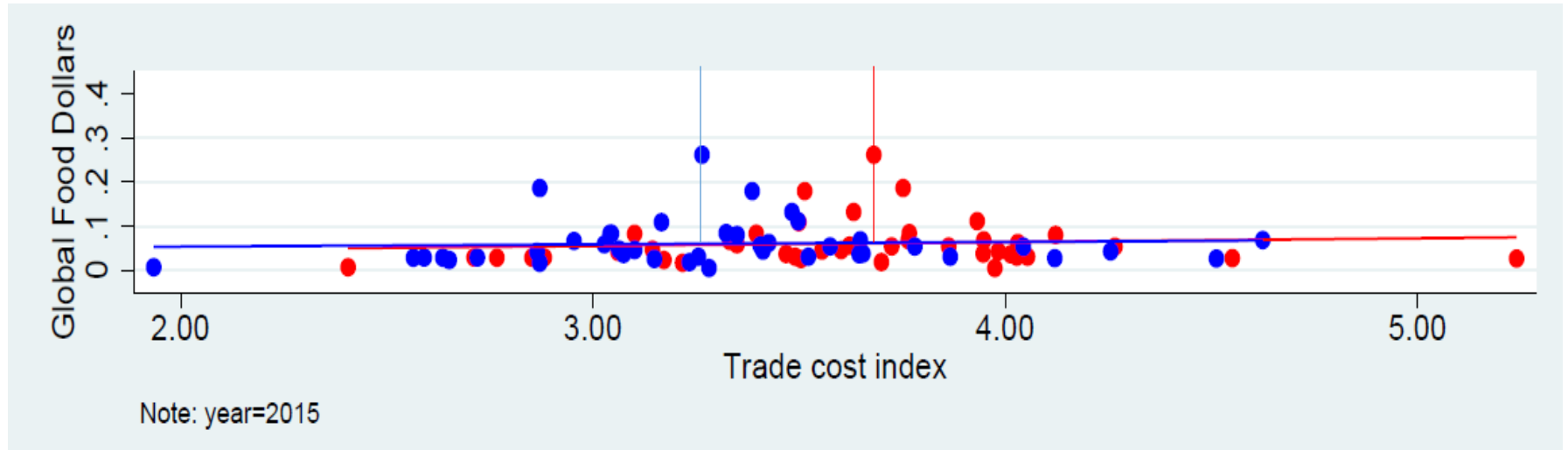


Graphical observation 2

GFD farmer share correlated with trade imbalance



Graphical observation 3



AVCs, trade costs and farm share of GFD (y-axis):

→ Upstream (red) and Downstream (blue)

→ *Bell-shaped relationship*



Regression analysis: GFD, production and trade

Estimation of log-linear model: $y_{it} = \alpha_i x_{jit}^{\beta_j} z_{kit}^{\delta_k} c_{lit}^{\gamma_l} + \varepsilon_{it}$

y_{it} = farm share of GFD in country i and year t

x_j = production variables: crops (x_1), animals (x_2), TFP (x_3)

z_k = trade flows: crops (z_1, z_3) and animals (z_2, z_4)

- Domestic consumption = output + import – export (z_1, z_2)

- Net export = export – import (z_3, z_4)

c_l = trade cost: upstream (c_1, c_2) and downstream (c_3, c_4)

- Import cost index (ICI) (c_1, c_3)

- Export cost index (ECI) (c_2, c_4)



Regressions results and preliminary findings

Variable (log)	Coefficient
Output crop (x1)	0.136***
Output animal (x2)	0.192
TFP agriculture (x3)	-0.182***
Consumption crop domestic (z1)	-0.029***
Consumption animal domestic (z2)	-0.254**
Export crop net (z3)	-0.023***
Export animal net (z4)	-0.007***
ICI upstream (c1)	0.131***
ECI upstream (c2)	0.177***
ICI downstream (c3)	-0.200***
ECI downstream (c4)	-0.164***
Year (t)	-0.003**
Constant	6.070***

Associations with GFD farm share

Farm share increasing in output, crops significant

TFP growth favors post farmgate

Eat local? Large producers?

Greater post farmgate share

Post farmgate value added share greater for net exporters

↑ inputs and comm. trade cost

↑ farm share

↑ “food” trade cost, ↓ farm share

Post farmgate share growth over time (Yi et al. 2021, figure 4)



Next steps, the global food dollar and trade

Address (strong) assumption by Yi et al. (2021):

- *“Exports are entirely sourced from domestic production and imports are entirely absorbed by domestic uses”*

Service sector trade (e.g., Muñoz, 2022) and AVCs

Subsidies and sectoral protection rates (e.g., Anderson)

Expand regression analysis:

- Robustness checks – levels vs. index; base year; additional controls (e.g., country income, agri-inputs); model specification (e.g., non-linear)
- Endogeneity and suitable instrumental variables





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