Global Agricultural Value Chains and Food Prices

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Summary

- What is the effect of **global agricultural value chain (GAVC) participation on food price levels and volatility**?
- We assemble a **panel data set** from 2000-2015 using UNCTAD, FAOSTAT, and WDI data
- Identification strategy: **Shift-share instrument** (Bartik IV)
- We find a **trade-off between first- and second-order effects on welfare** to GAVC participation: Food prices decline, but food price volatility increases
- The latter runs counter to conventional wisdom
- The reason is a **lack of diversification** (or increased concentration) in GAVCs

Price level is different from volatility

- Price level is a **different** concept than price volatility
- Price volatility refers to **upwards and downwards** fluctuations, at **constant** price level
- Prices levels can be high or low
- There can be high price volatility at low prices and low volatility at high prices

Masks in early 2020

THE CORONAVIRUS CRISIS

Not Enough Face Masks Are Made In America To Deal With Coronavirus

March 5, 2020 · 5:06 AM ET
Heard on Morning Edition

Borders Didn't Stop The Pandemic. But They Might Block The Trade Of Medical Goods

April 8, 2020 · 5:00 AM ET

Imports of medical supplies plummet as demand in U.S. soars

Health Mar 20, 2020 6:30 PM EDT

Masks later in 2020

N95 Masks and the Coronavirus: More Production Underway

Millions more of the respirators will be made in the United States and around the world.

Masks in 2021

A Glut of Chinese Masks Is Driving U.S. Companies Out of Business

Remember when N95s were in short supply? American companies stepped in to manufacture them. Now, they can't compete.

America's mask makers face post-pandemic meltdown

Russian invasion of Ukraine and global grain supply

Food security + Add to myFT

Ukraine war sparks food shortages in Arab nations as wheat prices soar

Grains and vegetable oil from Ukraine and Russia are crucial to national diets across the region

Policy response

Egypt Cancels 240,000 Tons of Ukrainian Wheat Contracts

- State buyer GASC canceled four cargoes on supplier requests
- Wheat-importer Egypt has adequate stockpiles of grain

Egypt: Decline in Ukraine Wheat Imports Drives Egypt to Diversify its Suppliers

June 22, 2022 | Attaché Report (GAIN) | EG2022-0015

Food self sufficiency policy

Ukraine war shows that food is foremost

Farmer, fertiliser, food, famine collectively constitute the biggest takeaway from the ongoing Russia-Ukraine conflict. Not fire-power or bombs, missiles or guns. The fallout is so alarming that even Canada, the world's sixth biggest wheat producer, is going all out to produce more. The basics are simple: produce more, expand storage.

Trinidad and Tobago: professor calls for greater focus on local food production

Inflation reduction act of 2022

- 400B $ **subsidy for clean energy and technology**
- Restricted to products with sizable **domestic value generation**
- Phasing out **suppliers of concern**

Motivation

- Multiple **global events** ignite international market, price and supply shocks and induce local shortages
- Economies – that are connected through trade and increasingly through GVCs – are **impacted by events elsewhere**
- In addition: Environmental & social concerns: **sustainable local food**
- Governments implement **trade restricting policies**, focus more on self-sufficiency and *onshoring* of key industries
- What are the **welfare effects of GVC participation**?
- Economic theory:
  - Trade and GVCs protect from **local (and global) shocks through diversification**
  - Trade and GVC **expose to global shocks through specialization**

Contributions

1. **Trade & Uncertainty**
   Turnovsky (1974), Batra and Russell (1974), Feder et al. (1977), Newbery and Stiglitz (1984), Gouel and Jean (2013), Novy and Taylor (2020)
2. **Welfare effects of GAVC**
   (Lim and Kim, 2022; Montalbano and Nenci, 2022; Ndubuisi and Owusu, 2021; Balié et al., 2019)
3. **Political economy of agricultural trade & uncertainty**
   (Berger et al., 2021; Gouel, 2016; Pieters and Swinnen, 2016; Rude and An, 2015; Bellemare et al., 2013; Martin and Anderson, 2012; Schmitz et al., 1981)

Outline

1. Introduction
2. Theoretical framework
3. Data and descriptive statistics
4. Empirical framework
   - 4.1 Estimation strategy
   - 4.2 Identification strategy
5. Results
6. Robustness checks and mechanisms
7. Additional Results
8. Political economy discussion
9. Conclusion

Theoretical framework

Arkolakis et al. (2012): Gains-from-trade can be expressed as

$$\widehat{W} = \widehat{\lambda}^{\frac{1}{\varepsilon}} \tag{1}$$

- $\widehat{W} = \frac{W'}{W}$: change in welfare
- $\widehat{\lambda} = \frac{\lambda'}{\lambda}$ change in the share of expenditure on domestic goods, λ is 1 minus the import penetration ratio
- ε: elasticity of trade

Three extensions to reflect GVC trade:

1. Decomposition of import penetration ratio,
2. Add dependency of trade sequences, and
3. Introduce uncertainty

Decomposition of import penetration ratio

In absence of storage, imports will either end up in production for domestic market or exports

$$\lambda = 1 - (\frac{M_p}{P} - \frac{M_x}{X}), \tag{2}$$

- M: Imports
- P: Production
- X: Exports
- $\frac{M_x}{X}$: Imports-in-Exports viz. GVC activity

Dependency on sequenced trade (chain)

GVC: Goods cross multiple borders during the production process. We can simply feature this circumstance by expressing GVC value generation of a country as the share ϕ of the sum of the value generated (r) along the entire value chain:

$$GVC = \phi \sum_{i=1}^{I} r_i \tag{3}$$

where I is the length of the GVC, and each country's welfare gain from GVC participation can be expressed as a share of total value generation along the value chain. So

$$\frac{M_x}{X} = \phi \sum_{i=1}^{I} r_i. \tag{4}$$

Uncertainty

$$\frac{W(r,p)'}{W(r,p)} = \left(\frac{\delta + \phi \sum_{i=1}^{I} r_i p_i'}{\delta + \phi \sum_{i=1}^{I} r_i p_i} \right)^{\frac{1}{\varepsilon}}. \tag{5}$$

- W: Welfare
- $\delta = 1 - \frac{M_p}{P}$ i.e. imports in production with domestic final utilization
- $\phi \sum_{i=1}^{I} r_i p_i$: GVC trade with return r and probability p
- ε: elasticity of trade
- Government will implement trade and GVC policy to steer r and p, returns and uncertainty.
- We estimate the effect of GVC participation on price levels and price (un)certainty

Empirical Strategy

Roadmap of empirical strategy & data

- Compile **GAVC**s indicators (EORA-UNCTAD)
  - Sector specific input-output data
- Compile food price and volatility indicators (FAO)
- Estimate the effect of GVC participation on **real food price levels** and **volatility**
- Research design: **shift-share instrument** (Bartik IV) with **shares**-driven identification (industry shares are exogeneous)
- We focus on agriculture and food because food
  - (i) is a necessity good that is consumed in all countries at comparable rates and risk preferences of consumers are well known,
  - (ii) is traded in all countries,
  - (iii) has limited storage capabilities, and
  - (iv) data is widely available.

Data

Global Value Chain Participation

- We use UNCTAD-EORA Multi-Region **Input-Output (MRIOs) tables** to measure **participation in agricultural GVCs** (2 sectors: Agriculture and Food & Beverages) following (Koopman et al., 2014).

$$GAVC_{it} = \frac{DVX_{it}^{agr} + DVX_{it}^{food} + FVA_{it}^{agr} + FVA_{it}^{food}}{X_{it}^{agr} + X_{it}^{food}}, \tag{6}$$

where

- FVA: value of exports that originate from imported inputs
- DVX: domestic value-added in intermediate goods and re-exported.

We also measure

- **upstream participation**, $\frac{FVA_{it}^{j}}{X_{it}^{agr}+X_{it}^{food}}$, and
- **downstream participation**, $\frac{DVX_{it}^{j}}{X_{it}^{agr}+X_{it}^{food}}$

Agricultural Global Value Chain participation by country

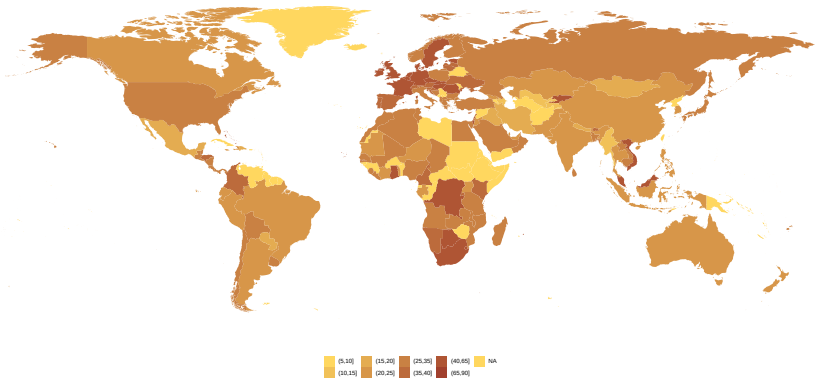

Figure: GAVC participation in % of exports by country in 2015

Food price data

- Source: Monthly FAOSTAT consumer food price index (FCPI) from 2000-2015
- **Real food price level**: Average FCPI weighted by PPP exchange rate in a year

$$p_{it} = \frac{1}{12} \sum_{i=1}^{12} FCPI_{im} * PPP_{im}, \tag{7}$$

- **Food price volatility:** Average coefficient of variation of monthly FCPI in a year

$$CV_{it}^{p} = \frac{\sigma_{pit}}{\mu_{pit}}. \tag{8}$$

Food price volatility is higher in LICs

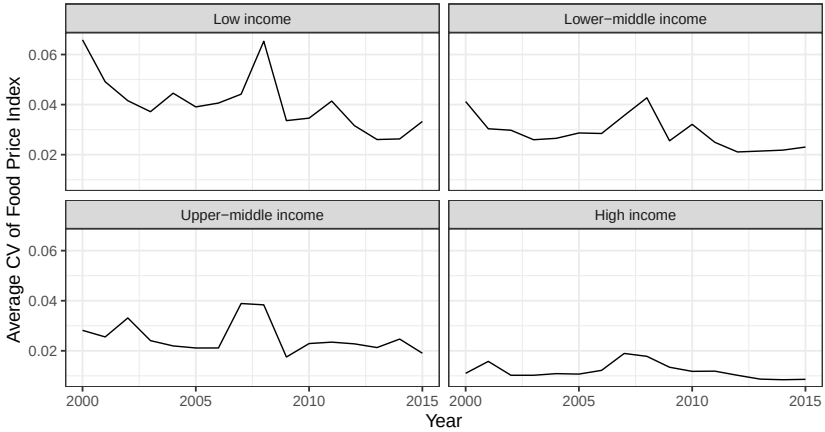

Figure: Average within-year coefficient of variation of food price index by income group

Global Food price variation

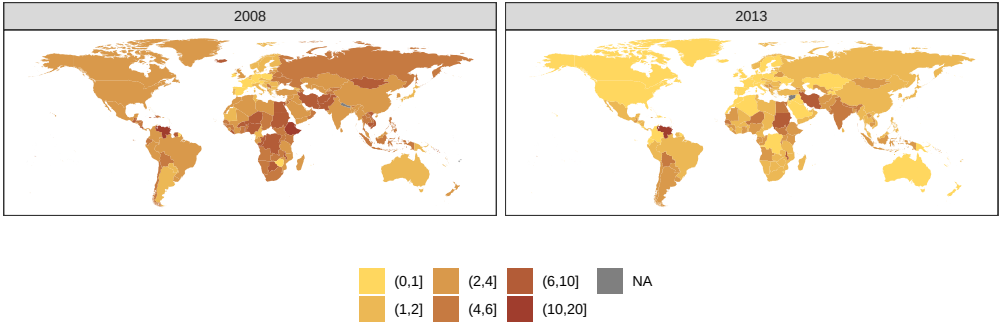

Figure: Global within-year food price variation in 2008 and 2013 in %

Estimation Strategy

Food price level equation:

$$p_{it} = \beta_1 GAVC_{it} + \gamma_1' X_{it} + \delta_{1i} + \eta_{1t} + e_{1it}, \tag{9}$$

Food price variation equation:

$$CV_{it}^{p} = \beta_2 GAVC_{it} + \gamma_2' X_{it} + \delta_{2i} + \eta_{2t} + e_{2it} \tag{10}$$

Problem: Endogeneity of GAVC participation

- Prices can affect GAVC participation (simultaneity)
- Omitted variables: e.g. supply-side and demand-side drivers

Identification

Shift-share instrument (Bartik, 1991)

$$z_{it} = \frac{1}{gexp_{it}} \sum_k (\overbrace{w_{ik,t-1}}^{Share} \overbrace{e_{kt}}^{Shift}) \tag{11}$$

consists of the

- $w_{ik,t-1}$ sector-specific GVC share of industry k at year $t-1$; country i's share of the global k-sector
- e_{kt}: sum of all countries' GAVC participation in sector k (i.e., the shift, global shock)
- z_{it}: predicted GAVC participation as weighted global industry shocks
- Valid if the sector distribution across countries in *Agriculture* and *Food & Beverages* are exogenous to food prices, food price volatility and unobservables.
- We argue that **sector distribution in agriculture is largely driven by natural endowments**

Results

Real food price level

Table: Effects of GAVC on food price level, Bartik IV

Dependent Variable	Log food price level					
Model	OLS	Bartik IV				
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
GAVC share	-1.650**	-5.035***	-3.582***	-3.066***	-3.012***	-2.331***
	(0.6636)	(1.183)	(1.072)	(0.9326)	(0.8716)	(0.7855)
Agriculture	Yes		Yes	Yes	Yes	Yes
Economy	Yes			Yes	Yes	Yes
Demography	Yes				Yes	Yes
Trade Policy	Yes					Yes
Fixed-effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	2,179	2,171	2,171	2,171	2,171	2,171
R^2	0.94718	0.91585	0.93047	0.93694	0.94187	0.94943
Within R^2	0.47110	0.10774	0.26285	0.33145	0.38369	0.46387

Notes: Clustered (country & subregion) standard-errors in parentheses. Significance codes: ***: 0.01, **: 0.05, *: 0.1. Outcome variable is the lag of real food prices. Treatment is measured as the share of GVC participation ranging between 0-1. The models include 33 control variables relating to agriculture, the economy, trade and trade policy, and demography.

List of controls

Food price variation

Table: Effects of GAVC on food market instability (Bartik IV)

Dependent Variable:	CV of food price index					
Model	OLS	Bartik IV				
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
GAVC share	0.0123	0.1175***	0.0876*	0.0892*	0.0873*	0.0882*
	(0.0374)	(0.0409)	(0.0443)	(0.0469)	(0.0482)	(0.0478)
Agriculture	Yes		Yes	Yes	Yes	Yes
Economy	Yes			Yes	Yes	Yes
Demography	Yes				Yes	Yes
Trade Policy	Yes					Yes
Fixed-effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	2,174	2,174	2,174	2,174	2,174	2,174
F-test (1st stage), GAVC share		1,312.2	1,154.1	1,075.4	1,080.5	1,012.7
R^2	0.58808	0.36167	0.37826	0.57533	0.57837	0.58497
Within Adjusted R^2	0.33939	-0.00648	0.01431	0.32506	0.32720	0.33439

Notes: Clustered (country & subregion) standard-errors in parentheses. Significance codes: ***: 0.01, **: 0.05, *: 0.1. Outcome variable is the within-year coefficient of variation of the CFPI. Treatment is measured as the share of GVC participation ranging between 0-1. The models include 33 control variables relating to agriculture, the economy, trade and trade policy, and demography.

List of controls

How robust are these effects?

- Estimates are robust to
  - Eicker–Huber–White standard errors
  - Adão-Kolesár-Morales (Shift-share) standard errors
- Identifying assumption: Sector distribution between Agriculture and Food & Beverages is exogeneous to food prices, food price volatility and unobservables; It is driven by natural endowments
- Is the instrument *really* exogenous?
- There is no concluding formal test for this. But we can collect evidence (Goldsmith-Pinkham et al., 2020)
  1. Alternative estimators
  2. Test for overidentification
  3. Relationship between industry shares and covariates Results

Alternative IV estimators and test for overidentification

Table: Alternative IV estimators (TWFE and country correlates)

	β	SE	EHW-SE	HTE-robust SE	IM-SE
OLS	0.012310	0.020506	0.021629		
Bartik TSLS	0.088224	0.034570	0.045442	0.045442	
LIML	0.087524	0.034570	0.046798		0.036188
MBTSL	0.089327	0.034589	0.046846	0.046856	
TSLS	0.013935	0.029141	0.022237		
	Overidentification (Sargan) test: $p = 0.919357$				

LIML: Limited information maximum likelihood (Anderson and Rubin, 1949), MBTSL: Modification of bias-corrected two-stage least square (Kolesár et al., 2015), IM-SE: Information Matrix based SE

- Other estimators using the Bartik IV are very similar to Bartik TSLS
- Sargan's J does not reject that the two instruments are exogeneous, i.e. the two instruments do not correlate with the error

Whats driving industry shares?

Table: Relationship between industry shares and country characteristics

Dependent Variable Model:	Agriculture (1)	Food and Beverages (2)	Bartik IV (3)
Variables			
Agricultural land (sq. km)	2.47×10^{-8} (2.26×10^{-8})	$2.99 \times 10^{-8*}$ (1.75×10^{-8})	5.89×10^{-7} (3.91×10^{-7})
Arable land (hectares)	-1.47×10^{-9} (2.45×10^{-9})	3.21×10^{-9} (1.98×10^{-9})	$8.79 \times 10^{-8**}$ (4.1×10^{-8})
Land under cereal production (hectares)	$-8.8 \times 10^{-9**}$ (4.1×10^{-9})	$-6.59 \times 10^{-9*}$ (3.6×10^{-9})	$-6.64 \times 10^{-7***}$ (1.01×10^{-7})
Land area (sq. km)	1.58×10^{-8} (9.83×10^{-9})	-5.85×10^{-9} (8.03×10^{-9})	$6.11 \times 10^{-7***}$ (1.85×10^{-7})
Food production index (2004-2006 = 100)	0.0016*** (0.0006)	0.0014*** (0.0004)	0.0740*** (0.0129)
Livestock production index (2004-2006 = 100)	-9.67×10^{-5} (0.0005)	-0.0008* (0.0005)	-0.0229* (0.0126)
Capture fisheries production (metric tons)	-1.15×10^{-8} (2.63×10^{-8})	-3.36×10^{-8} (2.17×10^{-8})	$-1.17 \times 10^{-6***}$ (2.88×10^{-7})
Total fisheries production (metric tons)	-6.31×10^{-9} (1.93×10^{-8})	$2.56 \times 10^{-8*}$ (1.53×10^{-8})	$5.52 \times 10^{-7***}$ (2.1×10^{-7})
Agriculture forestry and fishing value added (% of GDP)	-0.0004 (0.0011)	-0.0010 (0.0009)	0.0319 (0.0221)
Exports of goods and services (% of GDP)	0.0014** (0.0006)	0.0014** (0.0006)	0.1233*** (0.0161)
Imports of goods and services (% of GDP)	0.0004 (0.0006)	0.0013** (0.0006)	
GDP (constant 2010 US$)	-1.17×10^{-14} (3.1×10^{-14})	$6.07 \times 10^{-14**}$ (2.9×10^{-14})	$1.16 \times 10^{-12**}$ (5.83×10^{-13})
GDP growth (annual %)	0.0019 (0.0023)	0.0017 (0.0019)	-0.0818* (0.0437)
Regional Trade Agreements (RTA)	-0.0012** (0.0006)	9.34×10^{-5} (0.0006)	0.0687*** (0.0148)
Customs Unions (CU)	0.0065*** (0.0021)	0.0052*** (0.0017)	0.4819*** (0.0478)
Free Trade Agreements (FTA)	0.0023*** (0.0008)	0.0006 (0.0006)	0.0349* (0.0194)
Fit statistics			
Observations	136	136	2,174
R^2	0.37142	0.52444	0.50491
Adjusted R^2	0.16806	0.37058	0.49680

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Each column reports results of a single regression of a 2001 industry share on 2010 characteristics. The final column is the Bartik instrument constructed using the growth rates. List of controls Back

Why does volatility increase with GVC participation

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- GVCs are many sequenced trade connections. Each connection is dependent on the previous connection.
- Each connection is associated with a probability of trade occurrence
- If businesses source diversified shocks can easily be absorbed
- If business suppliers are concentrated, shocks are propagated

Concentration vs. Diversification

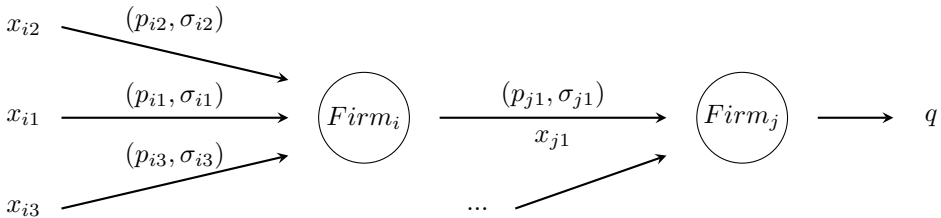

Figure: Diversification of GVCs. x are inputs, p input prices, σ the associated probability of input delivery, and the subscripts i and j describe two subsequent stages in a value chain.

- Firms source inputs (x_i) from J sources (J countries)
- For profit maximization, firms minimize $\sum x_{ij} p_{ij}$
- Under uncertainty, firms also maximize J and minimize $Cov(\sigma_j \sigma_k)$ for $j \neq k$

Agri-food value chains are not diversified

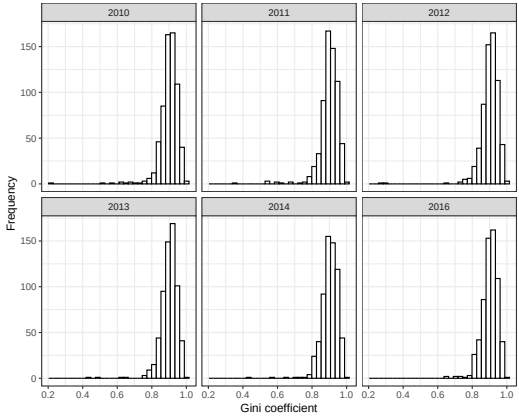

Figure: Frequency of GINI coefficients of agri-food commodities. We use UN COMTRADE data and select commodities at the 6-digit level Harmonised System (HS) code. We subset to chapters 01 - 24 (Food and Agriculture) and calcualte GINI coefficients of origins for 649 commodities for the years from 2010-2015. The higher the coefficient the more concentrated (unequal) are supply countries.

Simpson

Global division of labor and specialization

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- Adam Smith: *"...defence, however, is more important than opulence"* (Book IV, Chapter II, p. 465)

Additional Results

Positioning: Food price level

Table: Effects of GAVC position on food price level (Bartik IV)

Dependent Variable	Log food price level				
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
GAVC - Position	-9.558***	-6.405**	-6.248**	-6.217**	-4.578**
	(2.706)	(2.288)	(2.420)	(2.300)	(1.814)
Agriculture		Yes	Yes	Yes	Yes
Economy			Yes	Yes	Yes
Demography				Yes	Yes
Trade Policy					Yes
Fixed-effects					
Country	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	2,171	2,171	2,171	2,171	2,171
F-test (1st stage), GAVC - Position	210.25	203.16	151.55	151.77	156.45
R^2	0.862	0.908	0.913	0.917	0.936
Within Adjusted R^2	-0.455	0.027	0.077	0.114	0.313

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: Clustered (country & subregion) standard-errors in parentheses. Significance codes: ***: 0.01, **: 0.05, *: 0.1. Outcome variable is log of real food prices. Treatment is is an index ranging from -1 to 1 where -1 is exclusively forward-type GAVC and 1 is forward-type GAVC participation. The models include 33 control variables relating to agriculture, the economy, trade and trade policy, and demography.

List of controls

Table: Effects of GAVC position on food market instability (Bartik IV)

Dependent Variable	CV of food price index				
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
GAVC - Position	0.2230***	0.1566*	0.1815*	0.4748	0.1711*
	(0.0703)	(0.0750)	(0.0890)	(11.80)	(0.0856)
Agriculture		Yes	Yes	Yes	Yes
Economy			Yes	Yes	Yes
Demography				Yes	Yes
Trade Policy					Yes
Fixed-effects					
Country	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	2,174	2,174	2,174	2,174	2,174
F-test (1st stage), GAVC - Position	210.22	203.45	151.84	158.55	163.49
R^2	0.356	0.384	0.571	0.265	0.581
Within Adjusted R^2	-0.015	0.024	0.318	-0.172	0.328

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Notes: Clustered (country & subregion) standard-errors in parentheses. Significance codes: ***: 0.01, **: 0.05, *: 0.1. Outcome variable is within-year coefficient of variation of the CFPI. Treatment is is an index ranging from -1 to 1 where -1 is exclusively forward-type GAVC and 1 is forward-type GAVC participation. The models include 33 control variables relating to agriculture, the economy, trade and trade policy, and demography. List of controls

By region: Food price level

Table: Effects of GAVC on food price level, by region (Bartik IV)

Dependent Variable	Log food price level					
Contintent	All	EA & P	E & CA	LA & C	ME & NA	SSA
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
GAVC share	-2.503***	0.4451	-2.688*	-5.484	-3.687**	-2.588
	(0.8631)	(0.3560)	(1.286)	(2.069)	(0.9960)	(1.459)
Agriculture	Yes	Yes	Yes	Yes	Yes	Yes
Economy	Yes	Yes	Yes	Yes	Yes	Yes
Demography	Yes	Yes	Yes	Yes	Yes	Yes
Trade Policy	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	2,043	290	654	354	252	493
F-test (1st stage), gvc_share	908.30	-102.43	205.10	352.46	72.101	64.190
R^2	0.948	0.982	0.977	0.973	0.985	0.925
Within Adjusted R^2	0.470	0.778	0.722	0.631	0.854	0.389

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

By region: Food price variation

Table: Effects of GAVC on food market instability, by region (Bartik IV)

Dependent Variable	CV of food price index					
Contintent	All	EA & P	E & CA	LA & C	ME & NA	SSA
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
GAVC share	0.0864	-0.0067	-0.0416	-0.0856	-0.3231	0.5775*
	(0.0512)	(0.0336)	(0.0328)	(0.1191)	(0.2210)	(0.2256)
Agriculture	Yes	Yes	Yes	Yes	Yes	Yes
Economy	Yes	Yes	Yes	Yes	Yes	Yes
Demography	Yes	Yes	Yes	Yes	Yes	Yes
Trade Policy	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	2,046	290	654	357	252	493
F-test (1st stage), gvc_share	911.60	-102.43	205.10	339.17	72.101	64.190
R^2	0.603	0.693	0.601	0.594	0.698	0.707
Within Adjusted R^2	0.359	0.282	0.261	0.246	0.199	0.562

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Political Economy Implications

Political economy: LIC, LMIC and producers benefit least from GAVCs

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Policy implications

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  - Higher prices? (producers)

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  - Higher volatility?
- Internalizing the externality
- Progressive tariff rates and quotas
- Feasible under GATT article XX1: Exceptions for national security

Conclusions

Conclusion

1. GAVC participation comes with a **trade-off in welfare between consumer prices and uncertainty**
2. Uncertainty of GVC stems from **concentration** and **lack of diversification**
3. Trade-off is more pronounced for **downstream industries**
4. Trade-off is more pronounced in **SSA, LIC and LMIC**
5. The trade-off helps explain longstanding domestic and international political economy issues: **GVC-hesitancy of LICs, LMICs, and producer groups in HICs**
6. Policy could consider diversification using tariff rate quotas

What's next?

The political economy of agri-food value chain diversification

- Agri-food value chains are resilient only if they are diversified
- Need to diversify is inversely proportional to political compatibility (uncertainty) of countries
- Diversification comes at the cost of gains-from trade (anti-specialization)
- There could be tariffs/subsidies (Pigou-type) that reflect diversification and security (*friendshoring*)
- In a way this is implemented in the inflation reduction act

Thank you for your attention

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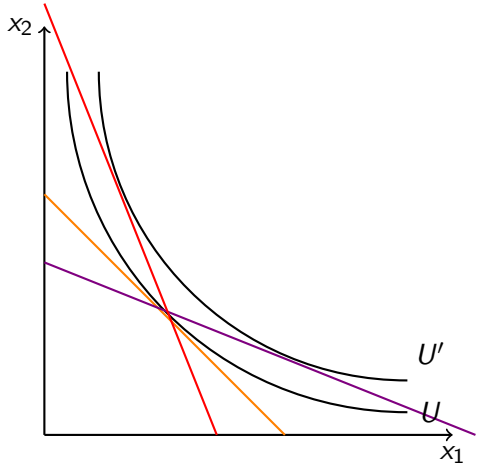
Volatility leads to higher utility for consumers



Adapted from Mas-Colell et al. (1995) Back

Integrated economies have higher food prices and lower volatility

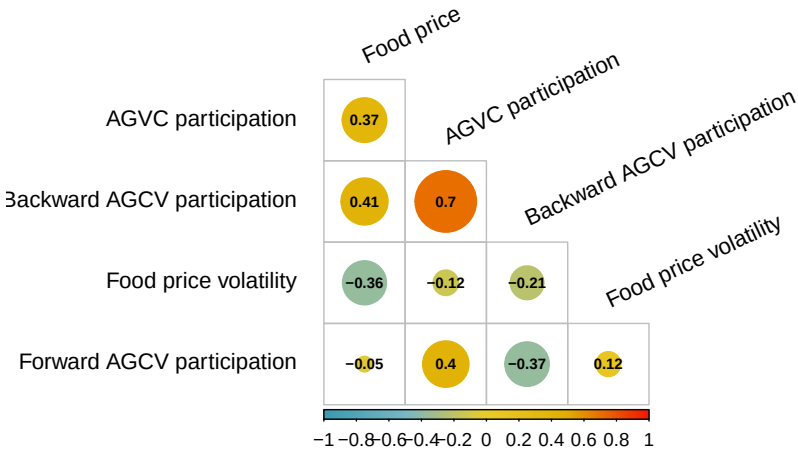


Figure: Correlation matrix of real food prices, food price volatility and GAVC indicators (All significant at the 1% level)

Food price volatility by region

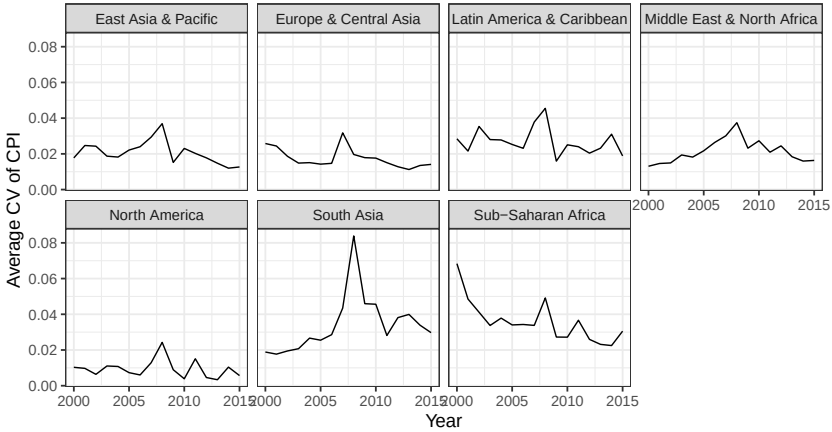


Figure: Average within-year coefficient of variation of food price index by contintent

List of control variables

Demography	Population ages 0-14 total,Population ages 15-64 total,Population ages 65 and above total,Population density (people per sq. km of land area),Population growth (annual %),Population female,Population male,Rural population,Urban population,Population total
Agriculture	Agricultural land (sq. km),Arable land (hectares),Land under cereal production (hectares),Land area (sq. km),Cereal production (metric tons),Food production index (2004-2006 = 100),Livestock production index (2004-2006 = 100),Capture fisheries production (metric tons),Total fisheries production (metric tons),Agriculture forestry and fishing value added (% of GDP)
Economy	Inflation GDP deflator (annual %),GDP (constant 2010 US$),GDP growth (annual %)
Trade	Exports of goods and services (% of GDP),Imports of goods and services (% of GDP)
Trade Policy	Regional Trade Agreements (RTA),Customs Unions (CU),Free Trade Agreements (FTA),Partial Scope Agreements (PSA),Economic Integration Agreements (EIA),Regional Trade Agreements (RTA) (i),Customs Unions (CU) i,Free Trade Agreements (FTA) i,Partial Scope Agreements (PSA) i,Economic Integration Agreements (EIA) i Main results Additional results Robustness check

Shift-share identification

- A weighted sum of a common set of shocks, with weights reflecting heterogeneous exposure shares : $z_l = \frac{1}{gexp_{it}} \sum_k (\overbrace{s_{ln}}^{Share} \overbrace{g_n}^{Shift})$
- The shocks vary at a different level $n = 1, ..., N$ than the shares $l = 1, ..., L$, where we also observe an outcome y & treatment x
- We want to use z_l to estimate β in the model $y_l = \beta x_l + \epsilon_l$
- In trade and GVC applications, we need industry level (or regional level) data
- We use two sectors (according to ISIC Rev 3)
  - **I Agriculture:** Agriculture, hunting and related service activities; Forestry, logging and related service activities; Fishing, aquaculture and service activities incidental to fishing
  - **II Food & Beverages;** Manufacture of food products and beverages and Manufacture of tobacco products

Results by income group: Price level

Table: Effects of GAVC on food price level, by WB income group (Bartik IV)

Dependent Variable	Log food price level			
Income group	Low	Lower-middle	Upper-middle	High
Model:	(1)	(2)	(3)	(4)
Variables				
GAVC share	-1.005	-0.3532	-8.256***	-3.932***
	(1.119)	(0.7375)	(2.083)	(1.128)
Agriculture	Yes	Yes	Yes	Yes
Economy	Yes	Yes	Yes	Yes
Demography	Yes	Yes	Yes	Yes
Trade Policy	Yes	Yes	Yes	Yes
Fixed-effects				
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	365	563	588	655
R^2	0.95705	0.94701	0.93725	0.97377
Within R^2	0.46471	0.58806	0.36709	0.68031

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Results by income group: Volatility

Table: Effects of GAVC on food market instability, by WB income group (Bartik IV)

Dependent Variable	CV of food price index			
Income group	Low	Lower-middle	Upper-middle	High
Model:	(1)	(2)	(3)	(4)
Variables				
GAVC share	0.5739	0.0872	-0.0217	0.0306
	(0.3148)	(0.0503)	(0.0234)	(0.0606)
Agriculture	Yes	Yes	Yes	Yes
Economy	Yes	Yes	Yes	Yes
Demography	Yes	Yes	Yes	Yes
Trade Policy	Yes	Yes	Yes	Yes
Regional Dummies				
Fixed-effects				
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	365	563	591	655
R^2	0.64333	0.65031	0.53908	0.50560
Within R^2	0.54747	0.47217	0.25027	0.13307

Clustered (Country & subregion) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Agri-food value chains are not diversified

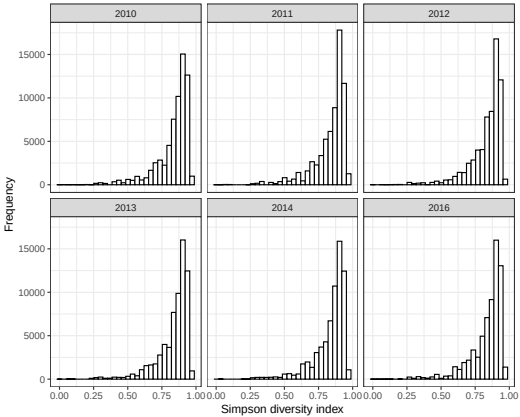


Figure: Frequency of Simpson's diversity index (equivalent to Herschindahl-Hirsch index of agri-food commodity origins. Index is weighted by trade value of the commodity. We use UN COMTRADE data and select commodities at the 6-digit level Harmonised System (HS) code. We subset to chapters 01 - 24 (Food and Agriculture) and calcualte Simpson's diversity index of origins for 649 commodities for the years from 2010-2015. The index indicates the probability that two origin countries taken at random from the dataset represent the same country.

Back

Theoretical framework

Primitives

- Trade and GVC affect consumers and producers through commodity price p and volatility σ
- Unitary household model: consumers are also producers
- Separability of profit and utility functions
- Marketable surplus M_i = Production - Consumption, we we divide between
- Pure consumers, net consumers, net producers, autarkic producers
- Two goods: food (x) and leisure (ℓ). Each good has associated prices $p > 0$ and $w > 0$.
- Consumers and producers interact on markets, and their optimizing behavior determines the relative price of labor w/p.
- The government, adopts policies on the basis of each type of agent's best-response function.
- What are the agents welfare responses to changes in prices and volatility?

Price-volatility regimes and welfare

- **Producers:**
  - Producers maximize profits $\pi_j^*(w,p) = pF(L^*(w,p)) - wL^*(w,p)$ which is increasing in prices
  - Output price volatility leads to producers employing less inputs and forgo expected profits
- **Consumers**
  - Consumer utility is decreasing in prices
  - Can be risk-loving for a specific commodity when the budget share of that commodity is not too large. (Waugh, 1944; Turnovsky et al., 1980, e.e.) Graph
- An agent's coefficient of **absolute price risk aversion** A_i for a given commodity can be described as:

$$A_i = -\frac{M_i}{p}[\beta(\eta - R) + \epsilon_i j] \tag{12}$$

β: budget share of food, $\eta > 0$: income elasticity of her demand for food, R: Arrow-Pratt coefficient of relative (income) risk aversion, ϵ_{ij}: Elasticity of marketable x w.r.t. ℓ (Bellemare et al., 2013; Barrett, 1996)

Consumers

Consumer indirect utility function:

$$V(p, w, y_i) = u[x_i^*(p, w, y_i), \ell_i^*(p, w, y_i)]. \tag{13}$$

curvature of the indirect utility function in the space defined by p, w, and y, such that

$$V_{pp} = \begin{bmatrix} V_{pp} & V_{pw} & V_{py} \\ V_{wp} & V_{ww} & V_{wy} \\ V_{yp} & V_{yw} & V_{yy} \end{bmatrix}, \tag{14}$$

Consumer's coefficient of absolute price risk aversion (Bellemare et al., 2013):

$$A_{pp}^i = -\frac{V_{pp}}{V_y} = \frac{x_i}{p}[\beta(\eta - R) + \epsilon], \tag{15}$$

x_i: demand, β: budget share of food, $\eta > 0$: income elasticity of her demand for food, R: Arrow-Pratt coefficient of relative (income) risk aversion

Producers

Producers indirect utility function:

$$V(p, w, y_j) = u(x_j^*(p, w, y_j), \ell_j^*(p, w, y_j)). \tag{16}$$

Increases in p cause the producer's welfare to increase via her production, but also to decrease via her consumption; the welfare effect of an increase in p depends on whether j is a net seller (i.e., $M_j > 0$) or net buyer (i.e., $M_j < 0$ of food), or whether she is autarkic with respect to food (i.e., $M_j = 0$).
Coefficient of absolute price risk aversion (Bellemare et al., 2013):

$$A_{pp}^j = -\frac{M_j}{p}[\beta(\eta - R) + \epsilon], \tag{17}$$

Government

The government maximizes a social welfare function which adds indirect utility functions of pure food consumers (λ_1), net sellers of food (λ_2), net buyers of food (λ_3), and consumers who are autarkic with respect to food (λ_4), such that

$$\max_{p,\sigma_p} W = \lambda_1 E[V_1] + \lambda_2 E[V_2] + \lambda_3 E[V_3] + (1 - \lambda_1 - \lambda_2 - \lambda_3) E[V_4]. \tag{18}$$

This implies that governments choose between (i) trade openness and high integration of GVCs or (ii) no trade and low integration of GVCs,

$$W_o(p_o, \sigma_{po}) \lesseqgtr W_c(p_c, \sigma_{pc}), \tag{19}$$

and whichever state of trade openness (o) or no trade (c) and GVC integration yields the highest social welfare.

Welfare effects of prices and volatility

	Low volatility	High volatility
Low prices	(Consumers, Producers)	(Consumers, Producers)
High prices	(Consumers, Producers)	(Consumers, Producers)

- Social welfare function adds indirect utility functions of pure food consumers (λ_1), net sellers of food (λ_2), net buyers of food (λ_3), and consumers who are autarkic with respect to food (λ_4):

$$\max_{p,\sigma_p} W = \lambda_1 E[V_1] + \lambda_2 E[V_2] + \lambda_3 E[V_3] + (1 - \lambda_1 - \lambda_2 - \lambda_3) E[V_4]. \quad (20)$$

The Government

- Trade (and GVC integration) affect prices and volatility
- Governments maximize social welfare when choosing between (i) trade openness (o) and high integration of GVCs or (ii) no trade (c) and low integration of GVCs, i.g.

$$W_o(p_o, \sigma_{po}) \lesseqgtr W_c(p_c, \sigma_{pc}), \tag{21}$$

- The effect of trade on prices is well known (gains-from-trade)
- The effect of trade on price volatility is ambiguous, thus an empirical question