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
- Price 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.

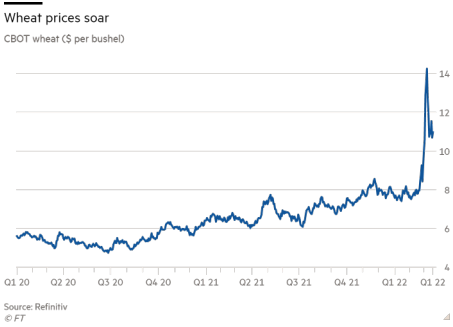
America's mask makers face post-pandemic meltdown

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)

Prices in Global Agri-food Value Chains

The price of food and intermediate inputs along the value chain - produced and consumed in country i - is a function of a mark-up (μ) and marginal cost (MC) (Baqaee and Farhi, 2024):

$$p_{ii} = \mu_{ii} MC \tag{1}$$

Assuming technology (MC) is constant across countries, if $\mu_{ii} > \mu_{ij}$, then the product will be sourced from abroad:

$$p_{ij} = \mu_{ij} MC. \tag{2}$$

Mark-ups can be profits, trade costs, taxes, tariffs or other costs or returns, allowing producers (sellers) to be non-price takers.

$\rightarrow$ **Importing will lead to lower prices**

Price Volatility in Global Agri-food Value Chains

The volatility (instability) of prices can be measured as the *variance* of prices for home-sourced final goods:

$$Var(p_{ii}) = Var(\mu_{ii} MC) \Rightarrow Var(p_{ii}) = \mu_{ii}^2 Var(MC). \tag{3}$$

and for foreign-sourced final goods:

$$Var(p_{ij}) = Var(\mu_{ij} MC) \Rightarrow Var(p_{ij}) = \mu_{ij}^2 Var(MC). \tag{4}$$

as $\mu_{ii}^2 > \mu_{ij}^2$ under trade:

$$Var(p_{ii}) > Var(p_{ij}) \tag{5}$$

$\rightarrow$ **Importing will lead to lower price volatility**

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

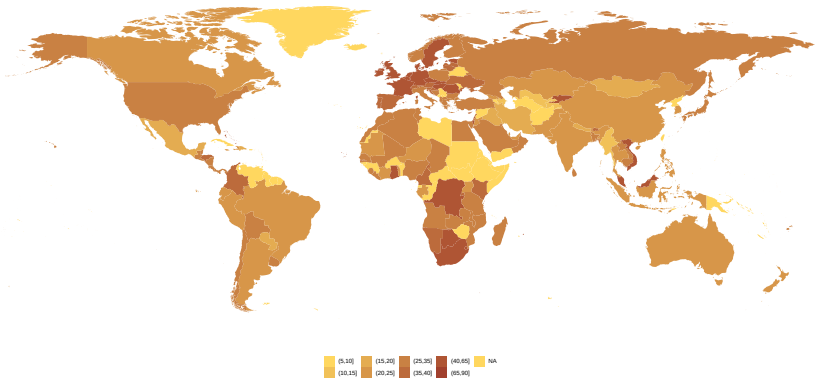


Figure: GAVC participation in % of exports by country in 2015

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

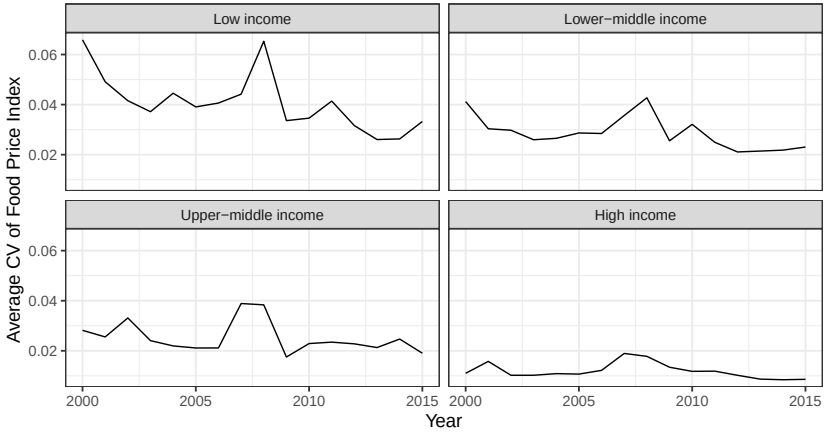


Figure: Average within-year coefficient of variation of food price index by income group

Global Food price variation

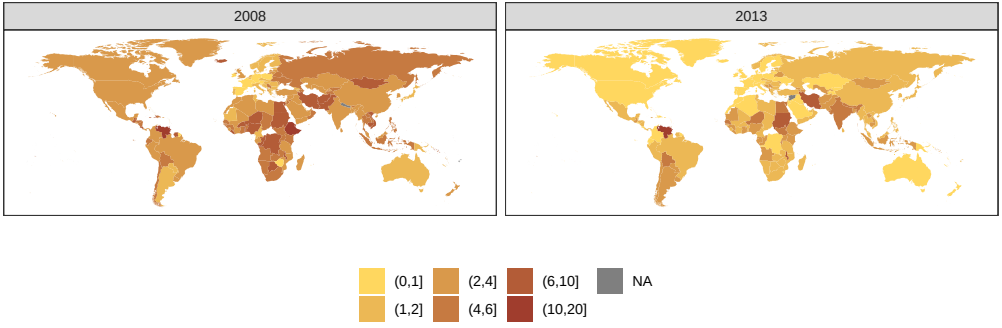


Figure: Global within-year food price variation in 2008 and 2013 in %

Estimation Strategy

Food price level equation:

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

Food price variation equation:

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

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 global sector growth rates in *Agriculture* and *Food & Beverages* are exogenous to food prices, food price volatility and unobservables.
- We argue that **global sector growth is independent of country level food prices**

Results

Real food price level

Table: Participation in GAVCs and food price level

Dependent Variable	Δ Log food price			
FD		OLS		SSIV
	(1)	(2)	(3)	(4)
Δ GAVC share	0.0211***	-0.0243***	-0.0237***	-0.0695***
	(0.0029)	(0.0048)	(0.0048)	(0.0175)
Agriculture			✓	✓
Demography			✓	✓
Trade policy			✓	✓
F-test (1st stage)				215.58
Observations	1,885	1,885	1,885	1,885
R^2	-0.34630	0.37598	0.39915	0.26691
Year fixed effects		✓	✓	✓

Notes: Standard errors in parentheses. ***: 0.01, **: 0.05, *: 0.1.

List of controls

Food price variation

Table: Participation in GAVCs and food price volatility

Dependent Variable	Δ food price volatility			
FD		OLS		SSIV
	(1)	(2)	(3)	(4)
Δ GAVC share	0.1853***	0.0448	0.0485	0.3500**
	(0.0481)	(0.0718)	(0.0732)	(0.1649)
Agriculture			✓	✓
Demography			✓	✓
Trade policy			✓	✓
F-test (1st stage)				216.42
Observations	1,885	1,885	1,885	1,888
R^2	0.01177	0.06391	0.06606	0.04857
Year fixed effects		✓	✓	✓

Notes: Standard errors in parentheses. ***: 0.01, **: 0.05, *: 0.1.

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

- 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

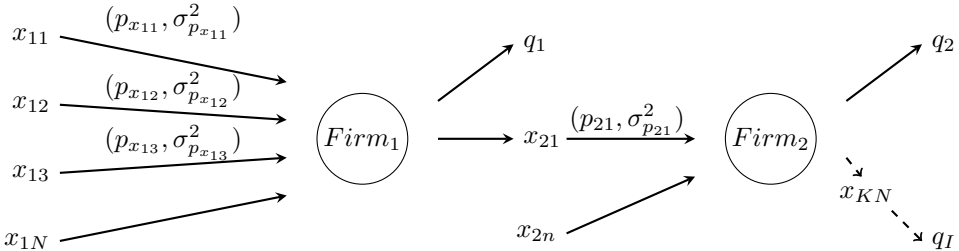


Figure: Diversification of GVCs. x are inputs, p input prices, σ the associated probability of input delivery, and the subscripts i and j describe two subsequent stages in a value chain.

- 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

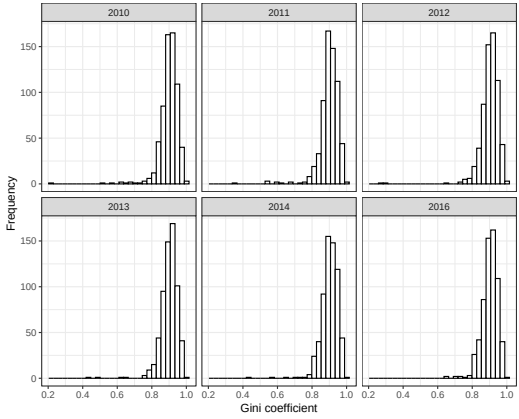


Figure: Frequency of GINI coefficients of agri-food commodities. We use UN COMTRADE data and select commodities at the 6-digit level Harmonised System (HS) code. We subset to chapters 01 - 24 (Food and Agriculture) and calcualte GINI coefficients of origins for 649 commodities for the years from 2010-2015.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

Simpson

Agri-food imports and exports are concentrated

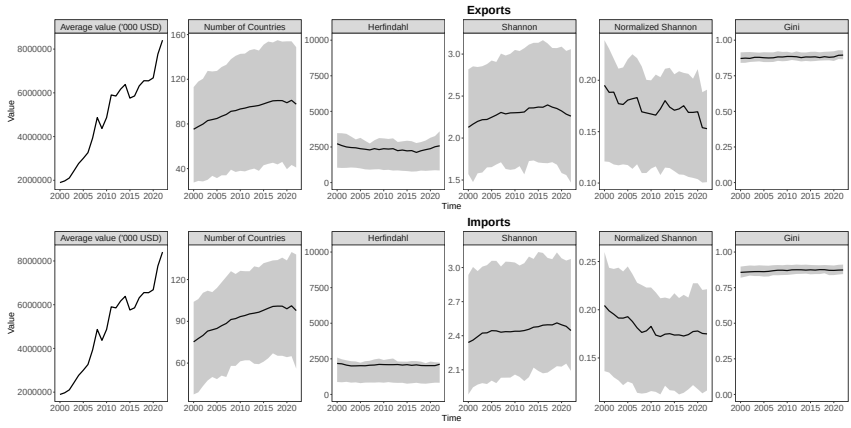


Figure: From left to right: Average trade values, average numbers of import or export countries, Herfindahl (or Herfindahl-Hirschmann) Index, Shannon exponential, or effective number of trade partners, normalized number of effective trade partners (0-1), with lower values indicating skewed distributions, and the sixth the the Gini coefficient, where 1 means 1% of countries supply 100% of the good, and 0 means equal contribution from all countries

Global division of labor and specialization

- Resilience of global agricultural value chains (food systems) hinges upon diversification
- Trade theory: Division of labor creates dependencies
- Agri-food value chains are globally more concentrated than diversified
- Moral hazard? Governments have bailed out businesses in the past
- Externality: Agribusinesses are rational in concentrating while collectively irrational
- Private marginal benefit of diversifying (concentrating) is smaller (larger) than the social marginal benefit
- Adam Smith: *"...defence, however, is more important than opulence"* (Book IV, Chapter II, p. 465)

Additional Results

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

- **Domestic:**
  - Consumers care little about volatility, producers do care
  - Welfare effects of GVC participation are **positive for consumers** and **negative for producers**
  - $\rightarrow$ results help explain hesitancy of producers in HIC with regards to trade liberalization and GVCs
- **International:**
  - **Negative welfare effects** of GVC participation are increasing in
    a. Share of **producers** in total population,
    b. Average **income shares dedicated to food purchases**
  - Both are increasing as per capita incomes decrease
  - $\rightarrow$ results help explain hesitancy of LIC and LMIC in trade liberalization negotiations and GVCs

Policy implications

- What is the policy goal?
  - Higher prices? (producers)
  - Lower prices? (consumers)
  - Lower volatility? (resilience)
  - 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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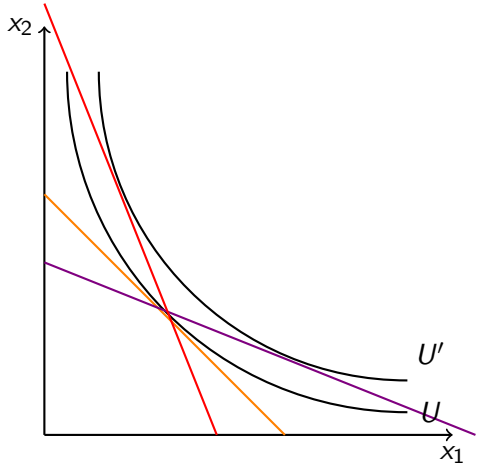
Volatility leads to higher utility for consumers



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

Integrated economies have higher food prices and lower volatility

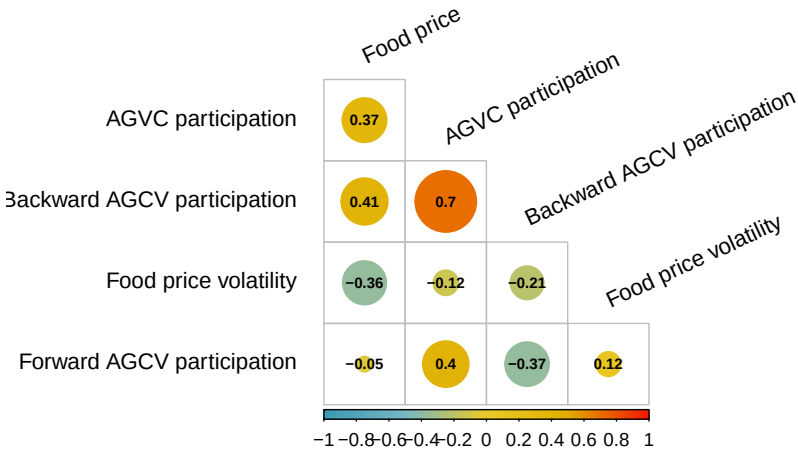


Figure: Correlation matrix of real food prices, food price volatility and GAVC indicators (All significant at the 1% level)

Food price volatility by region

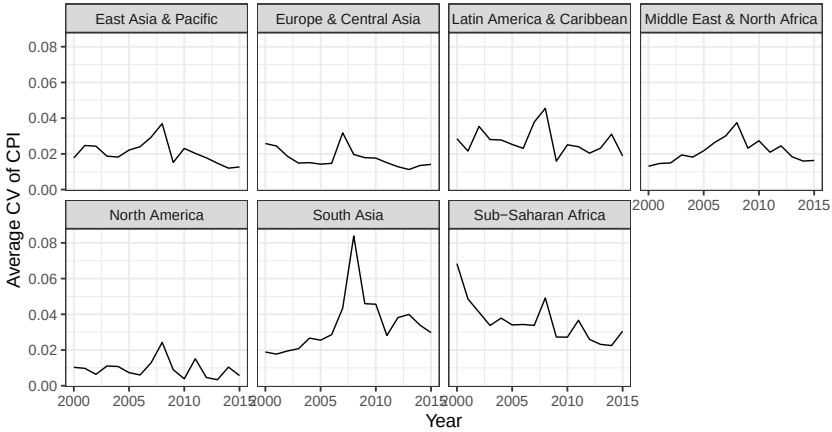


Figure: Average within-year coefficient of variation of food price index by contintent

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

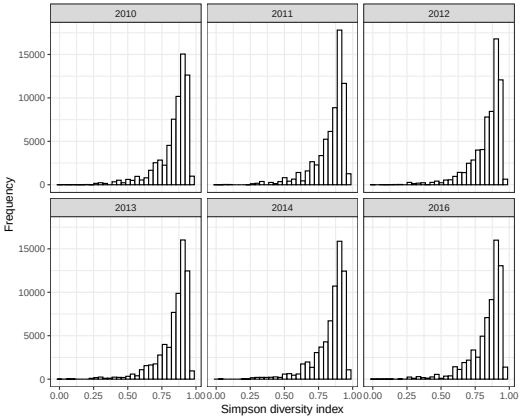


Figure: Frequency of Simpson's diversity index (equivalent to Herschindahl-Hirsch index of agri-food commodity origins. Index is weighted by trade value of the commodity. We use UN COMTRADE data and select commodities at the 6-digit level Harmonised System (HS) code. We subset to chapters 01 - 24 (Food 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