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Intra-African Agricultural Trade and Food Availability: Product-Level Panel Evidence

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Abstract

Purpose: This paper asks whether a larger intra-African share of food imports is associated with higher national food availability and with less volatile availability. Methodology: We merge BACI bilateral trade flows with FAO Food Balance Sheets in a panel of 43 African importers and 81 product units (37,102 observations, 2010 to 2023). The outcome is ln(1 + food supply quantity in kg per person per year); models use country-product and year fixed effects, country-clustered errors and wild bootstrap inference; fixed-effects Poisson (PPML) and weighted estimates serve as sensitivity checks. Findings: Comparisons across country-product pairs show a positive association (+1.8% in 1 + availability per 10 percentage points), which vanishes within pairs (-0.11%; 95% CI -0.30% to +0.08%, on the same scale), that is -0.002 kg per person per year (95% CI -0.005 to +0.002) at the median availability of 0.73 kg. A zero-inclusive PPML estimator gives -0.41% in availability (95% CI -0.84% to +0.02%). Slopes differ across categories ($p = 0.018$), but negative estimates for oils and pulses do not survive multiplicity adjustment. Supplier concentration is not significantly related to volatility. These null results do not show that supplier origin cannot matter. Originality: To our knowledge, few studies relate the supplier composition of imports to product-level availability in Africa. Implications: Within pairs, availability is positively associated with import volumes, partly by accounting construction, but not detectably with their supplier composition; integration may not be well judged by its share alone, and monitoring could usefully track availability. The findings do not evaluate trade facilitation, sourcing schemes or reserves.

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1. Introduction

Food import dependence is a central concern of African policy. Roughly one in five people in Africa faced hunger in 2023 (**FAO et al., 2024**), and many countries meet a large share of their domestic supply of cereals and vegetable oils from abroad. The African Continental Free Trade Area (AfCFTA), whose trading phase began in 2021, is often presented as a way to rebalance these imports toward African suppliers, on the premise that closer suppliers mean cheaper, more reliable and more plentiful food. To our knowledge, that premise has seldom been examined at the level at which food is traded and consumed, namely the individual product.

Existing evidence is macroeconomic or simulated. Panel studies relate trade openness to food security indicators at the country level (**Dithmer & Abdulai, 2017**). General equilibrium assessments of the AfCFTA quantify welfare and trade gains but not the availability of specific foods (**Abrego et al., 2019**, **2020**). Work on import dependence documents how much countries import, not from where (**Clapp, 2017**; **Fader et al., 2013**; **Kummu et al., 2020**). The question addressed here is narrower: whether the supplier composition of food imports (intra-African versus extra-African exporters) and the concentration of suppliers are associated with the availability of the same product in the importing country once permanent country-

product characteristics are removed. We do not identify effects of AfCFTA implementation, whose trading phase began only in 2021: the within-pair variation we exploit is mostly year-to-year switching between suppliers (Section 2).

We build a country-product-year panel linking bilateral import flows from BACI (**Gaulier & Zignago, 2010**) to FAO Food Balance Sheets (**FAO, n.d.**) for 43 African importers and 81 product units between 2010 and 2023. Three questions guide the analysis. Does the intra-African share of food imports move with per capita availability? Does the association differ across cereals, vegetable oils, pulses and animal products? Is supplier concentration associated with more unstable availability?

The paper makes three contributions. First, it constructs product-level supplier shares matched to supply data and shows that the sign of the association depends on the comparison: positive between country-product pairs, null within them. Second, it reports bounds rather than bare null results: the 95% interval excludes increases above 0.08% in 1 + availability for a 10 percentage point rise in the intra-African share (about +0.002 kg per person per year at the median availability), while acknowledging that small effects, and larger effects for foods supplied in very small quantities, cannot be excluded. Third, it discusses availability, price and volatility indicators as possible complements to share-based monitoring of AfCFTA implementation; this discussion rests on descriptive facts and null associations and is kept distinct from any causal claim about trade facilitation, sourcing schemes or reserves. All estimates are associations, not causal effects, because no credible instrument is available. Section 2 states the hypotheses, Section 3 describes data and method, Section 4 presents descriptive evidence, Section 5 reports results, and Sections 6 to 9 discuss, derive implications, state limitations and conclude. Appendices A to H document the sample, the product matching, the robustness results and the replication material.

2. Conceptual background and hypotheses

Supplier composition can matter for availability through several channels. Proximity and regional corridors may lower delivery costs and lead times, yet African trade costs remain several times higher than elsewhere (**Porteous, 2019**), which weakens this advantage. Imports from neighbours can complement seasonal production and absorb local shocks, in line with historical evidence that openness to trade mitigated the effects of weather shocks in colonial India (**Burgess & Donaldson, 2010**). Conversely, regional suppliers may be thin and subject to export restrictions that amplify price swings (**Giordani et al., 2016**; **Gouel, 2016**; **Martin & Anderson, 2012**), and trade shocks and policy responses contributed to the 2007-08 price spike (**Headey, 2011**).

Reverse causality is also plausible, since a country facing shortages may turn to nearby markets. Because opposing channels can operate, the sign of the average association is an empirical question. We test three hypotheses. *H1:* a larger intra-African share of food imports is positively associated with the availability of the products concerned. *H2:* the association varies across product categories. *H3:* a higher concentration of suppliers is associated with more volatile availability.

What the outcome measures and what the share captures. Food Balance Sheets record the aggregate supply and utilisation of each product in the importing country; they do not say which countries supplied it. The availability series is therefore not a function of the supplier mix, and any association between the two must operate through how a change of supplier alters quantities (for example if African suppliers ship smaller or less regular volumes, or if switching accompanies a change in total imports, stocks or re-exports) or through other channels that shape what is available domestically, such as delivery lead times, prices that affect domestic production and use, quality and standards, and the reliability of supply. A null result is thus not inevitable by construction. The variation that identifies our coefficients is mostly year-to-year switching between suppliers of the same product in the same country. This is conceptually different from the broader regional integration, and the AfCFTA effects, that policy debates have in mind, which would operate over longer horizons through trade costs, investment and production capacity. Our estimates speak to the first kind of variation only, and we keep associational language throughout. Two data issues qualify the reading. First, measurement error: BACI reconciles declarations and records the exporting country, which need not be the country of production, and its tonnes only imperfectly match FBS import quantities (Appendix C). Second, shared sources: FAO trade statistics and BACI both rest largely on national customs declarations reported to the United Nations, so errors in the share and in the import component of the FBS may be correlated rather than independent. Classical noise in the share would attenuate its coefficient, whereas correlated errors have no predictable sign.

What the existing checks resolve and what they do not. Lagged regressors (Table D1, specification 9) ensure that the share precedes availability, which reduces exposure to same-year simultaneity and contemporaneous reporting shocks but not persistent shocks, because the share is serially correlated. Five-year moving averages (specification 10) reduce the weight of transitory reporting noise and allow slower adjustment, at the cost of

removing much of the variation; they cannot separate slow adjustment from slow-moving omitted trends. The comparison of BACI tonnes with FBS import quantities (Appendix C) documents the size of the measurement problem, and the regressions of Table 3, Panel B combine FBS import quantities with BACI shares, but neither removes errors shared by the two sources. None of these checks replaces exogenous variation. We do not instrument the share with its own lags or with exporter-reported flows: lagged shares are correlated with current unobserved determinants of availability through persistence, and exporter reports share data sources with importer declarations, so we see no defensible exclusion restriction. A long-difference specification, which would compare changes over the full period and so give more weight to persistent shifts, is a possible extension that we have not carried out.

3. Data and empirical strategy

3.1 Data, product matching and sample

Trade data. Trade flows come from BACI, HS92 version V202601 (CEPII; files last modified 20 January 2026), which reconciles reporter and partner declarations into bilateral flows by six-digit product and year (**Gaulier & Zignago, 2010**). Values are in thousand current US dollars and quantities in tonnes. BACI records the exporting country of each flow, which we call the supplier; because of re-exports and transit trade it need not be the country where the product was produced, so "origin" in this paper means the exporter and not the country of production. Only imports of African countries in HS chapters 01 to 24 are used.

Availability data. Availability comes from the FAO Food Balance Sheets (FBS). The outcome is FAOSTAT element 645, food supply quantity in kilograms per person per year, taken from the recent FBS series (2010 to 2023; bulk file FoodBalanceSheets_E_All_Data_(Normalized), last modified 14 October 2025). Element 664 (food supply, kilocalories per person per day) is used for the dietary-energy checks, and elements 5511 (production), 5611 (import quantity) and 5911 (export quantity) for the import dependence ratio and element 5301 (domestic supply quantity) for the weights used in Table 1 (**FAO, n.d.**). The historic FBS (bulk file FoodBalanceSheetsHistoric_E_All_Data_(Normalized), last modified 5 February 2024) is used only for the spliced robustness check covering 2000 to 2023 (Appendix F). Countries are matched on the numeric M49 code; the former Sudan (code 736) is merged with Sudan in both sources.

Product matching. BACI six-digit HS92 codes are assigned to FBS items by 162 prefix rules applied by longest-prefix matching (Appendix B lists every rule by product unit; Appendix C documents the handling of processed goods, unmatched trade and aggregates). Of the 698 HS6 codes of chapters 01 to 24 observed in BACI, 458 are mapped to the 81 product units, covering 78.7% of the import value of African importers (1995 to 2024). Each mapped HS6 code belongs to exactly one unit, so no trade flow is counted twice, and unmatched trade enters neither the numerator nor the denominator of the shares and concentration indices, which are computed on matched flows only. FBS aggregate items (codes of 2900 and above, such as the grand total or cereals excluding beer) are never used as outcomes; the only aggregate used is item 2960, fish and seafood, which serves as one unit in place of its sub-items.

Sample. The estimation sample has 37,102 country-product-year observations, 43 importing countries, 81 FBS product units and 3,133 country-product pairs. Appendix Table A1 traces every reduction: 44,859 observations have recent-FBS availability from 2010, of which 42,913 have positive imports (the share is undefined otherwise) and 37,102 have imports of at least 10 thousand US dollars, a threshold that keeps shares meaningful. In the preferred regression, 107 observations belonging to 107 country-product pairs that appear only once are absorbed by the pair fixed effects and removed, which gives 36,995 observations and 3,026 pairs. Eleven of the 54 African countries are absent from the recent FBS and are excluded (Benin, Burundi, Central African Republic, Chad, Equatorial Guinea, Eritrea, Mali, Somalia, South Sudan, Sudan and Togo; Appendix Table A3 gives the reason for each), so the sample does not represent the whole continent. These exclusions were generated by the processing code from the recent FBS bulk file itself (countries with no non-missing availability value in 2010 to 2023) and not from an a priori list, so they reflect the release used. Appendix Table A2 lists the 43 countries and Appendix Table B the 81 units. Products are grouped into cereals, vegetable oils, pulses, animal products and other foods.

3.2 Variables and the scale of the outcome

IntraShare is the share of the value of a country's imports of a product that is supplied by African exporters. HHI is the Herfindahl-Hirschman index of supplier countries (**Hirschman, 1964**), the sum of squared supplier shares, equal to one when a single country supplies everything. The outcome is ln(1 + A), where A is availability in kilograms per person per year; the transformation keeps observations with zero recorded availability (4,410 of the 37,102 observations, 11.9%), all of which have imports of at least 10 thousand US dollars. Zero availability with positive imports is not necessarily an error, and Appendix Table A4 classifies the zeros with a hierarchical rule: 903 (20%) are primary products whose food use is zero, consistent with processing before consumption (for

example oilseeds, sugar crops and olives); 2,047 (46%) have BACI imports below 0.005 kg per person per year, and since FBS values are published to two decimals and every positive value in the sample is a multiple of 0.01 kg, rounding is one possible explanation for these zeros; 1,242 (28%) have non-positive or missing domestic supply, as when imports are offset by exports or stock changes; and 218 (4.9% of the zeros, 0.6% of the sample) remain unexplained, 146 of them for cereals. We have not found evidence that these are coding errors, but we could not check them against the raw utilisation elements, and specification 13 of Table D1 shows that dropping all zeros does not change the conclusion. Import dependence (IDR) is the FBS import quantity divided by production plus imports minus exports (elements 5611, 5511 and 5911), clipped to the interval 0 to 1 (656 of 17,873 ratios fall outside it because of stock changes and re-exports). It equals the ratio of imports to domestic supply (element 5301) only when stock changes are zero: the two coincide exactly in 54% of observations (correlation 0.89), and the former is the definition used throughout, including in Table 1. The ratio is defined for 17,873 of the 37,092 observations that have a quantity share, because domestic supply is zero or negative in the FBS identity for many pairs (Appendix Table A1b); it is split by supplier group with BACI quantity shares.

Because the outcome is ln(1 + A), a coefficient β on the share describes the change in ln(1 + A), not in ln A. For a ten percentage point change in the share, the implied proportional change in 1 + A is 100[exp(0.1β) - 1] percent. The change in availability itself depends on its baseline level A0: it equals ΔA = (1 + A0)[exp(0.1β) - 1] kilograms, or ((1 + A0)/A0)[exp(0.1β) - 1] in proportion to A0. For foods supplied in large quantities the two percentage changes are nearly identical; for foods supplied in small quantities, the percentage change in A is much larger than that in 1 + A. We therefore report the percentage change in 1 + A, as estimated, together with changes in kilograms at stated positive baselines: the sample median (0.73 kg per person per year) and the sample mean (8.49 kg), and category medians in Table 4 and Figure 5. A further point is that ln(1 + A) is not unit-neutral: the constant added to A is a different fraction of typical values if A is expressed in grams or in units of 10 kg (**Chen & Roth, 2024**; **Bellemare & Wichman, 2020**). In our data 47.5% of positive observations are below 1 kg, and the coefficient on the share moves from -0.004 (A in units of 10 kg) to -0.011 (kg), -0.006 (100 g) and +0.058 (g), none significant (p between 0.21 and 0.74; Appendix Table D4). A change in 1 + A is also not a change in A. We therefore keep ln(1 + A) in kilograms as the primary scale, with the positive-outcome logarithm of Appendix Table D2, and we add a fixed-effects Poisson pseudo-maximum-likelihood (PPML) estimator, which uses the zeros directly, does not depend on the unit of A and estimates a proportional change in A itself (**Santos Silva & Tenreyro, 2006**; **Correia et al., 2020**; Appendix Table D3). PPML assumes that the conditional mean of A is multiplicative in the regressors and in the pair and year effects, places no restriction on the variance, and drops pairs whose availability is zero in every year; it is a different estimand, not a correction of the main model.

Volatility is the rolling standard deviation of annual log changes in availability, $\ln A_t - \ln A_{t-1}$, computed over a window of five consecutive annual changes of a pair (rows of the pair's panel), provided at least four of the five are valid; a change is defined only for consecutive years in which availability is strictly positive in both years, so zeros and gaps produce missing changes that are never imputed. Of the 24,993 windows defined, 22,110 have five valid changes and 2,883 have four. HHI and IntraShare enter volatility regressions as five-year means over the same window, requiring at least four valid values. Appendix E gives the full definition and sample accounting.

3.3 Econometric models

The preferred specification is:

$$\ln(1 + A_{ipt}) = \beta_1 \, IntraShare_{ipt} + \beta_2 \, HHI_{ipt} + \mu_{ip} + \tau_t + \varepsilon_{ipt} \quad (1)$$

where i indexes the importing country, p the product and t the year, A is availability, μ is a country-product fixed effect and τ a year effect (**Wooldridge, 2010**). A conventional specification with country and year effects is reported as column (1) of Table 2 but mixes products whose availability differs by orders of magnitude (kilograms of milk versus spices), so we prefer country-product effects, which identify the coefficients from changes over time within the same flow. H2 is tested by estimating Equation 1 by category and in a fully interacted pooled model. H3 uses:

$$Vol_{ipt} = \gamma_1 \, MeanHHI_{ipt} + \gamma_2 \, MeanShare_{ipt} + \mu_{ip} + \tau_t + u_{ipt} \quad (2)$$

where Mean denotes five-year means. Identifying variation is limited: after removing pair and year effects, 17.7% of the variance of IntraShare and 29.2% of that of HHI remain, against only 2.5% for ln(1 + A), because Food Balance Sheet series are smooth and partly estimated.

Weighting. Equation 1 is estimated without weights, so observations are not explicitly weighted by trade value or dietary importance. Pairs do not necessarily contribute equally, because their numbers of observations and residualised regressor variation differ. The unweighted coefficient summarises the conditional within-pair association across observations: it gives most weight to the 19,764 observations of 'Other foods' and to pairs with small import flows, and it does not describe an association for a typical dollar of imports or a typical calorie. As a

sensitivity check we re-estimate Equation 1 by weighted least squares with two time-invariant pair weights, the pair's mean import value over the sample and its mean national dietary energy supplied by the product (kilocalories per person per day times population), so the weights are constant within each pair over time; this does not make them exogenous (Appendix Table D3). The weighted estimates answer a different question; they do not replace the unweighted model, and neither weighting is adopted as primary on the basis of its result. The trade-weighted sample is concentrated: its descriptive weight-concentration measure, (sum of weights) squared over the sum of squared weights, is 1,298 against 36,995 observations, and the ten largest pairs carry 24% of the weight (wheat is the product with the largest weight).

3.4 Inference

Standard errors are clustered by importing country (43 clusters; **Abadie et al., 2023)** with the CR1 small-sample correction; confidence intervals use t critical values with 42 degrees of freedom. Because the number of clusters is moderate, we add restricted wild cluster bootstrap-t p-values with the null imposed (**Cameron et al., 2008**; **Roodman et al., 2019)**: 999 replications, Rademacher weights drawn at the country level, symmetric two-sided p-values computed as (number of |t*| at least |t| + 1)/(999 + 1) and the random seed fixed at 20261014. For sub-regional samples of 5 to 14 clusters we use six-point Webb weights (**Webb, 2023)**. Wild bootstrap p-values are reported for the preferred specification, for Tables 2, 4 and 5 and for the regional estimates; the 18 specifications of Appendix D report cluster-robust p-values. Tests across categories use **Holm (1979)** and **Benjamini and Hochberg (1995)** adjustments. Appendix G gives the conversion of coefficients to kilograms. Confidence intervals, not post-estimation power calculations, are used to describe precision, and an insignificant coefficient is not treated as evidence of equivalence. The 18 specifications of Appendix D are robustness checks and not independent tests; their p-values are not adjusted, and we read isolated rejections in light of their number (Section 5.1).

4. Descriptive evidence

Table 1 summarises the sample and reports both mean and median availability, since the median gives the more representative positive baseline for these skewed series. The unweighted mean intra-African share is 37%, but the value-weighted share is only 14.5% in 2010 and 14.4% in 2023 (Figure 1). Many small flows come entirely from Africa (5.0% of observations have a share of one) or not at all (12.6% have a share of zero). This gap motivates the import threshold and the stricter thresholds in the robustness checks. In 2023, 6.5% of cereal imports by value come from African suppliers, against 14.2% for vegetable oils, 15.8% for animal products and 21.6% for pulses. Supplier concentration declines over the period, most clearly for animal products, whose mean HHI falls from about 0.58 in 2000 to 0.48 in 2023.

Table 1

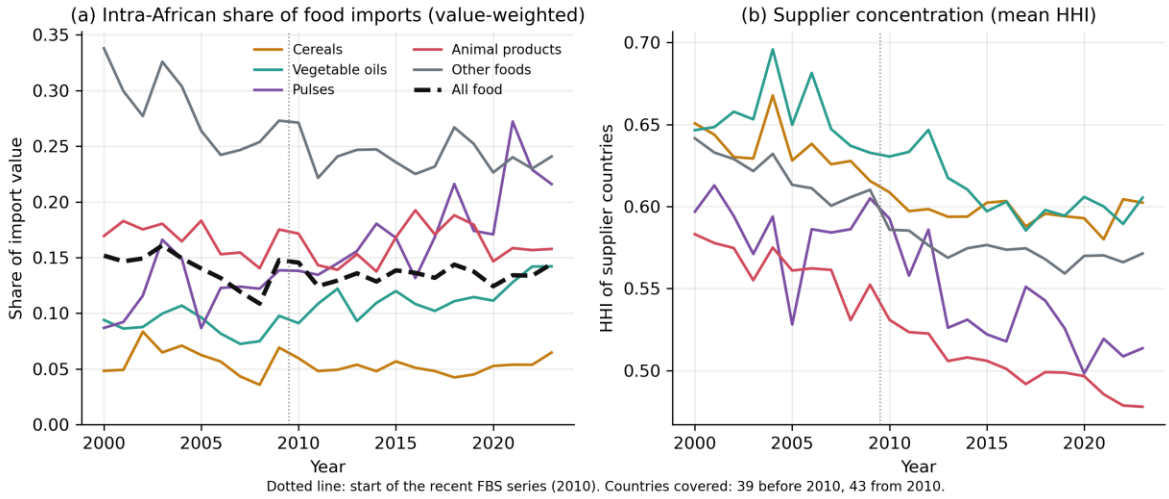
Sample and import dependence by product category, 2010 to 2023

Category	Obs.	Pairs	Avail. mean (kg/cap/yr)	Avail. median (kg/cap/yr)	Mean IntraShare	Mean HHI	Import dep. (%)	of which intra-African (pp)	of which extra-African (pp)
All food	37,102	3,133	8.49	0.73	0.372	0.531	17.4	1.9	15.5
Cereals	3,790	342	25.65	4.96	0.312	0.544	36.7	2.5	34.2
Vegetable oils	5,263	481	1.08	0.14	0.303	0.578	46.6	7.3	39.3
Pulses	1,693	129	3.41	0.88	0.374	0.523	6.7	1.5	5.2
Animal products	6,592	511	7.97	1.77	0.280	0.480	25.1	3.9	21.2
Other foods	19,764	1,670	7.77	0.54	0.432	0.533	5.1	1.2	4.0

Note: Means are unweighted except import dependence, which is weighted by domestic supply and defined as imports divided by production plus imports minus exports using BACI quantity shares for the supplier split. The ratio is clipped to the interval 0 to 1 and is defined for 17,873 of the 37,092 observations that have a quantity share (Appendix Table A1b), so the import dependence columns describe that subsample. Medians are computed over the estimation sample and are positive in every category. Source: author's calculations from BACI and FAO Food Balance Sheets.

Figure 1

Intra-African import share and supplier concentration by product category, 2000 to 2023

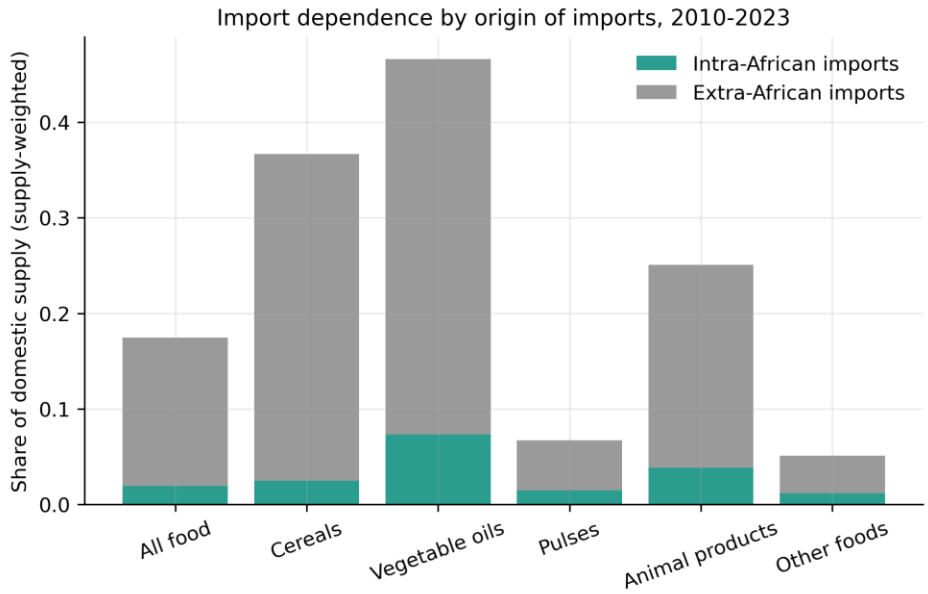


Note: Panel (a) shows value-weighted shares and panel (b) the mean Herfindahl-Hirschman index of supplier countries. The dotted line marks the start of the recent FBS series. Source: author's calculations from BACI and FAO Food Balance Sheets.

Import dependence is far larger than intra-African sourcing can offset (Figure 2). Imports represent 17.4% of domestic supply on a supply-weighted basis, of which only 1.9 percentage points come from Africa. For cereals, imports cover 36.7% of supply and African suppliers only 2.5 points; for vegetable oils the figures are 46.6% and 7.3 points. Intra-African trade is concentrated in Eastern and Southern Africa (Figure 3), where the shares of other foods reach 48% and 53%, whereas Northern Africa and Western Africa source almost no cereals from African suppliers (0.00 and 0.02).

Figure 2

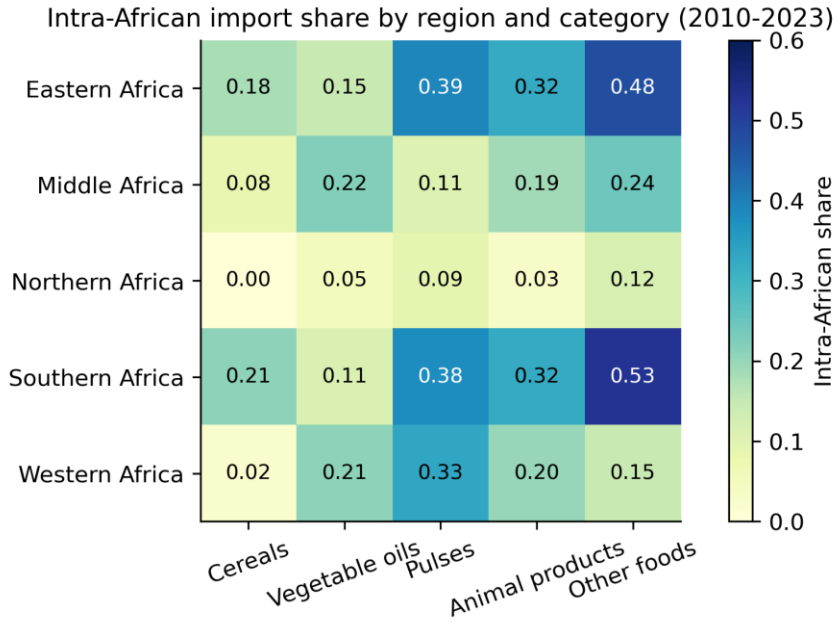
Import dependence by origin of imports, 2010 to 2023



Note: Supply-weighted import dependence ratio split between intra-African and extra-African origins. Source: author's calculations from BACI and FAO Food Balance Sheets.

Figure 3

Intra-African import share by UN sub-region and product category, 2010 to 2023



Note: Value-weighted shares. Source: author's calculations from BACI and FAO Food Balance Sheets.

5. Results

5.1 Intra-African share and availability (H1)

Table 2 reports the main results. The dependent variable is ln(1 + availability), so the coefficients and the percentage changes in the table describe proportional changes in 1 + availability, not in availability itself; the two differ markedly for foods supplied in small quantities (Section 3.2). Column (1) uses country and year effects only: a 10 percentage point higher intra-African share is associated with a 1.8% higher value of 1 + availability (wild bootstrap p = 0.029), while higher concentration is associated with lower availability. Adding product effects reduces the share coefficient by about 28% (column 2) and country-product effects eliminate it (column 3). The preferred estimate is -0.011 (SE 0.010), or -0.11% in 1 + availability for ten points (95% CI -0.30% to +0.08%; cluster p = 0.265; wild bootstrap p = 0.253). At a baseline availability of 0.73 kg per person per year (the sample median) this corresponds to -0.002 kg (95% CI -0.005 to +0.002 kg); at 8.49 kg (the sample mean) it corresponds to -0.010 kg (95% CI -0.028 to +0.008 kg). The same coefficient implies larger percentage changes in availability itself when the baseline is small: at 0.14 kg, the median for vegetable oils, it equals -0.88% of availability (95% CI -2.4% to +0.7%). The estimate is unchanged with product-by-year effects (column 4), country-by-year effects (column 5) and an import value control (column 6). The HHI coefficient is also null (0.002, p = 0.879). The positive pooled correlation therefore reflects stable differences across country-product pairs, not changes within them.

Table 2

Intra-African share and food availability, dependent variable ln(1 + kg per capita per year)

	(1)	(2)	(3) Preferred	(4)	(5)	(6)
Intra-African share	0.177**	0.127**	-0.011	-0.008	-0.012	-0.014
	(0.072)	(0.053)	(0.010)	(0.010)	(0.009)	(0.010)
HHI of suppliers	-0.649***	0.109	0.002	-0.003	0.002	-0.014
	(0.089)	(0.065)	(0.010)	(0.011)	(0.011)	(0.010)
ln(1 + import value)						0.027***
						(0.005)

	(1)	(2)	(3) Preferred	(4)	(5)	(6)
Change in 1 + availability for +10 pp share (%)	1.79	1.27	-0.11	-0.08	-0.12	-0.14
Change in availability for +10 pp, at baseline 0.73 kg (kg/cap/yr)	0.0310	0.0220	-0.0019	-0.0014	-0.0021	-0.0024
Change in availability for +10 pp, at baseline 8.49 kg (kg/cap/yr)	0.170	0.121	-0.010	-0.008	-0.011	-0.013
Wild bootstrap p (share)	0.029	0.033	0.253	0.430	0.193	0.152
Fixed effects	C, Y	C, P, Y	CP, Y	CP, PY	CP, CY	CP, Y
Observations	37,102	37,102	36,995	36,974	36,995	36,995
Within R-squared	0.0146	0.0031	0.0001	0.0001	0.0001	0.0110

Note: Standard errors clustered by country (43 clusters) in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01. Share and HHI are measured on a 0 to 1 scale. The percentage row is 100[exp(0.1 times the share coefficient) - 1] and describes 1 + availability, not availability. The kilogram rows apply (1 + A0)[exp(0.1 times the coefficient) - 1] at the stated positive baselines A0 (0.73 kg: sample median; 8.49 kg: sample mean). C = country, P = product, CP = country-product pair, Y = year, PY = product-year, CY = country-year. Columns (1) and (2) are shown for comparison only. Source: author's estimates.

The preferred estimate is broadly similar across many of the reported checks, with exceptions discussed below. Appendix D reports all 18 specifications (the preferred one and 17 variants) with estimates, standard errors, p-values, confidence intervals and sample sizes, and Figure 4 plots them. The coefficient is positive in two, significantly positive in none and significantly negative in one, the latter restricting the sample to the four-focal-category sample (cereals, vegetable oils, pulses and animal products; -0.024, cluster p = 0.031; discussed below). Results hold with quantity-based shares, stricter import thresholds, alternative concentration measures, lags, five-year moving averages, a kilocalorie outcome, the spliced 2000 to 2023 series and without SACU members. The specification that excludes zero availability restricts the sample to positive values but keeps the ln(1 + A) outcome. An additional check uses ln(availability) itself on the 32,561 positive-availability observations, so that the coefficient is directly a percentage change in availability: +0.08% per ten points (95% CI -0.53% to +0.69%; cluster p = 0.798; wild bootstrap p = 0.818; Appendix Table D2). Leave-one-country-out estimates range from -0.013 to -0.007, and dropping Western Africa gives -0.022 (p = 0.078). Lead and first-difference specifications are also null (first difference -0.001, SE 0.004), so these checks do not detect anticipation or dynamic patterns at annual frequency.

Precision and benchmarks. Precision is described by confidence intervals, not by a post-estimation power calculation. On the scale of 1 + availability, the preferred 95% interval (-0.30% to +0.08% per ten points) lies well below the pooled between-pair association of +1.8% in column (1): its upper bound is less than five percent of that association. It also excludes changes of 1% in 1 + availability in either direction, a benchmark that we use as illustrative of a substantively non-trivial association: it is about half the between-pair association and larger than the point estimate of every one of the 18 specifications of Appendix D (the largest in absolute value is -0.24%). An interval that is narrow around zero is compatible with no association and with small ones; it does not establish equivalence. Because the outcome is ln(1 + A), the same bounds are wider in percentage terms for foods supplied in small quantities: at a baseline of 0.14 kg they correspond to -2.4% to +0.7% of availability itself. The null result should not be read as proof that supplier origin cannot matter.

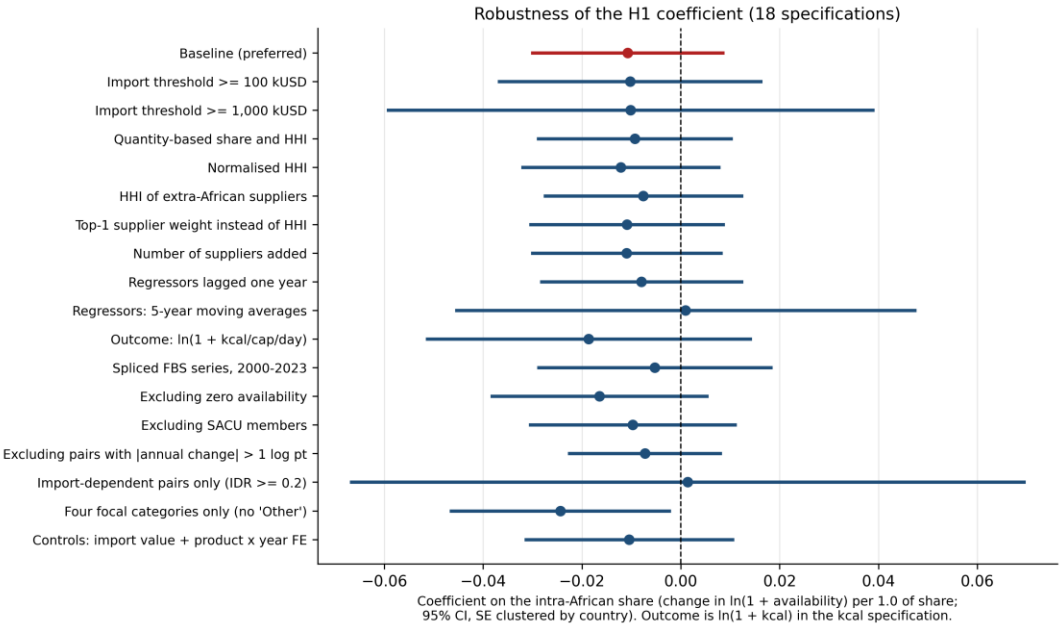
Zero-inclusive and weighted estimates. Because ln(1 + A) depends on the unit of A, Appendix Table D3 re-estimates Equation 1 by fixed-effects PPML, which uses the zeros directly and estimates a proportional change in availability itself. The estimate is -0.041 (SE 0.021; cluster p = 0.058), that is -0.41% in availability for ten points (95% CI -0.84% to +0.02%). It uses 35,078 observations in 2,812 pairs; 2,024 observations in 321 pairs are dropped: 261 pairs whose availability is zero in every year (1,964 observations, which carry no information in a Poisson model) and 60 pairs observed in a single year, which are absorbed by the pair fixed effects; 2,446 zeros remain in the estimation, and the algorithm converged. The wild bootstrap is not implemented for PPML, so the p-value is cluster-robust with 42 degrees of freedom. PPML weights observations by their predicted level, so large quantities (cereals, milk) count more than in the ln(1 + A) model. Its point estimate is larger in absolute value than the preferred one and its interval touches zero at the upper end, so the conclusion of no detectable association is not independent of the estimator: on this scale the data exclude increases above 0.02% but not decreases of up to 0.8% per ten points. Restricting PPML to positive observations gives -0.42% (p = 0.050), so the zeros are not responsible for the difference. The weighted least-

squares estimates are +0.51% (95% CI -0.76% to +1.80%) with import-value weights and -0.10% (95% CI -0.49% to +0.30%) with energy weights; both are imprecise, and their weights are concentrated (the descriptive weight-concentration measures are about 1,300 observations). None of these estimates replaces the preferred model. They show that the sign of the within-pair association is not stable across estimands, which supports describing the evidence as the absence of a detectable association and not as evidence of no association.

Specification 17 and multiplicity. Specification 17 of Table D1 is the only one of the 18 whose 95% interval excludes zero (-0.024; 95% CI -0.046 to -0.002; cluster p = 0.031; wild bootstrap p = 0.026; 17,297 observations), a change of -0.24% in 1 + availability for ten points. We treat this negative estimate as exploratory and not robust to the stated multiplicity correction. The 18 specifications are variants of one regression and not independent tests; one nominal rejection at the 5% level among 18 estimates is about what chance would produce if every null held (0.9 expected, although the tests are not independent), and after Bonferroni or Holm adjustment over the 18 specifications its p-value is 0.56 (Appendix D). The interval also ends close to zero. The estimate is consistent with the category results of Table 4, where the negative coefficients are those of vegetable oils and pulses, and the sample differs from the full sample only by dropping 'Other foods' (19,764 observations), whose coefficient is close to zero. We call this sample the four-focal-category sample, not a staples sample: it includes animal products and leaves out foods such as roots, sugar, fruits, oilseeds, beverages and spices that the classification places under 'Other foods'. We make no claim that it was specified in advance, and the full sample of 81 units remains the primary one.

Figure 4

Coefficient on the intra-African share across 18 robustness specifications



Note: Points are coefficients (change in ln(1 + availability) per 1.0 of share; the outcome is ln(1 + kcal) in the kilocalorie specification) with 95% confidence intervals, standard errors clustered by country. The preferred specification is in red. Numerical values are in Appendix Table D1. Source: author's estimates.

Table 3 shows what moves availability within pairs. Conditional on pair and year effects, the intra-African supplier share is unrelated to availability once volumes are included (Panel A, column 3), whereas per capita import volumes from Africa and from the rest of the world are both positively associated with it, with coefficients of similar magnitude (0.117 and 0.135). A cluster-robust test of equality gives a difference of -0.018 (SE 0.035; p = 0.603; 95% CI -0.090 to +0.053) in column (2) and -0.017 (SE 0.037; p = 0.652) in column (3); failing to reject equality is not evidence of equality, and the interval is wide relative to the coefficients. These volume results must be read with the accounting link in mind. Imports are a component of the FBS supply identity (production plus imports minus exports, adjusted for stocks), from which food supply is derived, so a positive association between import volumes and availability is partly mechanical and does not by itself show that additional imports raise what people can obtain. In addition, BACI tonnes are not equivalent to FBS quantities, especially for processed

products (median BACI-to-FBS ratio 0.81, correlation of logs 0.75; Appendix C), so the volume results are exploratory. A second link is algebraic. The two volumes are the quantity share multiplied by, and one minus the share multiplied by, total BACI import quantity per person, so by construction the share equals the intra-African volume divided by the sum of the two volumes. A linear regression of the share on the two log volumes explains only 9% of its within-pair variation, so column (3) does identify a share coefficient, but only from the non-linear relation between the share and the volumes; re-parameterising with total volume instead gives -0.004 for the share (p = 0.70) and 0.179 for ln(1 + total imports). The finding that the share adds nothing once volumes are included is therefore a statement about functional form and not an independent test of whether supplier origin matters, and the equality test compares coefficients on ln(1 + volume) in a log-linear form: it cannot separate behavioural from accounting links or show that the two groups of suppliers are interchangeable. Panel B shows that a higher share leaves total import dependence unchanged (0.000) and shifts it from extra-African to intra-African suppliers almost one for one (+0.143 and -0.144), a partly mechanical result. Within pairs, a higher share changes who supplies the product but, in these data, is not associated with detectable changes in total import dependence or in availability. Panel B has fewer observations (17,785) than Panel A (36,985) because the import dependence ratio is defined for 17,873 of the 37,092 observations with a quantity share (17,785 after singleton removal): coverage is lowest for vegetable oils (30%) and other foods (46%), and highest for animal products (62%), cereals (57%) and pulses (54%) (Appendix Table A1b). Panel B therefore describes a different, smaller subsample.

Table 3

Composition versus volume, and import dependence by origin

	(1)	(2)	(3)
Panel A. Dependent variable: ln(1 + availability); BACI quantities			
Intra-African share (quantity)	-0.009		-0.004
	(0.010)		(0.010)
HHI (quantity)	0.007		
	(0.010)		
ln(1 + intra-African imports, kg/cap)		0.117***	0.118***
		(0.022)	(0.022)
ln(1 + extra-African imports, kg/cap)		0.135***	0.135***
		(0.029)	(0.030)
Observations	36,985	36,985	36,985
Panel B. Dependent variable: import dependence ratio and its origin components			
	Total	Intra-African	Extra-African
Intra-African share (value)	-0.000	0.143***	-0.144***
	(0.008)	(0.015)	(0.017)
HHI (value)	0.005	0.006	-0.000
	(0.007)	(0.009)	(0.010)
Observations	17,785	17,785	17,785

Note: Country-product and year fixed effects in all columns; standard errors clustered by country in parentheses. *** p < 0.01. Import volumes enter the FBS supply identity, so the coefficients on volumes in Panel A partly reflect accounting rather than behaviour. Column (3) of Panel B is partly mechanical by construction. Panel B is estimated on the 17,785 observations for which the import dependence ratio is defined (Appendix Table A1b). Test of equality of the two volume coefficients: column (2), difference -0.018 (SE 0.035, p = 0.603); column (3), difference -0.017 (SE 0.037, p = 0.652). Source: author's estimates.

5.2 Heterogeneity across product categories (H2)

Slopes differ across categories (Table 4 and Figure 5). A cluster-robust Wald test rejects equality of the share coefficients across the four focal categories ($F(3, 42) = 3.75$, $p = 0.018$) and across all five ($F(4, 42) = 3.48$, $p = 0.015$). H2 is therefore supported in its joint form. The

pattern is nonetheless modest. Vegetable oils show a negative association (-0.026, wild bootstrap p = 0.027) and pulses a larger and less precise one (-0.102, p = 0.054), while cereals and animal products are centred on zero. After Holm adjustment for four categories, none of the individual coefficients is significant (adjusted p = 0.108 for oils and 0.162 for pulses), so the negative estimates for oils and pulses are consistent with chance and are treated as reasons for further evaluation, not as evidence of harm. Among 15 detailed groups, none is significant after Benjamini-Hochberg adjustment (smallest adjusted p = 0.31), and no sub-region differs significantly from zero. Interactions with import dependence are null (-0.015, SE 0.026). In kilograms, the point estimates are small: at the category median, -0.003 kg per person per year for oils (baseline 0.14 kg) and -0.019 kg for pulses (baseline 0.88 kg), with 95% intervals that include zero for pulses. With ln(availability) on positive observations, the oils estimate is -1.09% of availability (95% CI -2.28% to +0.11%; wild bootstrap p = 0.050; Holm-adjusted p = 0.20) and pulses -1.41% (p = 0.327), so the conclusion on multiplicity is unchanged (Appendix Table D2). As an exploratory check on dietary energy, pulses show a negative coefficient (-0.227, p = 0.020), but this rests on 602 country-year observations per category and is not corrected for multiple comparisons.

Table 4

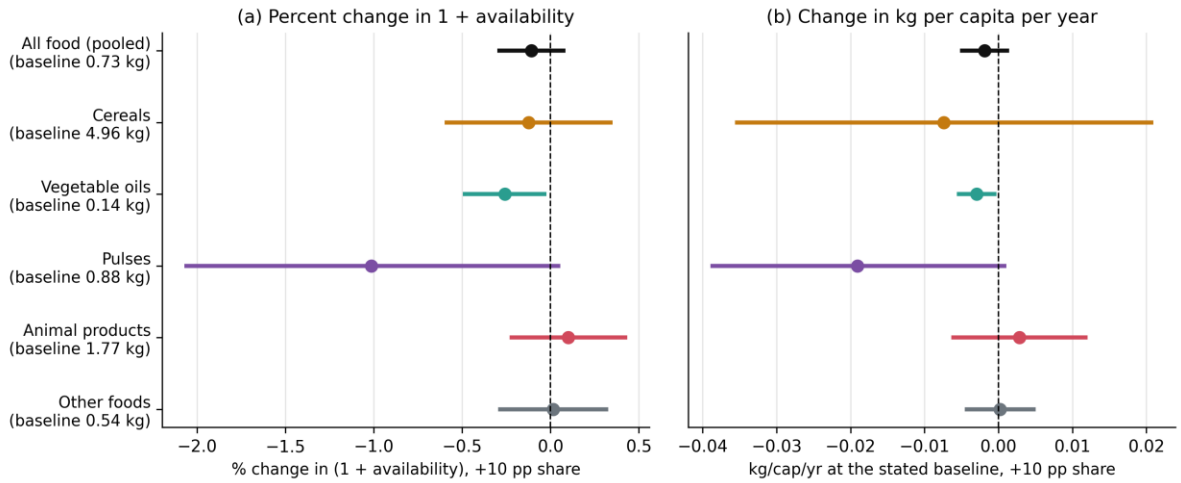
Intra-African share and availability by product category

Category	N	Coeff.	SE	95% CI	p (cluster)	p (wild)	Holm p	Change in 1 + A for +10 pp (%)	Change in kg/cap/yr at median baseline (baseline kg)
Cereals	3,768	-0.012	0.024	[-0.060, 0.035]	0.601	0.611	1.000	-0.12	-0.0074 (4.96)
Vegetable oils	5,248	-0.026	0.012	[-0.050, -0.002]	0.033	0.027	0.108	-0.26	-0.0029 (0.14)
Pulses	1,692	-0.102	0.053	[-0.209, 0.006]	0.063	0.054	0.162	-1.01	-0.0190 (0.88)
Animal products	6,589	0.010	0.016	[-0.023, 0.043]	0.541	0.557	1.000	+0.10	+0.0028 (1.77)
Other foods	19,698	0.002	0.015	[-0.030, 0.033]	0.919	0.916	n.a.	+0.02	+0.0002 (0.54)

Note: Separate regressions with country-product and year fixed effects; standard errors clustered by country. Holm p-values are based on the wild bootstrap and cover the four focal categories. Wald test of equal share coefficients across the four focal categories: F(3, 42) = 3.75, p = 0.018. The last two columns convert the coefficient with 100[exp(0.1 times the coefficient) - 1] (change in 1 + availability) and (1 + A0)[exp(0.1 times the coefficient) - 1] (kilograms), where A0 is the category median availability in the estimation sample (in parentheses). Source: author's estimates.

Figure 5

Change associated with a 10 percentage point higher intra-African share, by category



Note: Panel (a) shows the percent change in 1 + availability, the scale on which the models are estimated. Panel (b) converts the same estimates into kilograms per person per year at the category median availability shown in the axis labels (positive in every category). 95% confidence intervals, standard errors clustered by country. Source: author's estimates.

5.3 Supplier concentration and volatility (H3)

Table 5 relates supplier concentration to the volatility of availability, defined in Section 3.2 and Appendix E. The preferred coefficient is positive but imprecise: a 0.10 higher five-year mean HHI is associated with a 0.0057 higher volatility index, or about 1.8% of its mean of 0.309 (coefficient 0.057, SE 0.045; cluster and wild bootstrap p

= 0.213; 95% CI -0.034 to +0.149). The coefficient is positive in nine of the ten pooled specifications of Appendix Table E1, and it is significant at 5% only when concentration is measured among extra-African suppliers (0.034, p = 0.009), one of ten pooled variants and not adjusted for multiple comparisons. Top-supplier weight (0.030, p = 0.067), quantity-based HHI (0.031, p = 0.058) and the sample without SACU members (0.083, p = 0.076) are significant at 10% only. Non-overlapping windows give 0.065 (SE 0.074), and the pure cross-section is null. By category (Figure 6), cereals show the largest positive coefficient (0.316, p = 0.056; Holm p = 0.277), while vegetable oils show a negative one (-0.168, p = 0.068). H3 is thus not supported at conventional levels, although the direction is consistent with it and the imprecise interval leaves room for both small and moderate effects.

Implementation and near-zero quantities. The reported index is the standard deviation of five annual changes with at least four valid (22,110 windows with five valid changes and 2,883 with four); the rule is reproduced exactly from the stored data, and the alternative readings of the window (five levels, or five changes all valid) give coefficients of 0.042 (p = 0.355) and 0.065 (p = 0.151) against 0.057 (p = 0.213) for the reported rule (Appendix Tables E and E2). A log change is large whenever availability is close to zero: the 21.1% of windows that contain an availability value below 0.1 kg have a mean volatility of 0.627 against 0.224 elsewhere. Excluding those windows lowers the HHI coefficient to 0.027 (SE 0.038; p = 0.478; 17,345 observations); excluding windows with any value below 0.01 kg (0.7% of windows) gives 0.056 (p = 0.211), and excluding the bottom decile of mean availability gives 0.062 (p = 0.146). Near-zero quantities therefore inflate volatility: the positive point estimate falls by about half when windows below 0.1 kg are excluded, although it stays positive and imprecise. By contrast, when volatility is computed on changes in ln(1 + A), which keeps zeros and is less sensitive to near-zero values, the coefficient is 0.029 (SE 0.014; cluster p = 0.046; wild bootstrap p = 0.053; 26,212 observations), or 2.7% of that index's mean of 0.105 per 0.10 of HHI. It has the same sign as the baseline, its cluster p-value is below 0.05, as is that of the extra-African HHI variant in Table E1, and it was not specified in advance; read together with the other variants it does not change our conclusion that H3 is not supported in the preferred specification, but it reinforces the description of the direction as consistent and the evidence as suggestive.

Table 5

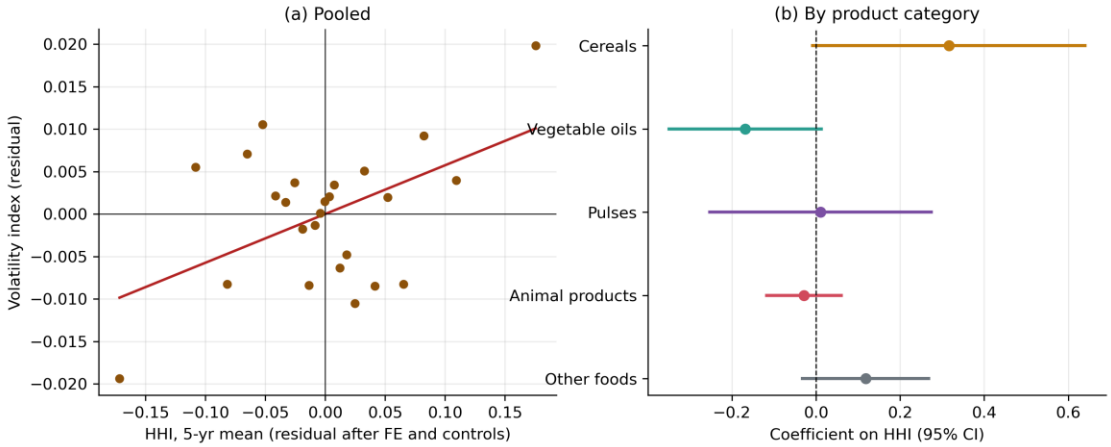
Supplier concentration and volatility of availability

	(1)	(2)	(3) Preferred	(4)
HHI, five-year mean	0.063	0.057	0.057	0.049
	(0.041)	(0.045)	(0.045)	(0.046)
Intra-African share, five-year mean		0.029	0.028	0.039
		(0.038)	(0.037)	(0.043)
Mean ln availability			-0.066	-0.062
			(0.069)	(0.069)
Mean ln import value			-0.004	-0.002
			(0.009)	(0.008)
Wild bootstrap p (HHI)	0.141	0.213	0.213	0.284
Fixed effects	CP, Y	CP, Y	CP, Y	CP, PY
Observations	22,006	22,006	22,006	21,996
Within R-squared	0.0005	0.0006	0.0023	0.0020

Note: Dependent variable is the rolling five-year standard deviation of annual log changes in availability (mean 0.309). Standard errors clustered by country in parentheses. Rolling windows overlap, so serial correlation is handled by clustering and by the non-overlapping check of Appendix E. Wild bootstrap: 999 Rademacher replications, null imposed. CP = country-product pair, Y = year, PY = product-year. Source: author's estimates.

Figure 6

Supplier concentration and volatility of availability



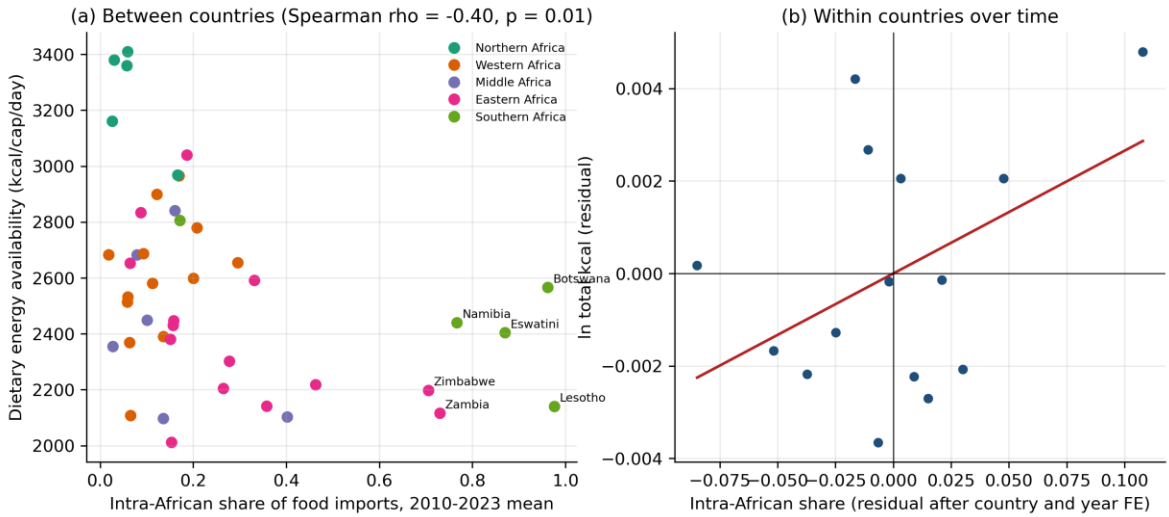
Note: Panel (a) is a binned partial scatter after fixed effects and controls; panel (b) shows the HHI coefficient with 95% confidence intervals by category. Source: author's estimates.

5.4 Macro evidence versus product-level evidence

Aggregate data tell a different story. Across countries, the mean intra-African share of food imports is negatively correlated with dietary energy availability, measured as the FBS grand-total energy supply (item 2901), which includes foods outside the 81 matched product units (Spearman rho = -0.40, p = 0.01; Figure 7a), a pattern driven by Southern African economies such as Lesotho, Eswatini and Botswana, where shares exceed 85% while energy availability is low. Within countries over time, the relation is flat: a country and year fixed effects regression of total energy on the all-food share gives 0.027 (SE 0.046), and the association with concentration is unstable (Figure 7b). Cross-country comparisons of shares thus may reflect geography and customs unions, and macro regressions can mislead if read as evidence on trade composition. The comparison is also asymmetric in coverage: the share describes matched foods only (78.7% of the import value of chapters 01 to 24), whereas energy is the complete FBS total, and the share of total energy supplied by the 81 matched units is not reported here; the category-level energy regressions are summed over the matched units of each category.

Figure 7

Cross-country and within-country relations between the intra-African share and dietary energy availability



Note: Panel (a) plots country means for 2010 to 2023; panel (b) plots residuals after country and year fixed effects. Dietary energy is the FBS grand total (item 2901), which includes foods outside the 81 matched units; the share covers matched foods only (78.7% of import value). Source: author's calculations from BACI and FAO Food Balance Sheets.

6. Discussion

Our results qualify the view that raising the intra-African share would in itself improve food availability, but they do not show that origin is irrelevant. Within country-product pairs the share is not detectably associated with availability, and on the scale of 1 + availability the bounds are narrow (-0.30% to +0.08% per ten points). The zero-inclusive PPML estimate is somewhat more negative (-0.41%, 95% CI -0.84% to +0.02%), so we describe the evidence as the absence of a detectable association and not as evidence of no association. Yet the design has limited within-pair variation, annual FBS series that are smooth and partly imputed, and no way to capture long-run adjustments, so a null result here is not evidence of absence, and for foods supplied in small quantities the same bounds translate into much wider percentage ranges for availability itself.

Import volumes behave differently: per capita volumes from African and non-African suppliers are both positively associated with availability within pairs (Table 3), which is directionally consistent with, but not comparable to, the country-level positive links between trade openness and food security reported by **Dithmer and Abdulai (2017)**. We interpret this prudently. Because imports are part of the FBS supply identity, the association is partly an accounting relation, and BACI tonnes are only an imperfect proxy for FBS quantities. It is therefore consistent with, but not evidence of, a behavioural or causal link from import volumes to what people can obtain. What the data do show is that, once volumes are held constant, the supplier share adds no detectable explanatory power, although this is partly a matter of functional form (Section 5.1). This is compatible with general equilibrium evidence that the gains of the AfCFTA come mostly from reducing non-tariff barriers rather than tariffs (**Abrego et al., 2019**, **2020**), and with evidence that high trade costs limit African agricultural trade (**Porteous, 2019**); our design, however, does not test these mechanisms.

On concentration, our positive but imprecise coefficient is compatible with the argument that diversification of suppliers cushions shocks (**Kummu et al., 2020**). The significance of extra-African concentration in one specification suggests that overseas supplier risk may be the relevant margin, but with ten pooled variants and no multiplicity correction we treat it as a hypothesis for further work. On self-sufficiency, the high and mostly extra-African dependence for cereals and oils is consistent with the documented import dependence of many countries (**Fader et al., 2013**) and suggests that switching suppliers presupposes regional supply capacity; whether self-sufficiency is a sensible objective is debated (**Clapp, 2017**).

The null result should not be read as evidence against the AfCFTA. The intra-African share was flat at about 14% over the sample (Figure 1), trading began only in 2021, and the available within-pair variation is small, so the design can detect only moderate shifts, if any, and cannot capture long-run adjustments. The confidence intervals nevertheless matter: plausible effects of a 10 point increase lie between -0.30% and +0.08% of 1 + availability, which is small relative to the volume channel, although that comparison is itself affected by the accounting link described above.

7. Policy implications

This section separates two things. The first is a set of monitoring suggestions that follows from descriptive facts (high and mostly extra-African import dependence, a flat intra-African share, a cross-country share pattern that reflects customs unions) and from the absence of a detectable within-pair association between the share and availability. The second is a set of hypotheses about trade facilitation, regional sourcing schemes and strategic reserves that this paper cannot test and for which it offers, at most, reasons for further evaluation. Table 6 states for each finding the strength of the evidence and which of the two categories its implication belongs to.

7.1 A monitoring proposal

AfCFTA monitoring could usefully track availability, prices and volatility alongside the intra-African share, because the share can be high, through geography or customs unions, without high availability, as the Southern African cases illustrate. Monitoring could also report import dependence by supplier group and product, so that thin African sourcing in cereals and oils, where dependence is highest, is visible. Finally, better data are part of monitoring: the 11 countries missing from the FBS and informal cross-border trade limit what can be observed. These suggestions require no causal interpretation of our estimates.

7.2 Hypotheses for further evaluation

Four questions deserve evaluation with designs able to identify causal effects, and our results neither confirm nor refute them. First, whether measures that reduce non-tariff barriers, border delays and storage costs raise reliable import volumes and delivered availability, a question motivated by the positive but partly mechanical association with volumes. Second, whether supply capacity must be built before origin substitution can be expected for cereals and vegetable oils. Third, whether regional sourcing schemes in oils and pulses help or hinder availability: the negative point estimates for these two categories do not survive the stated multiplicity correction and are imprecise, so they do not demonstrate harmful regional sourcing, and equally no benefit of such schemes is demonstrated. Fourth, whether supplier

diversification, including outside Africa, and strategic reserves for cereals reduce the volatility of availability: the concentration coefficient is largest for cereals but imprecise, and the evidence is suggestive at most.

Table 6

From evidence to monitoring proposals and hypotheses for evaluation

Finding	Evidence	Strength of the evidence	Implication and status
Share unrelated to within-pair availability	Table 2, Figure 4, Appendix D	Association; intervals exclude large effects on the 1 + A scale, not small ones; not proof that origin cannot matter	Monitoring: add availability, price and volatility indicators to AfCFTA monitoring
Volumes positively associated with availability	Table 3	Partly mechanical (FBS supply identity); BACI tonnes not equal to FBS quantities	Monitoring: track volumes and delivered availability. Further evaluation: whether trade facilitation raises availability (not tested here)
High dependence with thin African sourcing in cereals and oils	Table 1, Figure 2	Descriptive	Monitoring: report dependence by origin and product. Further evaluation: supply capacity and realistic origin targets
Negative point estimates for oils and pulses	Table 4, Figure 5	Not significant after Holm adjustment; imprecise; small in kilograms	Further evaluation only: check standards and supplier reliability; no conclusion on harm or benefit of regional sourcing
Positive but imprecise concentration-volatility link	Table 5, Figure 6, Appendix E	Not significant in the preferred specification; significant only in some variants without correction	Further evaluation: supplier diversification and reserves for cereals; no causal claim
High shares in SACU economies coincide with low availability	Figure 7	Cross-country description	Monitoring: a high share alone says little about availability
Missing countries and imperfect concordance	Section 8, Appendices A to C	Data limitation	Data: extend FBS coverage, publish product-level origin data and record informal trade

Source: author's synthesis of the estimation results.

8. Limitations

All estimates are conditional associations. Reverse causality and omitted time-varying factors such as income, conflict, trade policy, transport costs and climate cannot be excluded, and no instrument is available. Food Balance Sheets measure aggregate national availability, not household access, affordability or nutrition, and their series are smooth and partly imputed, which limits within-pair variation. Imports enter the FBS supply identity, so a partial accounting link between trade and availability exists, which weighs most on the volume results (Table 3) and less on shares; we therefore give the volume results descriptive weight only. The outcome is ln(1 + availability): coefficients are changes in 1 + availability and must be converted at a stated baseline to obtain changes in availability, which is particularly important for foods supplied in small quantities; a specification in ln(availability) on positive observations is reported in Appendix Table D2, and a fixed-effects PPML estimator that uses the zeros directly is reported in Appendix Table D3. Zero availability with positive imports (11.9% of observations) may partly reflect non-food use, rounding of small quantities, accounting or matching issues (Appendix Table A4); the unweighted estimates summarise within-pair associations across observations and do not represent the average dollar of imports or calorie (Appendix Table D3); and the share and availability are built from partly shared sources, so measurement errors may be correlated (Section 2). The HS92 to FBS concordance relies on prefix rules and covers 78.7% of import value, BACI tonnes are not FBS-equivalent for processed goods, and informal trade and re-exports are missing or misattributed. The splice with the historic FBS is approximate (Appendix F). Eleven countries are outside the sample. Inference rests on 43 clusters, and sub-regional results with 5 to 14 clusters are indicative only.

9. Conclusion

Using a product-level panel of 43 African importers, we find that a higher intra-African share of food imports is associated with higher availability only in comparisons across country-product pairs. Within pairs, the association with 1 + availability is statistically indistinguishable from zero, with confidence bounds that exclude increases above 0.08% per 10 percentage points, equivalent to about +0.002 kg per person per year at the median availability of 0.73 kg. These bounds rule out large associations but not small ones, and they do not show that origin cannot matter. Slopes differ across categories, but individual negative estimates for oils and pulses are not robust to multiplicity adjustment, and supplier concentration is only suggestively related to volatility.

Availability is positively associated with import volumes, partly by accounting construction, whereas no association with the supplier share is detected once volumes are held constant, a finding that is partly one of functional form. The zero-inclusive PPML estimate (-0.41%, 95% CI -0.84% to +0.02%) is somewhat more negative, so the evidence is best described as the absence of a detectable association. For policy, availability, prices and reliability could usefully complement the intra-African share in monitoring the AfCFTA. Whether trade facilitation, regional sourcing schemes or strategic reserves improve availability is a question these estimates do not answer and that merits evaluation. Future work could exploit AfCFTA implementation as it matures, bilateral tariff and non-tariff measures, and price data to move from association toward causal identification.

Declarations

Author contributions (CRediT): M. C. Ramaroson (lead author, PhD) led the work and carried out most of it: Conceptualization, Methodology, Software, Formal analysis, Validation, Investigation, Supervision, Project administration, Writing original draft, and Writing review and editing, including the final verification of all results, tables, figures and statements. A. Mihantasoa contributed Data curation, Visualization, Resources, and Writing review and editing, and supported the other tasks. Both authors have read and approved the final manuscript, agree with these declarations and are accountable for the work. The corresponding author is M. C. Ramaroson (ramaroson.cedrick@univ-fianarantsoa.mg).

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Competing interests: The authors declare no competing financial or non-financial interests.

Data availability: The source data are publicly available. BACI trade data (HS92, version V202601) can be downloaded from CEPII (https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37) and the Food Balance Sheets from FAOSTAT (https://www.fao.org/faostat/en/#data/FBS). The processed panel, the estimation scripts (Python notebooks), the HS92-to-FBS crosswalk and all result tables and appendix tables are deposited in a public repository (Zenodo) under the persistent identifier https://doi.org/10.5281/zenodo.23607303. Redistribution of processed data follows the licence terms of CEPII (BACI) and FAO (FAOSTAT), cited in the repository README; where redistribution of the processed panel is not permitted, the repository contains the code, the crosswalk, the result tables and the file names, release dates and checksums of the raw downloads, so that the panel can be rebuilt (Appendix H).

Ethics: The study uses only aggregated, publicly available data and involves no human participants; ethics approval and informed consent were therefore not required.

Originality and preprints: The manuscript has not been published previously, is not under consideration by another journal, and has not been posted as a preprint.

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Use of generative AI: Generative AI was used for linguistic editing of the manuscript. The authors have verified all figures and statistics by cross-referencing them with the results tables and scripts, have reviewed all references, and assume full responsibility for the content.

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Appendix A. Sample construction, countries and exclusions

This appendix documents how the estimation sample is built (Table A1), which countries it contains (Table A2) and which African countries are excluded and why (Table A3).

Table A1

Sample construction and reductions in the number of observations

Step	Observations	Countries	Change	Reason for the change
Panel of country-product-year rows, 2000 to 2023	83,308	49		All rows of the processed panel (recent and historic FBS availability merged with BACI trade by country, unit and year)
Year 2010 or later with recent-FBS availability (outcome defined)	44,859	43	-38,449	Rows before 2010 or without recent-FBS availability, including all rows of the six countries that have only a historic series (Benin, Central African Republic, Chad, Mali, Sudan, Togo)
Positive BACI imports (shares defined)	42,913	43	-1,946	Product has an FBS availability value but no recorded import flow for that country and year, so the origin share is undefined
Imports of at least 10 thousand US dollars and HHI defined: estimation sample	37,102	43	-5,811	Import flow below the reliability threshold for the share
Preferred regression after removal of singleton pairs	36,995	43	-107	107 country-product pairs observed in one year only are absorbed by the pair fixed effect (3,133 pairs become 3,026)
Lagged share available (t-1)	36,597	43	-505	First year of a pair, or a gap in the series (before singleton removal)
Rolling five-year volatility defined (H3)	22,166	43		At least four valid annual log changes in the window (Appendix E)
H3 regression sample	22,006	43	-160	Both five-year means required, and singleton removal
Memo: strictly positive availability	32,692	43		4,410 observations (11.9%) have zero availability and are kept in levels through ln(1 + A)

Note: Counts come from the processing and modelling notebooks (Table_01_sample_construction in the replication package). The change column is the difference from the preceding estimation step, except for the lag row, which is relative to 37,102. Source: author's calculations.

Table A1b

From the estimation sample to the Table 3, Panel B sample

Step	Observations	Lost vs previous step	Comment
Estimation sample (Table A1)	37,102		
Quantity share defined (Table 3, Panel A, before singleton removal)	37,092	10	No BACI quantity for the share
FBS import dependence ratio defined (Panel B sample before singleton removal)	17,873	19,219	Ratio missing, mostly where domestic supply is zero or negative
Panel B regression after removal of singleton pairs	17,785	88	Pairs observed once

Note: Among the 19,219 observations with a missing ratio (non-exclusive reasons): domestic supply zero or negative 8,898; 'Other foods' 10,599; zero availability 4,065. Share of observations with a defined ratio by category: animal products 61.7%, cereals 56.7%, pulses 53.9%, other foods 46.4%, vegetable oils 30.1%. 656 of the 17,873 ratios fall outside the interval 0 to 1 and are clipped. The ratio equals imports divided by production plus imports minus exports in all observations. Of the 32,692 strictly positive availability observations in Table A1, 32,561 remain in the positive-only regression after singleton pairs are removed (Table D1, specification 13). Source: author's calculations (notebook 04).

Table A2

The 43 countries in the estimation sample

Country	ISO3	M49	Region	Obs. in sample	Product units	Historic FBS series
Algeria	DZA	12	Northern Africa	873	75	Yes
Angola	AGO	24	Middle Africa	948	76	Yes
Botswana	BWA	72	Southern Africa	972	77	Yes
Burkina Faso	BFA	854	Western Africa	832	77	Yes

Country	ISO3	M49	Region	Obs. in sample	Product units	Historic FBS series
Cabo Verde	CPV	132	Western Africa	828	76	Yes
Cameroon	CMR	120	Middle Africa	835	78	Yes
Comoros	COM	174	Eastern Africa	616	76	No
Congo	COG	178	Middle Africa	874	76	Yes
Cote d'Ivoire	CIV	384	Western Africa	917	77	Yes
DR Congo	COD	180	Middle Africa	926	78	No
Djibouti	DJI	262	Eastern Africa	843	79	Yes
Egypt	EGY	818	Northern Africa	957	75	Yes
Eswatini	SWZ	748	Southern Africa	922	75	Yes
Ethiopia	ETH	231	Eastern Africa	887	79	Yes
Gabon	GAB	266	Middle Africa	868	79	Yes
Gambia	GMB	270	Western Africa	727	77	Yes
Ghana	GHA	288	Western Africa	977	77	Yes
Guinea	GIN	324	Western Africa	718	78	Yes
Guinea-Bissau	GNB	624	Western Africa	552	77	Yes
Kenya	KEN	404	Eastern Africa	982	77	Yes
Lesotho	LSO	426	Southern Africa	805	79	Yes
Liberia	LBR	430	Western Africa	743	78	Yes
Libya	LBY	434	Northern Africa	873	77	No
Madagascar	MDG	450	Eastern Africa	768	76	Yes
Malawi	MWI	454	Eastern Africa	823	76	Yes
Mauritania	MRT	478	Western Africa	807	78	Yes
Mauritius	MUS	480	Eastern Africa	984	77	Yes
Morocco	MAR	504	Northern Africa	951	74	Yes
Mozambique	MOZ	508	Eastern Africa	945	77	Yes
Namibia	NAM	516	Southern Africa	945	76	Yes
Niger	NER	562	Western Africa	837	78	Yes
Nigeria	NGA	566	Western Africa	1,020	79	Yes
Rwanda	RWA	646	Eastern Africa	812	76	Yes
Sao Tome and Principe	STP	678	Middle Africa	593	77	Yes
Senegal	SEN	686	Western Africa	966	78	Yes
Seychelles	SYC	690	Eastern Africa	914	79	No
Sierra Leone	SLE	694	Western Africa	699	78	Yes
South Africa	ZAF	710	Southern Africa	1,037	76	Yes
Tanzania	TZA	834	Eastern Africa	904	77	Yes
Tunisia	TUN	788	Northern Africa	889	75	Yes
Uganda	UGA	800	Eastern Africa	879	79	Yes
Zambia	ZMB	894	Eastern Africa	932	78	Yes
Zimbabwe	ZWE	716	Eastern Africa	922	79	Yes

Country	ISO3	M49	Region	Obs. in sample	Product units	Historic FBS series
Total				37,102		

Note: Obs. in sample = observations in the 37,102-observation estimation sample. Product units = number of units with an FBS availability value in the country over 2010 to 2023. The four countries without a historic series (Comoros, DR Congo, Libya, Seychelles) are absent from the 2000 to 2009 part of the spliced series, which therefore covers 39 countries before 2010. Regions follow the UN geoscheme. Source: author's calculations.

Table A3

African countries excluded from the estimation sample and exact reasons

Country	ISO3	M49	Region	Historic FBS series	Exact reason for exclusion
Benin	BEN	204	Western Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability
Burundi	BDI	108	Eastern Africa	No	No availability series in either the recent or the historic FBS
Central African Republic	CAF	140	Middle Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability
Chad	TCD	148	Middle Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability
Equatorial Guinea	GNQ	226	Middle Africa	No	No availability series in either the recent or the historic FBS
Eritrea	ERI	232	Eastern Africa	No	No availability series in either the recent or the historic FBS
Mali	MLI	466	Western Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability
Somalia	SOM	706	Eastern Africa	No	No availability series in either the recent or the historic FBS
South Sudan	SSD	728	Eastern Africa	No	No availability series in either the recent or the historic FBS
Sudan	SDN	729	Northern Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability
Togo	TGO	768	Western Africa	Yes	No availability series in the recent FBS (2010-2023); series only in the historic FBS (to 2013), so the country cannot enter the main 2010-2023 sample which requires recent-FBS availability

Note: The country list has 54 African countries (43 included plus 11 excluded). The BACI aggregate for the Southern African Customs Union (code 711, 1995 to 1999) is excluded as an importer because Botswana, Eswatini, Lesotho, Namibia and South Africa appear separately only from 2000; it is kept as an African exporter. The former Sudan (736) is merged with Sudan; Western Sahara (732) and the former Ethiopia (230) count only as African exporters. No country is dropped for any other reason: all 43 countries with a recent-FBS series enter the sample. The excluded countries were identified by the processing code as those with no non-missing availability in the recent FBS file used (Section 3.1), not from an a priori list. Source: author's calculations from FAOSTAT and BACI country codes.

Table A4

Zero availability despite positive imports (at least 10 thousand US dollars), by category and probable explanation

Category	Zero obs.	% of obs.	Pairs with a zero	Pairs zero in all years	Coun-tries	A: primary product	B: imports < 0.005 kg	C: supply <= 0	D: residual
All food	4,410	11.9	787	261	43	903	2,047	1,242	218
Cereals	457	12.1	88	33	41	0	88	223	146
Vegetable oils	1,056	20.1	189	57	41	0	737	298	21
Pulses	163	9.6	30	5	24	0	49	106	8

Category	Zero obs.	% of obs.	Pairs with a zero	Pairs zero in all years	Coun-tries	A: primary product	B: imports < 0.005 kg	C: supply <= 0	D: residual
Animal products	291	4.4	43	11	31	0	198	93	0
Other foods	2,443	12.4	437	155	43	903	975	522	43

Note: Hierarchical classification A > B > C > D. A = primary products processed before consumption (sugar cane, sugar beet, cottonseed, soyabeans, sunflower seed, rape and mustard seed, palm kernels, other oilcrops, coconuts, sesame seed, olives, groundnuts); B = BACI imports below 0.005 kg per person per year, so the zero is compatible with FBS rounding to two decimals (the smallest positive availability is 0.01 kg and every positive value is a multiple of 0.01 kg); C = domestic supply zero, negative or missing in the FBS identity (imports offset by exports or stock change); D = unexplained. Units with the most zeros (share of the unit's observations): other oilcrops 281 (66%), barley 264 (48%), olives 238 (43%), cream 216 (41%), cloves 206 (65%), rape and mustard oil 206 (59%), maize germ oil 186 (48%), pepper 169 (30%), sesame oil 161 (58%), dates 154 (28%). These zeros are not automatically errors; class D (218 observations) has not been checked against the raw utilisation elements and is retained. The full breakdown by unit is in the replication package. Source: author's calculations (notebook 04).The 261 pairs that are zero in all years are dropped, together with 60 single-observation pairs (321 pairs in total), in the PPML estimation of Table D3.

Appendix B. Product units and HS92-to-FBS crosswalk

Table B lists the 81 FBS product units, their groups and the HS92 prefixes assigned to each. A six-digit HS92 code is matched to the unit of its longest matching prefix (six, five, four, three, then two digits). Matched codes: 458 of 698 observed in BACI (chapters 01 to 24). The same 162 rules are provided as a machine-readable file in the replication package.

Table B

The 81 product units: FBS item, group and HS92 prefixes

FBS item	Unit	Fine group	Category	HS6 codes	HS92 prefixes assigned
2655	Wine	beverages	OTHER	4	2204
2656	Beer	beverages	OTHER	1	2203
2657	Beverages, fermented	beverages	OTHER	1	2206
2658	Beverages, alcoholic	beverages	OTHER	8	2205 2208
2511	Wheat	cereals	CEREALS	4	1001 1101 110311
2513	Barley	cereals	CEREALS	3	1003 1107
2514	Maize	cereals	CEREALS	4	1005 110220 110313
2515	Rye	cereals	CEREALS	2	1002 110210
2516	Oats	cereals	CEREALS	1	1004
2517	Millet	cereals	CEREALS	1	100820
2518	Sorghum	cereals	CEREALS	1	1007
2520	Cereals, other	cereals	CEREALS	3	100810 100830 100890
2807	Rice	cereals	CEREALS	5	1006 110230
2740	Butter, ghee	dairy_eggs	ANIMAL	1	0405
2743	Cream	dairy_eggs	ANIMAL	1	040130
2744	Eggs	dairy_eggs	ANIMAL	5	0407 0408
2848	Milk (excl. butter)	dairy_eggs	ANIMAL	16	0401 0402 0403 0404 0406
2960	Fish and seafood (FBS aggregate)	fish	ANIMAL	101	03 1604 1605
2611	Oranges, mandarins	fruits	OTHER	2	080510 080520
2612	Lemons and limes	fruits	OTHER	1	080530
2613	Grapefruit	fruits	OTHER	1	080540
2614	Citrus, other	fruits	OTHER	1	080590

FBS item	Unit	Fine group	Category	HS6 codes	HS92 prefixes assigned
2615	Bananas and plantains (composite)	fruits	OTHER	1	0803
2617	Apples	fruits	OTHER	1	080810
2618	Pineapples	fruits	OTHER	2	080430 200820
2619	Dates	fruits	OTHER	1	080410
2620	Grapes (excl. wine)	fruits	OTHER	2	0806
2625	Fruits, other	fruits	OTHER	50	0804 0807 0808 0809 0810 0811 0812 0813 2006 2007 2008 2009
2731	Bovine meat	meat	ANIMAL	7	0201 0202 021020
2732	Mutton and goat meat	meat	ANIMAL	9	0204
2733	Pigmeat	meat	ANIMAL	9	0203 021011 021012 021019
2734	Poultry meat	meat	ANIMAL	10	0207
2735	Meat, other	meat	ANIMAL	5	0205 0208 021090
2736	Offals, edible	offals_fats	ANIMAL	9	0206
2737	Animal fats, raw	offals_fats	ANIMAL	4	0209 1501 1502 1503
2551	Nuts	oilcrops_nuts	OTHER	11	080120 080130 0802
2552	Groundnuts	oilcrops_nuts	OTHER	3	1202 200811
2555	Soyabeans	oilcrops_nuts	OTHER	1	1201
2557	Sunflower seed	oilcrops_nuts	OTHER	1	120600
2558	Rape and mustard seed	oilcrops_nuts	OTHER	2	1205 120750
2559	Cottonseed	oilcrops_nuts	OTHER	1	120720
2560	Coconuts incl. copra	oilcrops_nuts	OTHER	1	080111 080119 1203
2561	Sesame seed	oilcrops_nuts	OTHER	1	120740
2562	Palm kernels	oilcrops_nuts	OTHER	1	120710
2563	Olives	oilcrops_nuts	OTHER	2	071120 200570
2570	Oilcrops, other	oilcrops_nuts	OTHER	5	1204 120730 120791 120792 120799
2680	Infant food	other_food	OTHER	1	190110
2745	Honey	other_food	OTHER	1	0409
2546	Beans	pulses	PULSES	4	07133
2547	Peas	pulses	PULSES	1	071310
2549	Pulses, other	pulses	PULSES	4	071320 071340 071350 071390
2531	Potatoes	roots	OTHER	5	0701 071010 1105
2532	Cassava	roots	OTHER	2	071410 110814
2533	Sweet potatoes	roots	OTHER	1	071420
2534	Roots other (incl. yams) (composite)	roots	OTHER	1	0714
2630	Coffee	stimulants_spices	OTHER	6	0901
2633	Cocoa	stimulants_spices	OTHER	6	1801 1802 1803 1804 1805
2635	Tea	stimulants_spices	OTHER	5	0902 0903

FBS item	Unit	Fine group	Category	HS6 codes	HS92 prefixes assigned
2640	Pepper	stimulants_spices	OTHER	2	090411 090412
2641	Pimento	stimulants_spices	OTHER	1	090420
2642	Cloves	stimulants_spices	OTHER	1	0907
2645	Spices, other	stimulants_spices	OTHER	18	0905 0906 0908 0909 0910
2536	Sugar cane	sugar	OTHER	1	121292
2537	Sugar beet	sugar	OTHER	1	121291
2542	Sugar (raw eq.)	sugar	OTHER	4	1701
2543	Sweeteners, other	sugar	OTHER	7	1702
2571	Soyabean oil	veg_oils	OILS	2	1507
2572	Groundnut oil	veg_oils	OILS	2	1508
2573	Sunflowerseed oil	veg_oils	OILS	2	15121
2574	Rape and mustard oil	veg_oils	OILS	2	1514
2575	Cottonseed oil	veg_oils	OILS	2	15122
2576	Palmkernel oil	veg_oils	OILS	2	15132
2577	Palm oil	veg_oils	OILS	2	1511
2578	Coconut oil	veg_oils	OILS	2	15131
2579	Sesameseed oil	veg_oils	OILS	1	151550
2580	Olive oil	veg_oils	OILS	3	1509 1510
2582	Maize germ oil	veg_oils	OILS	2	15152
2586	Oilcrops oil, other	veg_oils	OILS	1	151590
2601	Tomatoes	vegetables	OTHER	3	0702 2002
2602	Onions	vegetables	OTHER	1	070310
2605	Vegetables, other	vegetables	OTHER	53	0703 0704 0705 0706 0707 0708 0709 0710 0711 0712 2001 2004 2005

Note: HS6 codes = number of HS92 six-digit codes matched to the unit. Item 2534 combines FBS items 2534 (roots, other) and 2535 (yams); item 2615 combines 2615 (bananas) and 2616 (plantains), because HS92 does not separate them; item 2960 is the FBS aggregate for fish and seafood, used as one unit in place of its sub-items 2761 to 2769. Categories: CEREALS, OILS (vegetable oils), PULSES, ANIMAL (meat, offals and animal fats, dairy and eggs, fish), OTHER. The historic FBS items 2805 (rice, milled equivalent) and 2556 (groundnuts, shelled equivalent) are remapped to 2807 and 2552 for the splice. Source: author's construction.

Appendix C. Handling of processed goods, unmatched trade and aggregates; validation

Processed goods. A processed HS line is mapped to an FBS unit only when the FBS reports the same product or its primary-equivalent under that item. Examples: wheat flour (1101) to wheat, malt (1107) to barley, potato flour (1105) to potatoes, sugars (1701) to raw-sugar equivalent, milk products (0401 to 0404, 0406) to milk excluding butter, butter and cream to their own items. Vegetable oils (HS 1507 to 1515) map to the corresponding oil items, and oilseeds (1201 to 1207) to the oilcrop items; because FBS reports oils and oilseeds as separate items, these flows are not double counted. Lines for which no FBS item exists are deliberately left unmatched: live animals (01), other animal products (05), live plants (06), miscellaneous seeds and plants (1209 to 1214 except sugar plants), gums and plaiting materials (13 and 14), prepared meat (1601 and 1602), cereal preparations (19 except infant food), miscellaneous food preparations (21), ethyl alcohol (2207), feed residues (23), tobacco (24) and chocolate and cocoa preparations (1806).

Unmatched trade. The matched lines cover 78.7% of the import value of chapters 01 to 24 (between 76.0% and 81.8% in each year, 1995 to 2024). Unmatched value is excluded from both the numerator and the denominator of IntraShare and HHI, which therefore describe the origin structure of the matched product only. Table C1 gives the coverage by chapter, and the replication package lists the 25 largest unmatched HS6 codes (mostly food

preparations, tobacco products, soya cake, pet food and live animals).

Aggregates and double counting. Every HS6 code is assigned to a single unit and every unit corresponds to a single FBS item (or to two items for the two composite units), so the availability and trade of a product are counted once. Aggregate FBS items (codes 2900 and above) are not used, with the single exception of item 2960. Country-level dietary energy used in Section 5.4 is the FBS grand total (item 2901), which includes foods outside the 81 matched units; the intra-African share used with it describes matched foods only (78.7% of import value).

Validation against FBS import quantities. For 37,440 country-unit-year observations with positive imports in both sources, the median ratio of BACI tonnes to FBS import quantity is 0.81, 62.3% of ratios lie between 0.5 and 2, and the correlation of logs is 0.75. Agreement is good for pulses (median 1.00), beverages (1.00) and vegetable oils (0.94) and weaker for dairy and eggs (0.42), roots (0.59) and fruits (0.60), which is why quantity-based results are treated as exploratory.

Table C1

Coverage of the HS92-to-FBS crosswalk by HS chapter (import value of African importers, 1995 to 2024)

HS chapter	Description	Share of total value (%)	Share mapped (%)
1	Live animals	1.3	0.0
2	Meat	4.5	100.0
3	Fish	4.9	100.0
4	Dairy/eggs/honey	5.8	100.0
5	Other animal prod.	0.4	0.0
6	Live plants	0.2	0.0
7	Vegetables	2.6	100.0
8	Fruit & nuts	1.8	97.1
9	Coffee/tea/spices	2.5	100.0
10	Cereals	28.5	100.0
11	Milling products	2.7	87.0
12	Oil seeds	2.9	76.5
13	Gums/resins	0.3	0.0
14	Plaiting materials	0.1	0.0
15	Fats & oils	11.3	85.7
16	Meat/fish preps	1.5	72.3
17	Sugars	7.8	91.8
18	Cocoa	1.0	38.6
19	Cereal preps	3.7	17.9
20	Veg/fruit preps	2.0	98.8
21	Misc. edible	3.4	0.0
22	Beverages	3.7	62.7
23	Feed residues	3.2	0.0
24	Tobacco	3.7	0.0

Note: Chapters 01, 05, 06, 13, 14, 21, 23 and 24 have no FBS counterpart and are not mapped. Source: author's calculations from BACI.

Appendix D. Estimation settings and the 18 availability specifications

Estimation and inference settings. The linear models use absorbed fixed effects (alternating projections; singleton groups removed). Standard errors are clustered by importing country (CR1 correction; 43 clusters, or 38 when SACU members are excluded). Confidence intervals are the estimate plus or minus t(0.975; G - 1) standard errors. Wild cluster bootstrap-t: restricted (null imposed), 999 replications, Rademacher weights at the

country level for the full sample and six-point Webb weights for sub-regional samples, symmetric p-values, seed 20261014. Bootstrap p-values are reported for the preferred specification, for the six columns of Table 2 (0.029, 0.033, 0.253, 0.430, 0.193, 0.152), for Table 4 and for Table 5. Alternative clustering of the preferred estimate (-0.0108) gives p = 0.322 (product clusters, 81), 0.276 (country-product clusters, 3,026), 0.311 (two-way country and product) and 0.340 (five regional clusters). Table D1 reports the 18 specifications; its p-values are cluster-robust.

Table D1

The 18 specifications for the intra-African share and availability

#	Specification	N	Clusters	Coeff. (SE)	p (cluster)	95% CI	Change in 1 + A, +10 pp (%)	Concentration coeff. (p)
1	Baseline (preferred)	36,995	43	-0.011 (0.010)	0.265	[-0.030, 0.008]	-0.11	0.002 (0.879)
2	Import threshold >= 100 kUSD	29,578	43	-0.010 (0.013)	0.437	[-0.037, 0.016]	-0.10	0.004 (0.792)
3	Import threshold >= 1,000 kUSD	18,755	43	-0.010 (0.024)	0.677	[-0.059, 0.039]	-0.10	0.003 (0.899)
4	Quantity-based share and HHI	36,985	43	-0.009 (0.010)	0.341	[-0.029, 0.010]	-0.09	0.007 (0.495)
5	Normalised HHI	35,544	43	-0.012 (0.010)	0.224	[-0.032, 0.008]	-0.12	0.008 (0.395)
6	HHI of extra-African suppliers	35,102	43	-0.008 (0.010)	0.445	[-0.027, 0.012]	-0.08	0.009 (0.278)
7	Top-1 supplier weight instead of HHI	36,995	43	-0.011 (0.010)	0.264	[-0.030, 0.009]	-0.11	0.003 (0.761)
8	Number of suppliers added	36,995	43	-0.011 (0.009)	0.254	[-0.030, 0.008]	-0.11	0.018 (0.207)
9	Regressors lagged one year	36,487	43	-0.008 (0.010)	0.432	[-0.028, 0.012]	-0.08	0.003 (0.723)
10	Regressors: 5-year moving averages	35,911	43	0.001 (0.023)	0.967	[-0.045, 0.047]	+0.01	-0.002 (0.908)
11	Outcome: ln(1 + kcal/cap/day)	36,990	43	-0.019 (0.016)	0.256	[-0.051, 0.014]	-0.19	0.008 (0.654)
12	Spliced FBS series, 2000-2023	58,596	43	-0.005 (0.012)	0.651	[-0.029, 0.018]	-0.05	0.015 (0.137)
13	Excluding zero availability	32,561	43	-0.016 (0.011)	0.133	[-0.038, 0.005]	-0.16	0.004 (0.730)
14	Excluding SACU members	32,322	38	-0.010 (0.010)	0.347	[-0.030, 0.011]	-0.10	-0.000 (0.977)
15	Excluding pairs with |annual change| > 1 log pt	35,434	43	-0.007 (0.008)	0.342	[-0.023, 0.008]	-0.07	0.002 (0.827)
16	Import-dependent pairs only (IDR >= 0.2)	7,246	43	0.001 (0.034)	0.968	[-0.067, 0.069]	+0.01	0.027 (0.364)
17	Four-focal-category sample (cereals, oils, pulses, animal products; excludes 'Other foods')	17,297	43	-0.024 (0.011)	0.031	[-0.046, -0.002]	-0.24	-0.008 (0.488)
18	Controls: import value + product x year FE	36,974	43	-0.010 (0.010)	0.319	[-0.031, 0.010]	-0.10	-0.018 (0.117)

Note: Coefficients on the share variable of each specification (measured on a 0 to 1 scale), country-product and year fixed effects unless stated (specification 18 uses product-year fixed effects). Specification 1 is the preferred one. In specification 11 the outcome is ln(1 + kcal per person per day), so the percentage refers to 1 + kcal; in specification 12 the outcome is the spliced series (2000 to 2023); in specification 4 the share and HHI are quantity-based; in specification 10 both regressors are five-year moving averages. Specification 13 restricts the sample to positive availability but keeps ln(1 + A). The concentration column gives the coefficient on the concentration measure of each specification (HHI, normalised HHI, extra-African HHI or top-supplier weight). The share coefficient is positive in two specifications (10 and 16), significantly positive at 5% in none and significantly negative in one (17). Specification 17 is discussed in Section 5.1; the 18 specifications are robustness checks and their p-values are not adjusted for multiplicity (Holm, Bonferroni and Benjamini-Hochberg adjusted p-values over the 18: 0.56 for specification 17 and at least 0.57 for all others). Source: author's estimates.

Additional check in ln(availability). Table D2 re-estimates the preferred specification with ln(availability) as the outcome on the observations with strictly positive availability, so the coefficient is directly a percentage change in availability (100[exp(0.1 times the coefficient) - 1] per ten points). The pooled estimate is close to zero and imprecise, in line with Table D1; by category, only vegetable oils approach conventional significance and not after Holm adjustment over the four focal categories.

Table D2

Preferred specification with ln(availability) as the outcome, positive availability only

Sample	N	Change in availability, +10 pp (%)	95% CI	p (cluster)	p (wild bootstrap)	Holm p (4 focal)
All food	32,561	+0.08	[-0.53, +0.69]	0.798	0.818	
Cereals	3,313	-0.08	[-1.34, +1.20]	0.902	0.909	1.000
Vegetable oils	4,169	-1.09	[-2.28, +0.11]	0.074	0.050	0.200
Pulses	1,528	-1.41	[-4.10, +1.35]	0.305	0.327	0.981
Animal products	6,297	-0.06	[-0.89, +0.78]	0.895	0.886	1.000
Other foods	17,254	+0.80	[-0.15, +1.77]	0.098	0.107	

Note: Country-product and year fixed effects, share and HHI as regressors, standard errors clustered by country (43 clusters), wild bootstrap with 999 Rademacher replications (seed 20261014). The percentage is 100[exp(0.1 times the coefficient) - 1] and refers to availability itself. Script 04_check_ln_availability.py in the replication package. Source: author's estimates.

Table D3

Zero-inclusive PPML and weighted estimates of the association between the intra-African share and availability

Specification	N	Pairs	Coeff.	SE	p	95% CI	Change for +10 pp (%)	95% CI (%)
Preferred: OLS, ln(1 + A), unweighted (Table D1, spec. 1)	36,995	3,026	-0.0108	0.0095	0.265	[-0.030, 0.008]	-0.11	[-0.30, +0.08]
19. FE-PPML, A in kg, zeros retained	35,078	2,812	-0.0412	0.0212	0.058	[-0.084, 0.002]	-0.41	[-0.84, +0.02]
19c. FE-PPML, positive observations only	32,561	2,741	-0.0422	0.0210	0.050	[-0.085, 0.000]	-0.42	[-0.84, +0.00]
20. WLS, weights = pair mean import value	36,995	3,026	+0.0512	0.0631	0.421	[-0.076, 0.179]	+0.51	[-0.76, +1.80]
20b. WLS, weights = pair mean national energy from the product	36,402	2,949	-0.0096	0.0198	0.630	[-0.050, 0.030]	-0.10	[-0.49, +0.30]

Note: p = cluster-robust p-value. Country-product and year fixed effects; standard errors clustered by country (43 clusters), t(42) p-values; the wild bootstrap is not implemented for PPML. Specifications 19 to 20b are additional to the 18 of Table D1. PPML drops 2,024 observations in 321 pairs (261 pairs with zero availability in every year, i.e. 1,964 observations, and 60 single-observation pairs) and keeps 2,446 zeros; it converged; its coefficient does not change when A is expressed in grams (unit invariance); the PPML coefficient on HHI is -0.016 (p = 0.541). The change for +10 pp is 100[exp(0.1 times the coefficient) - 1] and refers to availability itself in the PPML rows and to 1 + availability in the others. Weights are time-invariant pair averages; descriptive weight-concentration measures ((sum of weights)² divided by sum of squared weights) are 1,298 (import value) and 1,374 (energy), against 36,995 and 36,402 observations. Source: author's estimates (notebook 04).

Table D4

Unit dependence of the ln(1 + cA) specification: coefficient on the intra-African share

Unit of A	Coeff.	SE	p	Share of positive observations with cA < 1
10 kg units (A/10)	-0.0038	0.0039	0.345	0.799
kg (preferred)	-0.0108	0.0095	0.265	0.475
100 g units (10A)	-0.0060	0.0179	0.740	0.194
g (1000A)	+0.0582	0.0458	0.211	0.000

Note: Preferred specification (country-product and year fixed effects, SE clustered by country) with ln(1 + cA) as the outcome. The coefficient and its significance move with the unit because ln(1 + cA) interpolates between a linear and a logarithmic transform. Source: author's estimates (notebook 04).

Appendix E. Volatility: definition, sample accounting and robustness

Definition. For each country-product pair, the annual log change is ln A_t - ln A_{t-1}, defined only when the two years are consecutive and A is strictly positive in both. Volatility in year t is the standard deviation of a window of five consecutive annual changes (rows of the pair's panel), computed when at least four of the five are valid. HHI and IntraShare are means over the same five years, requiring at least four valid values. With the recent FBS series (log changes from 2011), the first possible window ends in 2014 and each pair can contribute up to ten overlapping windows (2014 to 2023). The dependent variable has mean 0.309 in the H3 sample. The earlier wording of this

appendix, five consecutive annual observations, described a different rule. Appendix Table E compares three readings with the stored index: the rule above reproduces it exactly (24,993 windows, of which 22,110 have five valid changes and 2,883 have four), whereas the rule of five levels (four changes, all valid) matches it for 12.7% of windows and the rule of five changes all valid defines only 22,110 windows.

Zero availability and gaps. The log change is undefined when availability is zero in either year, so a zero removes the changes into and out of it, and a window containing a zero is defined only if four valid changes remain: 194 of the 24,993 windows (0.8%) contain a zero level. Of the 37,102 estimation observations, 4,410 (11.9%) have zero availability. A missing year breaks the log change; windows are formed over the rows a pair actually has, so six windows (0.02%) cover more than five calendar years. The 24,993 windows are counted over the full panel; 22,166 fall in the estimation sample and 22,006 in the regression (Table A1). Because windows overlap, errors are serially correlated: standard errors are clustered by country, and a non-overlapping specification is reported below.

Table E1

Robustness of the association between supplier concentration and volatility

Specification	N	Clusters	Coeff.	SE	p	95% CI	Holm p (5 cat.)
Baseline (preferred)	22,006	43	0.057	0.045	0.213	[-0.034, 0.149]	
DV: coefficient of variation (5y)	22,006	43	0.020	0.027	0.459	[-0.034, 0.075]	
DV: ln(0.01 + volatility)	22,006	43	0.001	0.140	0.993	[-0.282, 0.284]	
DV winsorised at 1st/99th percentile	22,006	43	0.045	0.042	0.287	[-0.039, 0.130]	
Concentration: HHI of extra-African suppliers	20,952	43	0.034	0.012	0.009	[0.009, 0.059]	
Concentration: top-1 supplier weight	22,006	43	0.030	0.016	0.067	[-0.002, 0.063]	
Quantity-based HHI	22,006	43	0.031	0.016	0.058	[-0.001, 0.064]	
Import threshold >= 1,000 kUSD	12,653	43	0.023	0.061	0.710	[-0.101, 0.147]	
Excluding SACU members	19,120	38	0.083	0.046	0.076	[-0.009, 0.176]	
Import-dependent pairs only (IDR >= 0.2)	4,709	43	-0.033	0.065	0.616	[-0.164, 0.099]	
Category: Cereals	2,245	43	0.316	0.160	0.055	[-0.008, 0.640]	0.277
Category: Vegetable oils	2,667	43	-0.168	0.090	0.067	[-0.350, 0.013]	0.277
Category: Pulses	1,027	43	0.011	0.131	0.934	[-0.253, 0.275]	1.000
Category: Animal products	4,382	43	-0.029	0.044	0.516	[-0.117, 0.060]	1.000
Category: Other foods	11,685	43	0.118	0.074	0.119	[-0.032, 0.268]	0.358
Interaction: HHI x high import dependence (main term)	15,396	43	0.033	0.061	0.590	[-0.090, 0.155]	
Interaction: HHI x high import dependence (interaction term)	15,396	43	0.050	0.096	0.605	[-0.143, 0.243]	

Note: Dependent variable is the rolling five-year standard deviation of annual log changes (except where the specification changes it); coefficients are on the five-year mean HHI (or the measure named in the row), country-product and year fixed effects, standard errors clustered by country, p-values cluster-robust. The preferred specification has wild bootstrap p = 0.213 (999 Rademacher replications, seed 20261014); the other columns of Table 5 have wild bootstrap p of 0.141, 0.213 and 0.284. The last two rows give the main term and the interaction term of HHI with a high import dependence indicator. The coefficient is positive in nine of the ten pooled specifications (rows 1 to 10: baseline, coefficient of variation, ln(0.01 + volatility), winsorised outcome, extra-African HHI, top-supplier weight, quantity HHI, import threshold of 1,000 thousand US dollars, excluding SACU, and import-dependent pairs only), the exception being the last. Source: author's estimates.

Non-overlapping windows and cross-section. With non-overlapping windows (volatility computed within each of two sub-periods, 2011 to 2017 and 2018 to 2023, with at least four valid changes and four valid shares; pair and period fixed effects; 4,182 observations, 43 clusters) the coefficient on mean HHI is 0.065 (SE 0.074) without controls and 0.066 (SE 0.077) with controls. In the cross-section of 2,646 country-product pairs (volatility over 2011 to 2023 regressed on 2010 to 2023 mean regressors, country and product fixed effects, volatility winsorised at the 1st and 99th percentiles), the coefficient on mean HHI

is -0.016 (SE 0.050), and 0.044 (SE 0.046) once mean availability and import value are controlled for.

Table E

Reconstruction of the stored volatility index under three window definitions

Definition	Windows defined	Identical to stored index where both defined	Defined only in stored index	Windows spanning a gap	Windows with a zero level
D1: five levels = four changes, all valid	24,794	12.7%	199	0	0
D2: five annual changes, at least four valid (stored index)	24,993	100%	0	6	194
D3: five annual changes, all valid	22,110	100%	2,883	0	0

Note: Counts over the full panel (2010 to 2023). The stored index is the one used in Table 5. Source: author's calculations (notebook 04).

Table E2

Volatility regressions: sensitivity to near-zero quantities and to the window definition (coefficient on five-year mean HHI)

Specification	N	Coeff. (SE)	p	95% CI	Mean of outcome	Share of baseline	Boot. p
Baseline (stored index, preferred)	22,006	0.057 (0.045)	0.213	[-0.034, 0.149]	0.309	1.000	0.213
Excluding windows with any availability < 0.01 kg	21,842	0.056 (0.044)	0.211	[-0.033, 0.144]	0.306	0.993	0.214
Excluding windows with any availability < 0.1 kg	17,345	0.027 (0.038)	0.478	[-0.049, 0.102]	0.224	0.789	0.495
Excluding bottom decile of mean availability (< 0.06 kg)	19,844	0.062 (0.042)	0.146	[-0.022, 0.147]	0.295	0.902	0.152
Outcome: SD of annual changes in ln(1 + A), zeros allowed	26,212	0.029 (0.014)	0.046	[0.001, 0.057]	0.105	1.192	0.053
Window definition D1	21,838	0.042 (0.045)	0.355	[-0.049, 0.133]	0.303	0.993	0.348
Window definition D3	19,480	0.065 (0.044)	0.151	[-0.025, 0.154]	0.304	0.886	0.171

Note: p = cluster-robust p-value; Boot. p = wild bootstrap p-value. Controls as in the preferred specification (five-year means of the intra-African share, ln availability and ln import value), country-product and year fixed effects, standard errors clustered by country, 999 Rademacher bootstrap replications. Window definition D2 is the baseline. 21.1% of the windows in the H3 sample contain an availability value below 0.1 kg; their mean volatility is 0.627 against 0.224 for the others. Source: author's estimates (notebook 04).

Appendix F. Splice of the historic and recent FBS series

Purpose and use. The recent FBS (2010 onward) and the historic FBS (to 2013) follow different methodologies. The splice is used only in two robustness checks (specification 12 of Table D1 and the extended sample), never in the main results.

Procedure. (i) Item codes of the historic series are aligned with the recent ones (rice 2805 to 2807, groundnuts 2556 to 2552) and the former Sudan (code 736) is merged with Sudan. (ii) For each country-unit pair, the mean ratio of recent to historic availability is computed over the overlap years 2010 to 2013; where both values are zero the ratio is set to one, and the ratio is bounded to the interval 0.1 to 10 (2.3% of ratios are bounded). (iii) The historic series for 2000 to 2009 is multiplied by this ratio, and the recent series is used from 2010. Kilocalorie availability is spliced in the same way with its own ratio. Only items present in both releases can be spliced.

Comparability. The overlap contains 11,864 country-unit-year observations. The median ratio of recent to historic availability is 0.995 (10th percentile 0.68, 90th percentile 1.60); 29.5% of pairs agree within 5% and 64.8% within 20%, and the correlation of logs is 0.968. Agreement is closest for dairy and eggs and fish (log correlation 0.99), fruits and cereals (0.98), and weakest for sugar (log correlation 0.81), stimulants and spices (0.90) and oilcrops (0.94). The splice therefore preserves the ranking of availability across pairs but not its exact level, which is why it is a secondary check. The spliced sample has 58,596 observations in the estimation (2000 to 2023); four countries (Comoros, DR Congo, Libya, Seychelles) have no historic series and enter only from 2010. The coefficient on the share in this sample is -0.005 (SE 0.012; Table D1, specification 12).

Appendix G. Conversion of coefficients to kilograms

Conversion at stated baselines. For a coefficient β and a ten point change in the share, the change in 1 + availability is 100[exp(0.1β) - 1] percent, the change in availability at a stated positive baseline A_0 is (1 + A_0)[exp(0.1β) - 1] kilograms, and its proportion of A_0 is ((1 + A_0)/A_0)[exp(0.1β) - 1]. Applied to the preferred estimate and its confidence bounds this gives the kilogram figures of Table 2 (-0.0019 kg, 95% CI -0.0052 to +0.0015 at 0.73

kg, the sample median; -0.0102 kg, 95% CI -0.0284 to +0.0080 at 8.49 kg, the sample mean). A coefficient on the scale of 1 + availability implies a much larger percentage change in availability for foods supplied in small quantities (at 0.14 kg, the median for vegetable oils, -0.88% with 95% CI -2.4% to +0.7%). Precision is described by these confidence intervals; no post-estimation power calculation is used.

Appendix H. Replication material

The replication package deposited with this manuscript contains: (i) the four Python notebooks, in order, that load and profile the sources, build the processed panel (country-product-year) and the HS92-to-FBS crosswalk, and estimate all models, tables and figures, with plain script exports; the fourth notebook (04_Revision_Checks_Projet3_AEMR139) produces the additional checks of the revision (Tables A1b, A4, D3, D4, E and E2, the multiplicity adjustment and the equality test of Table 3); (ii) the processed panel files written by the second notebook (panel_item, panel_group, panel_country_year, cross_section_item, concordance_hs6_fbs, unit_reference, trade_unit_year, overlap_fbs_2010_2013, flows_unit_importer_origin); (iii) all result tables (CSV and a single workbook), figures and the file of key results; (iv) the appendix tables of this manuscript as CSV files (countries included and excluded, the 81 units with their HS92 prefixes, the 162 crosswalk rules, the 25 largest unmatched HS6 codes, coverage by chapter); and (v) a README with the software versions (Python 3.12.4, pandas 2.3.1, numpy 1.26.4), the data releases, the seed (20261014) and the run order. The source data (BACI V202601 and the two FAOSTAT FBS files) are not redistributed and must be downloaded from CEPII and FAOSTAT.

Reproducibility and data-sharing plan. (1) The code, the crosswalk, the result tables and the supporting outputs are deposited as a single versioned release on Zenodo (persistent identifier: https://doi.org/10.5281/zenodo.23607303), which is also given in the Data availability statement. (2) The README will list for each raw source its URL, release or version, last-modified date and a SHA-256 checksum (BACI V202601; the recent and historic FAOSTAT FBS files), so that the exact inputs can be re-downloaded and verified. (3) The processed panel is shared only where the licence terms of CEPII and FAO allow redistribution; otherwise the repository holds the notebooks that rebuild it from the raw files, with the run order and the seed (20261014). (4) The README will map every table and figure of the article and of the appendices to the notebook and output file that produce it, including the revision tables listed above, and will fix the software versions.