

Package: agriTradeRisk (via r-universe)

October 24, 2026

Type Package

Title Agricultural Export Competitiveness and Risk Analysis

Version 0.1.0

Description An integrated and reproducible workflow for analysing the competitiveness and risk of agricultural and horticultural exports. It measures destination and product concentration (Herfindahl-Hirschman, entropy and equivalent-number indices), revealed comparative advantage (Balassa, 1965) [<doi:10.1111/j.1467-9957.1965.tb00050.x>](https://doi.org/10.1111/j.1467-9957.1965.tb00050.x) and its symmetric form, relative unit values, and constant market share decomposition of export growth. It tests vertical price transmission between export and domestic prices with Engle-Granger cointegration (Engle and Granger, 1987) [<doi:10.2307/1913236>](https://doi.org/10.2307/1913236) using MacKinnon (2010) critical values and symmetric or asymmetric error correction models. It quantifies exchange-rate exposure of a multi-currency export portfolio (volatility, diversification ratio, risk contributions and value at risk), screens destination markets with composite entry-risk scores, and identifies risk-efficient destination mixes by mean-variance portfolio optimisation (Markowitz, 1952) [<doi:10.2307/2975974>](https://doi.org/10.2307/2975974). Simulated example data for Indian mango, grape, pomegranate and processed horticultural exports illustrate the workflow.

License GPL (>= 3)

Encoding UTF-8

Language en-GB

LazyData true

Depends R (>= 3.5.0)

Imports graphics, stats

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr

Config/testthat/edition 3

RoxygenNote 7.3.1

NeedsCompilation no

Author Anbukkani Perumal [aut, cre, cph]

Maintainer Anbukkani Perumal <anbueconomic@gmail.com>

Repository <https://cran.r-universe.dev>

Date/Publication 2026-10-24 11:50:02 UTC

RemoteUrl <https://github.com/cran/agriTradeRisk>

RemoteRef HEAD

RemoteSha 99ab8a55ac6112b70d3dfab762ecf312a60b5076

Contents

cms_decomposition	2
competitiveness_index	3
exchange_rate_exposure	5
export_concentration	6
fx_rates	7
grape_prices	7
hort_exports	8
market_diversification	8
market_entry_risk	10
plot.market_diversification	11
price_transmission	12
trade_totals	13

Index	14
--------------	-----------

cms_decomposition	<i>Constant market share decomposition of export growth</i>
-------------------	---

Description

Decomposes the change in a country's exports between two periods into four effects (Leamer and Stern, 1970; Ahmadi-Esfahani, 2006):

$$\Delta X = rX^0 + \sum_k (r_k - r)X_k^0 + \sum_k \sum_j (r_{kj} - r_k)X_{kj}^0 + \sum_k \sum_j (X_{kj}^1 - X_{kj}^0 - r_{kj}X_{kj}^0)$$

world growth exports would have grown at the rate r of world imports covered by the data;

commodity composition gain from specialising in products whose world demand grew faster than average;

market distribution gain from exporting each product to markets where its demand grew faster;

competitiveness the residual, the change in market shares.

r_{kj} , r_k and r are growth rates of world imports of product k in market j , of product k in all markets, and of all products in all markets in the data.

Usage

```
cms_decomposition(data, product, market, export0, export1, world0, world1)
```

Arguments

data	A data frame with one row per product-market pair.
product, market	Names of product and market columns.
export0, export1	Columns with the country's exports in the base and end periods.
world0, world1	Columns with world imports of the product by the market in the base and end periods (must be positive).

Value

A list of class 'cms_decomposition' with 'effects' (data frame of the four effects, their total and their shares of the export change), 'by_product' (effects by product) and 'growth' (world growth rates).

References

Leamer, E. E. and Stern, R. M. (1970). **Quantitative International Economics**. Allyn and Bacon, Boston.

Ahmadi-Esfahani, F. Z. (2006). Constant market shares analysis: uses, limitations and prospects. **Australian Journal of Agricultural and Resource Economics**, 50(4), 510-526.

Examples

```
d0 <- subset(hort_exports, year == 2015)
d1 <- subset(hort_exports, year == 2023)
cms <- merge(d0, d1, by = c("product", "destination"),
             suffixes = c("0", "1"))
cms_decomposition(cms, "product", "destination", "export_value0",
                  "export_value1", "world_import0", "world_import1")
```

competitiveness_index *Revealed comparative advantage and export competitiveness*

Description

Computes standard competitiveness indicators for a country's exports of product k :

- Balassa revealed comparative advantage $RCA = (x_k/X)/(w_k/W)$, where x_k and X are the country's exports of the product and of all goods, and w_k and W the corresponding world exports. Values above 1 indicate a revealed comparative advantage.
- Revealed symmetric comparative advantage $RSCA = (RCA - 1)/(RCA + 1)$, bounded between -1 and 1.

- World market share x_k/w_k .
- If quantities are supplied, the export unit value, the world unit value and their ratio, a price-based competitiveness (or quality) indicator.

Usage

```
competitiveness_index(
  data,
  export,
  total_export,
  world_export,
  world_total,
  quantity = NULL,
  world_quantity = NULL
)
```

Arguments

<code>data</code>	A data frame, one row per product (and year).
<code>export</code>	Column with the country's exports of the product.
<code>total_export</code>	Column with the country's total exports.
<code>world_export</code>	Column with world exports of the product.
<code>world_total</code>	Column with world total exports.
<code>quantity, world_quantity</code>	Optional columns with the country's and the world's export quantities of the product.

Value

'data' with added columns 'rca', 'rsca', 'world_share' and, when quantities are given, 'unit_value', 'world_unit_value' and 'unit_value_ratio'. The result has class 'competitiveness_index'.

References

Balassa, B. (1965). Trade liberalisation and "revealed" comparative advantage. *The Manchester School*, 33(2), 99-123. doi:[10.1111/j.14679957.1965.tb00050.x](https://doi.org/10.1111/j.14679957.1965.tb00050.x)

Examples

```
prod_year <- aggregate(cbind(export_value, world_import) ~ product + year,
  data = hort_exports, FUN = sum)
dat <- merge(prod_year, trade_totals, by = "year")
ci <- competitiveness_index(dat, "export_value", "india_total_exports",
  "world_import", "world_total_exports")
head(ci[, c("product", "year", "rca", "rsca", "world_share")])
```

exchange_rate_exposure

Exchange-rate exposure of a multi-currency export portfolio

Description

Treats export earnings invoiced in several currencies as a currency portfolio. Using log changes of exchange rates (home currency per unit of foreign currency) and the share of export value earned in each currency, it computes:

- annualised volatility of each currency and their correlations;
- a trade-weighted (geometric) effective exchange-rate index;
- portfolio volatility $\sigma_p = \sqrt{s' \Sigma s}$ and the undiversified volatility $\sum_i s_i \sigma_i$; their ratio is the diversification ratio (values above 1 indicate risk reduction from currency diversification);
- each currency's percentage contribution to portfolio variance, $s_i(\Sigma s)_i / \sigma_p^2$;
- parametric and historical value at risk of export earnings in home currency over 'horizon' periods at confidence level 'conf'.

If an export series is supplied, the exposure elasticity is estimated by regressing its log change on the log change of the effective exchange rate.

Usage

```
exchange_rate_exposure(
  rates,
  shares,
  export_value = 1,
  freq = 12,
  horizon = 1,
  conf = 0.95,
  exports = NULL
)
```

Arguments

rates	A data frame or matrix of exchange rates, one column per currency (home currency per unit of foreign currency), one row per period, in time order.
shares	Named numeric vector of export shares by currency; names must match columns of 'rates'. Normalised to sum to 1.
export_value	Export value (home currency) exposed over the horizon, used for value at risk.
freq	Periods per year (12 for monthly data) for annualisation.
horizon	Value-at-risk horizon in periods.
conf	Confidence level for value at risk.
exports	Optional numeric series of export values or prices (same length as 'rates') for estimating the exposure elasticity.

Value

A list of class ‘exchange_rate_exposure’ with ‘currencies’ (share, annualised volatility and risk contribution per currency), ‘correlation’, ‘portfolio’ (annualised portfolio and undiversified volatility, diversification ratio, parametric and historical value at risk), ‘effective_index’ (trade-weighted index, first period = 100) and, if ‘exports’ is supplied, ‘elasticity’ (estimate, standard error, p-value).

Examples

```
sh <- c(USD = 0.35, EUR = 0.20, GBP = 0.15, AED = 0.20, BDT = 0.10)
ex <- exchange_rate_exposure(fx_rates[, names(sh)], sh,
                             export_value = 1e9, freq = 12)
ex
```

export_concentration *Export concentration indices*

Description

Measures how concentrated exports are across destinations (or across products, by passing the product column as ‘partner’). For partner shares s_j the function reports the Herfindahl-Hirschman index $HHI = \sum_j s_j^2$, its normalised form $(HHI - 1/n)/(1 - 1/n)$, the equivalent number of equally sized partners $1/HHI$, the combined share of the ‘top’ largest partners, and Theil’s entropy $-\sum_j s_j \ln s_j$ with its normalised form (divided by $\ln n$). Higher HHI and lower entropy indicate greater concentration and therefore greater exposure to shocks in individual markets.

Usage

```
export_concentration(data, value, partner, by = NULL, top = 3)
```

Arguments

data	A data frame with one row per partner (and group).
value	Name of the column holding export values (non-negative).
partner	Name of the column identifying destinations (or products).
by	Optional names of grouping columns, for example product and year.
top	Number of leading partners for the top-share measure.

Value

A data frame of class ‘export_concentration’ with one row per group and columns ‘total’, ‘n_partners’, ‘hhi’, ‘hhi_normalised’, ‘equivalent_partners’, ‘top_share’, ‘entropy’, ‘entropy_normalised’, ‘leading_partner’ and ‘leading_share’.

Examples

```
ec <- export_concentration(hort_exports, value = "export_value",
                           partner = "destination",
                           by = c("product", "year"))

head(ec)
```

fx_rates

*Simulated monthly exchange rates of the Indian rupee***Description**

Synthetic monthly exchange rates (Indian rupees per unit of foreign currency), January 2014 to December 2023. AED and SAR follow their US dollar pegs. Not official statistics.

Usage

```
fx_rates
```

Format

A data frame with 120 rows and 8 columns: 'date', 'USD', 'EUR', 'GBP', 'AED', 'SAR', 'BDT' and 'RUB'.

Source

Simulated.

grape_prices

*Simulated monthly grape export and domestic prices***Description**

Synthetic monthly export unit values and domestic wholesale prices of grapes (INR per kg), January 2012 to December 2023, generated as a cointegrated pair with faster adjustment when domestic prices are above their long-run relationship. Not official statistics.

Usage

```
grape_prices
```

Format

A data frame with 144 rows and 3 columns: 'date', 'export_unit_value' and 'domestic_price'.

Source

Simulated.

hort_exports

*Simulated Indian horticultural exports by product and destination***Description**

Simulated annual exports of four Indian horticultural product groups to eight destination markets, with world imports of each product by each destination. The data are ****synthetic****, generated by 'data-raw/make_data.R' for illustration; they are not official trade statistics.

Usage

hort_exports

Format

A data frame with 448 rows and 6 columns:

year Year, 2010-2023.

product "mango", "grapes", "pomegranate" or "processed" (processed fruit and vegetable products).

destination Destination market.

export_value Exports from India, USD million.

export_quantity Export quantity, tonnes.

world_import World imports of the product by the destination, USD million.

Source

Simulated.

market_diversification

*Risk-efficient destination market mix***Description**

Applies mean-variance portfolio analysis (Markowitz, 1952) to the allocation of exports across destination markets. Each market is an "asset" whose return is a performance measure such as the growth of export earnings or the realised export price (unit value) change. The function finds destination shares w that minimise $w'\Sigma w - \tau\mu'w$ subject to $\sum w = 1$ and $l \leq w \leq u$, where share bounds reflect market-access or capacity limits. It reports the minimum-variance mix, the mix with the highest return per unit of risk on the efficient frontier, the current mix and the efficient frontier, so that the risk reduction available from diversification can be compared with the current market structure.

Usage

```
market_diversification(
  returns = NULL,
  shares = NULL,
  mean = NULL,
  cov = NULL,
  min_share = 0,
  max_share = 1,
  n_frontier = 25
)
```

Arguments

returns	A data frame or matrix of returns, one column per market and one row per period. Alternatively supply 'mean' and 'cov'.
shares	Optional named vector of current destination shares.
mean, cov	Optional mean vector and covariance matrix of returns, used instead of 'returns'.
min_share, max_share	Lower and upper bounds on each market's share (scalars or one per market).
n_frontier	Number of points on the efficient frontier.

Details

The problem is solved by projected gradient descent on the bounded simplex, which needs no additional packages.

Value

A list of class 'market_diversification' with 'weights' (data frame of current, minimum-variance and best return-to-risk shares by market), 'summary' (expected return, risk, return-to-risk ratio and Herfindahl index of each mix), 'frontier' (data frame of efficient portfolios) and the inputs 'mean' and 'cov'. A 'plot()' method draws the frontier.

References

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77-91. doi:[10.2307/2975974](https://doi.org/10.2307/2975974)

Examples

```
grapes <- subset(hort_exports, product == "grapes")
wide <- reshape(grapes[, c("year", "destination", "export_value")],
  idvar = "year", timevar = "destination",
  direction = "wide")
vals <- as.matrix(wide[order(wide$year), -1])
colnames(vals) <- sub("export_value.", "", colnames(vals))
growth <- diff(log(vals))
cur <- vals[nrow(vals), ] / sum(vals[nrow(vals), ])
md <- market_diversification(growth, shares = cur, max_share = 0.4)
```

```
md
plot(md)
```

market_entry_risk	<i>Composite market-entry risk score</i>
-------------------	--

Description

Combines indicators of the risk of entering or expanding in destination markets, for example sanitary and phytosanitary rejection rates, tariff rates, non-tariff measure counts, price volatility, exchange-rate volatility, distance or transit time, and competitor market share, into a single score. Each indicator is rescaled to 0-1 by min-max normalisation and oriented so that 1 is the riskiest value; the score is the weighted mean of the rescaled indicators. Optionally, a market attractiveness indicator (such as import demand growth) is combined with the score into a risk-adjusted attractiveness index $A(1 - \rho risk)$, where A is rescaled attractiveness and ρ the risk aversion.

Usage

```
market_entry_risk(
  data,
  market,
  indicators,
  higher_is_riskier,
  weights = NULL,
  attractiveness = NULL,
  risk_aversion = 0.5
)
```

Arguments

<code>data</code>	A data frame with one row per market.
<code>market</code>	Name of the market column.
<code>indicators</code>	Names of indicator columns.
<code>higher_is_riskier</code>	Logical vector, one per indicator: 'TRUE' if a higher value means more risk.
<code>weights</code>	Optional non-negative weights, one per indicator (normalised to sum to 1). Equal weights by default.
<code>attractiveness</code>	Optional name of a column measuring market attractiveness (higher is better).
<code>risk_aversion</code>	Weight ρ (0 to 1) of risk in the risk-adjusted attractiveness index.

Value

A data frame of class 'market_entry_risk' with the market, the rescaled indicators, 'risk_score', 'risk_rank' (1 = least risky) and, if 'attractiveness' is given, 'attractiveness_scaled', 'risk_adjusted_attractiveness' and 'priority_rank'.

Examples

```
mk <- data.frame(market = c("UAE", "UK", "Netherlands", "USA",
                             "Bangladesh"),
                 sps_rejections = c(2, 5, 8, 6, 1),
                 tariff = c(0, 0, 0, 2, 10),
                 price_cv = c(0.15, 0.10, 0.12, 0.18, 0.25),
                 demand_growth = c(0.06, 0.03, 0.04, 0.05, 0.08))
market_entry_risk(mk, "market",
                  c("sps_rejections", "tariff", "price_cv"),
                  higher_is_riskier = c(TRUE, TRUE, TRUE),
                  attractiveness = "demand_growth")
```

plot.market_diversification

Plot the efficient frontier of destination markets

Description

Plot the efficient frontier of destination markets

Usage

```
## S3 method for class 'market_diversification'
plot(x, ...)
```

Arguments

x A [market_diversification()] object.

... Further arguments passed to [graphics::plot()].

Value

‘x’, invisibly.

Examples

```
set.seed(1)
r <- matrix(rnorm(60, 0.05, 0.1), 20, 3,
            dimnames = list(NULL, c("A", "B", "C")))
plot(market_diversification(r))
```

price_transmission	<i>Vertical price transmission between export and domestic prices</i>
--------------------	---

Description

Tests whether domestic prices (for example wholesale or farm-gate prices) move with export prices (or export unit values) in the long run and how quickly deviations are corrected.

Usage

```
price_transmission(
  domestic,
  world,
  log = TRUE,
  ecm_lags = 1,
  max_lag = 4,
  asymmetric = FALSE
)
```

Arguments

domestic	Numeric vector or time series of domestic prices.
world	Numeric vector or time series of export or world prices, same length as ‘domestic’.
log	Logical; take natural logarithms of prices first.
ecm_lags	Number of lagged differences p in the error correction model.
max_lag	Maximum lag order considered in the residual ADF test.
asymmetric	Logical; estimate an asymmetric error correction model.

Details

****Step 1: long-run relationship.**** $d_t = a + b w_t + u_t$, where b is the long-run price transmission elasticity when prices are in logs.

****Step 2: Engle-Granger cointegration test.**** An augmented Dickey-Fuller regression without deterministic terms is fitted to the residuals u_t , with the lag order chosen by AIC up to ‘max_lag’. The t statistic is compared with the asymptotic critical values of MacKinnon (2010) for two variables with a constant: -3.896 (1) -3.044 (10)

****Step 3: error correction model.****

$$\Delta d_t = c + \beta_0 \Delta w_t + \sum_{i=1}^p (\phi_i \Delta d_{t-i} + \theta_i \Delta w_{t-i}) + \alpha u_{t-1} + e_t.$$

β_0 is the short-run elasticity and α (expected to be negative) the speed of adjustment; the half-life of a deviation is $\ln 0.5 / \ln(1 + \alpha)$ periods. With ‘asymmetric = TRUE’ the error correction term is split into positive and negative parts (Granger and Lee, 1989), and an F test of equal adjustment speeds is reported.

Value

A list of class 'price_transmission' with 'long_run' (intercept, elasticity, R-squared), 'cointegration' (ADF statistic, lag, critical values and decision at 5 percent), 'ecm' (coefficient table of the error correction model), 'adjustment' (speed of adjustment and half-life; separate values for positive and negative deviations when asymmetric, with the F test), and the fitted 'lm' models.

References

Engle, R. F. and Granger, C. W. J. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica*, 55(2), 251-276. doi:10.2307/1913236

Granger, C. W. J. and Lee, T. H. (1989). Investigation of production, sales and inventory relationships using multicointegration and non-symmetric error correction models. *Journal of Applied Econometrics*, 4(S1), S145-S159. doi:10.1002/jae.3950040508

MacKinnon, J. G. (2010). Critical values for cointegration tests. Queen's Economics Department Working Paper No. 1227, Queen's University, Kingston, Ontario.

Examples

```
pt <- price_transmission(grape_prices$domestic_price,
                        grape_prices$export_unit_value)

pt
price_transmission(grape_prices$domestic_price,
                  grape_prices$export_unit_value,
                  asymmetric = TRUE)$adjustment
```

trade_totals

*Simulated total exports of India and the world***Description**

Synthetic annual totals used with [hort_exports] to compute revealed comparative advantage. Not official statistics.

Usage

```
trade_totals
```

Format

A data frame with 14 rows and 3 columns: 'year', 'india_total_exports' and 'world_total_exports' (USD million).

Source

Simulated.

Index

* datasets

fx_rates, [7](#)

grape_prices, [7](#)

hort_exports, [8](#)

trade_totals, [13](#)

cms_decomposition, [2](#)

competitiveness_index, [3](#)

exchange_rate_exposure, [5](#)

export_concentration, [6](#)

fx_rates, [7](#)

grape_prices, [7](#)

hort_exports, [8](#)

market_diversification, [8](#)

market_entry_risk, [10](#)

plot.market_diversification, [11](#)

price_transmission, [12](#)

trade_totals, [13](#)