Package: xtpqardl (via r-universe)

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Type Package

Title Panel Quantile Autoregressive Distributed Lag Model

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Description Estimation of Panel Quantile Autoregressive Distributed Lag (PQARDL) models that combine panel ARDL methodology with quantile regression. Supports Pooled Mean Group (PMG), Mean Group (MG), and Dynamic Fixed Effects (DFE) estimators across multiple quantiles. Computes long-run cointegrating parameters, error correction term speed of adjustment, half-life of adjustment, and performs Wald tests for parameter equality across quantiles. Based on the econometric frameworks of Pesaran, Shin, and Smith (1999) <doi:10.1080/01621459.1999.10474156>, Cho, Kim, and Shin (2015) <doi:10.1016/j.jeconom.2015.02.030>, and Bildirici and Kayikci (2022) <doi:10.1016/j.energy.2022.124303>.

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URL `https://github.com/muhammedalkhalaf/xtpqardl`

BugReports `https://github.com/muhammedalkhalaf/xtpqardl/issues`

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LazyData true

Depends R (>= 3.5.0)

Imports stats, quantreg

Suggests testthat (>= 3.0.0)

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Contents

`coef.xtpqardl` *Coefficients Method for xtpqardl Objects*

Description

Extract estimated coefficients from a Panel Quantile ARDL model.

Usage

```
## S3 method for class 'xtpqardl'
coef(object, type = c("beta", "rho", "all"), ...)
```

Arguments

`object`	An object of class `"xtpqardl"`.
`type`	Character string specifying which coefficients to extract: `"beta"` for long-run coefficients (default), `"rho"` for ECT speed of adjustment, or `"all"` for both.
`...`	Additional arguments (currently unused).

Value

A named numeric vector or list of coefficients.

Examples

```
data(pqardl_sample)
fit <- xtpqardl(
  formula = d_y ~ d_x1 + d_x2,
  data = pqardl_sample,
  id = "country",
  time = "year",
  lr = c("L_y", "x1", "x2"),
  tau = c(0.25, 0.50, 0.75)
```

```
)
coef(fit)
coef(fit, type = "rho")
```

compute_irf — *Compute Impulse Response Function*

Description

Computes the impulse response function (IRF) for Panel Quantile ARDL models, showing the response to a one-unit shock via the error correction mechanism.

Usage

```
compute_irf(object, horizon = 20)
```

Arguments

`object`	An object of class `"xtpqardl"`.
`horizon`	Integer specifying the number of periods for the IRF. Default is 20.

Details

The IRF for the error correction model is computed as:

$$IRF_t(\tau) = (1 + \rho(\tau))^t$$

which shows the decay of a unit shock over time through the error correction mechanism. Values approach zero as $t \to \infty$ when $-1 < \rho(\tau) < 0$.

Value

A matrix with rows representing time periods and columns representing quantiles. Each entry shows the response at that period for that quantile.

Examples

```
data(pqardl_sample)
fit <- xtpqardl(
  formula = d_y ~ d_x1 + d_x2,
  data = pqardl_sample,
  id = "country",
  time = "year",
  lr = c("L_y", "x1", "x2"),
  tau = c(0.25, 0.50, 0.75)
)
irf <- compute_irf(fit, horizon = 15)
```

```
print(irf)
```

---

pqardl_sample *Simulated Panel Data for PQARDL Estimation*

Description

A simulated panel dataset for demonstrating Panel Quantile ARDL estimation. Contains 10 countries observed over 30 years with variables suitable for error correction modeling.

Usage

```
pqardl_sample
```

Format

A data frame with 300 rows and 9 variables:

country Factor indicating the panel unit (10 countries)

year Integer year variable (1990-2019)

y Dependent variable in levels (e.g., GDP per capita)

x1 First explanatory variable in levels (e.g., investment)

x2 Second explanatory variable in levels (e.g., trade openness)

L_y Lagged dependent variable (y at t-1)

d_y First difference of y

d_x1 First difference of x1

d_x2 First difference of x2

Details

The data are simulated from a panel error correction model with heterogeneous adjustment speeds across countries. The true long-run relationship is:

$$y_{it} = \beta_1 x_{1,it} + \beta_2 x_{2,it} + \mu_i + \varepsilon_{it}$$

with error correction dynamics:

$$\Delta y_{it} = \rho_i (y_{i,t-1} - \beta_1 x_{1,i,t-1} - \beta_2 x_{2,i,t-1}) + \gamma_1 \Delta x_{1,it} + \gamma_2 \Delta x_{2,it} + u_{it}$$

where $\rho_i \sim U(-0.6, -0.2)$ varies by panel.

Source

Simulated data for package demonstration.

Examples

```
data(pqardl_sample)
head(pqardl_sample)

# Check panel structure
table(pqardl_sample$country)
```

print.irf.xtpqardl *Print Method for irf.xtpqardl Objects*

Description

Print Method for irf.xtpqardl Objects

Usage

```
## S3 method for class 'irf.xtpqardl'
print(x, ...)
```

Arguments

`x`	An object of class `"irf.xtpqardl"`.
`...`	Additional arguments (currently unused).

Value

Invisibly returns the input object.

print.summary.xtpqardl *Print Method for summary.xtpqardl Objects*

Description

Print Method for summary.xtpqardl Objects

Usage

```
## S3 method for class 'summary.xtpqardl'
print(x, digits = 4, ...)
```

Arguments

`x`	An object of class `"summary.xtpqardl"`.
`digits`	Number of significant digits to display. Default is 4.
`...`	Additional arguments (currently unused).

Value

Invisibly returns the input object.

---

print.wald_test.xtpqardl *Print Method for wald_test.xtpqardl Objects*

Description

Print Method for wald_test.xtpqardl Objects

Usage

```
## S3 method for class 'wald_test.xtpqardl'
print(x, ...)
```

Arguments

`x`	An object of class "`wald_test.xtpqardl`".
`...`	Additional arguments (currently unused).

Value

Invisibly returns the input object.

---

print.xtpqardl *Print Method for xtpqardl Objects*

Description

Print Method for xtpqardl Objects

Usage

```
## S3 method for class 'xtpqardl'
print(x, ...)
```

Arguments

`x`	An object of class "`xtpqardl`".
`...`	Additional arguments (currently unused).

Value

Invisibly returns the input object.

summary.xtpqardl *Summary Method for xtpqardl Objects*

Description

Produces a detailed summary of Panel Quantile ARDL estimation results, including long-run coefficients, ECT speed of adjustment, half-life of adjustment, and short-run parameters by quantile.

Usage

```
## S3 method for class 'xtpqardl'
summary(object, ...)
```

Arguments

`object`	An object of class `"xtpqardl"`.
`...`	Additional arguments (currently unused).

Value

An object of class `"summary.xtpqardl"` containing formatted tables of results.

Examples

```
data(pqardl_sample)
fit <- xtpqardl(
  formula = d_y ~ d_x1 + d_x2,
  data = pqardl_sample,
  id = "country",
  time = "year",
  lr = c("L_y", "x1", "x2"),
  tau = c(0.25, 0.50, 0.75)
)
summary(fit)
```

vcov.xtpqardl *Variance-Covariance Matrix for xtpqardl Objects*

Description

Extract the variance-covariance matrix of the estimated parameters.

Usage

```
## S3 method for class 'xtpqardl'
vcov(object, type = c("beta", "rho"), ...)
```

Arguments

`object`	An object of class `"xtpqardl"`.
`type`	Character string specifying which covariance matrix to extract: `"beta"` for long-run coefficients (default), or `"rho"` for ECT coefficients.
`...`	Additional arguments (currently unused).

Value

A variance-covariance matrix.

`wald_test` *Wald Test for Parameter Equality Across Quantiles*

Description

Performs Wald tests for the null hypothesis that parameters are equal across different quantiles. Tests both long-run coefficients (beta) and ECT speed of adjustment (rho).

Usage

```
wald_test(object, joint = TRUE)

## S3 method for class 'xtpqardl'
wald_test(object, joint = TRUE)
```

Arguments

`object`	An object of class `"xtpqardl"`.
`joint`	Logical. If `TRUE` (default), performs joint test for all coefficients. If `FALSE`, performs individual tests for each variable.

Details

The Wald test statistic is computed as:

$$W = (R\theta)'[RVR']^{-1}(R\theta)$$

where θ is the vector of coefficients, V is the variance-covariance matrix, and R is a restriction matrix testing equality of coefficients across quantiles.

Under the null hypothesis of equal coefficients, W follows a chi-squared distribution with degrees of freedom equal to the number of restrictions.

Value

An object of class "wald_test.xtpqardl" containing:

beta_test Wald test result for long-run coefficients

rho_test Wald test result for ECT coefficients

individual_beta Individual tests for each long-run variable (if joint = FALSE)

tau Quantiles tested

References

Koenker R, Bassett G (1982). "Tests of Linear Hypotheses and L1 Estimation." *Econometrica*, 50(6), 1577-1583. doi:10.2307/1913398

Examples

```
data(pqardl_sample)
fit <- xtpqardl(
  formula = d_y ~ d_x1 + d_x2,
  data = pqardl_sample,
  id = "country",
  time = "year",
  lr = c("L_y", "x1", "x2"),
  tau = c(0.25, 0.50, 0.75)
)
wald_test(fit)
```

---

xtpqardl *Panel Quantile Autoregressive Distributed Lag Model*

Description

Estimate Panel Quantile ARDL (PQARDL) models that combine panel ARDL methodology with quantile regression. Supports Pooled Mean Group (PMG), Mean Group (MG), and Dynamic Fixed Effects (DFE) estimators.

Usage

```
xtpqardl(
  formula,
  data,
  id,
  time,
  lr,
  tau = c(0.25, 0.5, 0.75),
  p = 1,
```

```
  q = 1,
  model = c("pmg", "mg", "dfe"),
  lagsel = NULL,
  pmax = 4,
  qmax = 4,
  constant = TRUE
)
```

Arguments

`formula`	A formula specifying the model. The response variable should be in first differences (e.g., `d.y ~ d.x1 + d.x2`), where short-run dynamics are estimated.
`data`	A data frame containing panel data with variables specified in the formula and `lr` argument.
`id`	Character string specifying the panel (cross-section) identifier variable name.
`time`	Character string specifying the time variable name.
`lr`	Character vector of long-run level variable names. The first element should be the lagged dependent variable level (for the error correction term), and remaining elements are the long-run explanatory variables.
`tau`	Numeric vector of quantiles to estimate, each in (0,1). Default is `c(0.25, 0.50, 0.75)`.
`p`	Integer specifying the autoregressive lag order for the dependent variable. Default is 1.
`q`	Integer or integer vector specifying the distributed lag order(s) for explanatory variables. If a single integer, the same lag order is applied to all variables. Default is 1.
`model`	Character string specifying the estimation method: `"pmg"` for Pooled Mean Group (default), `"mg"` for Mean Group, or `"dfe"` for Dynamic Fixed Effects.
`lagsel`	Character string for automatic lag selection. If `"bic"` or `"aic"`, optimal lag orders are selected using the specified criterion. Default is `NULL` (no automatic selection).
`pmax`	Maximum p to consider in lag selection. Default is 4.
`qmax`	Maximum q to consider in lag selection. Default is 4.
`constant`	Logical. Include a constant term? Default is `TRUE`.

Details

The PQARDL model extends the standard panel ARDL framework to allow for heterogeneous effects across the conditional distribution of the response variable. The error correction representation is:

$$\Delta y_{it} = \rho_i(\tau) \cdot ECT_{i,t-1} + \sum_{j=1}^{p-1} \phi_{ij} \Delta y_{i,t-j} + \sum_{m=0}^{q-1} \theta_{im} \Delta x_{i,t-m} + \varepsilon_{it}(\tau)$$

where $ECT_{i,t-1} = y_{i,t-1} - \beta(\tau)' X_{i,t-1}$ is the error correction term, $\rho(\tau)$ is the speed of adjustment (should be negative for convergence), and $\beta(\tau)$ are the long-run cointegrating parameters.

Value

An object of class "xtpqardl" containing:

beta_mg Matrix of mean group long-run coefficients across quantiles

rho_mg Vector of mean group ECT speed of adjustment by quantile

halflife_mg Vector of mean group half-life of adjustment by quantile

sr_mg Matrix of mean group short-run coefficients

phi_mg Matrix of mean group AR coefficients (if p > 1)

beta_V Variance-covariance matrix for beta_mg

rho_V Variance-covariance matrix for rho_mg

beta_all Matrix of per-panel long-run coefficients

rho_all Matrix of per-panel ECT coefficients

halflife_all Matrix of per-panel half-life values

tau Vector of estimated quantiles

p AR lag order used

q Distributed lag order(s) used

model Estimation method used

n_obs Total number of observations

n_panels Number of panels

valid_panels Number of successfully estimated panels

depvar Dependent variable name

lrvars Long-run variable names

call The matched call

References

Pesaran MH, Shin Y, Smith RP (1999). "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels." *Journal of the American Statistical Association*, 94(446), 621-634. doi:10.1080/01621459.1999.10474156

Cho JS, Kim TH, Shin Y (2015). "Quantile Cointegration in the Autoregressive Distributed-Lag Modeling Framework." *Journal of Econometrics*, 188(1), 281-300. doi:10.1016/j.jeconom.2015.02.030

Bildirici M, Kayikci F (2022). "Uncertainty, Renewable Energy, and CO2 Emissions in Top Renewable Energy Countries: A Panel Quantile Regression Approach." *Energy*, 247, 124303. doi:10.1016/j.energy.2022.124303

Koenker R, Bassett G (1978). "Regression Quantiles." *Econometrica*, 46(1), 33-50. doi:10.2307/1913643

Examples

```
# Load example panel data
data(pqardl_sample)

# Estimate PQARDL model at 25th, 50th, and 75th quantiles
fit <- xtpqardl(
  formula = d_y ~ d_x1 + d_x2,
  data = pqardl_sample,
  id = "country",
  time = "year",
  lr = c("L_y", "x1", "x2"),
  tau = c(0.25, 0.50, 0.75),
  model = "pmg"
)

# View results
summary(fit)

# Wald test for parameter equality across quantiles
wald_test(fit)
```

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