

Package ‘xtbreakpoint’

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Title Panel Cointegration Tests with Structural Breaks

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Description Implements panel cointegration tests allowing for structural breaks and cross-section dependence following the methodology of Banerjee and Carrion-i-Silvestre (2015) <[doi:10.1002/jae.2348](https://doi.org/10.1002/jae.2348)>. The package provides iterative factor-break estimation, individual ADF tests on defactored residuals, standardized panel test statistics, and the Bai and Ng (2004) <[doi:10.1111/j.1468-0262.2004.00528.x](https://doi.org/10.1111/j.1468-0262.2004.00528.x)> MQ test for identifying common stochastic trends. Supports five model specifications with varying deterministic components and break structures.

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URL <https://github.com/muhammedalkhalaf/xtbreakpoint>

BugReports <https://github.com/muhammedalkhalaf/xtbreakpoint/issues>

Encoding UTF-8

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Imports stats

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xtbreakcoint-package *Panel Cointegration Tests with Structural Breaks*

Description

Implements panel cointegration tests allowing for structural breaks and cross-section dependence following the methodology of Banerjee and Carrion-i-Silvestre (2015). The package provides iterative factor-break estimation, individual ADF tests on defactored residuals, standardized panel test statistics, and the Bai and Ng (2004) MQ test for identifying common stochastic trends.

Details

The main function is `xtbreakcoint`, which performs the panel cointegration test.

Key Features:

- Accounts for cross-section dependence through common factors
- Allows for structural breaks in the cointegrating relationship
- Supports five model specifications with varying deterministic components
- Provides individual and panel test statistics
- Includes the Bai & Ng (2004) MQ test for stochastic trends

Model Specifications:

Model 1 (constant) Constant only

Model 2 (trend) Constant plus linear trend

Model 3 (levelshift) Constant plus level shift at break

Model 4 (trendshift) Constant, trend, plus level shift (default)

Model 5 (regimeshift) Constant, trend, level shift, plus slope shift

Author(s)

Muhammad Alkhalaf

References

- Banerjee, A., & Carrion-i-Silvestre, J. L. (2015). Cointegration in panel data with structural breaks and cross-section dependence. *Journal of Applied Econometrics*, 30(1), 1-22. doi:10.1002/jae.2348
- Bai, J., & Ng, S. (2004). A PANIC attack on unit roots and cointegration. *Econometrica*, 72(4), 1127-1177. doi:10.1111/j.14680262.2004.00528.x
- Bai, J., & Ng, S. (2002). Determining the number of factors in approximate factor models. *Econometrica*, 70(1), 191-221. doi:10.1111/14680262.00273

print.xtbreakpoint *Print Method for xtbreakpoint Objects*

Description

Print method for objects of class "xtbreakpoint".

Usage

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

Arguments

x An object of class "xtbreakpoint".
... Additional arguments (ignored).

Value

Invisibly returns x.

See Also

[xtbreakpoint](#), [summary.xtbreakpoint](#)

Examples

```
# Generate example panel data  
set.seed(42)  
N <- 5  
T <- 30  
  
panel_data <- data.frame(  
  id = rep(1:N, each = T),  
  time = rep(1:T, N),  
  y = rnorm(N * T),  
  x = rnorm(N * T)  
)
```

```
result <- xtbreakpoint(y ~ x, data = panel_data, id = "id", time = "time",
                      max_factors = 0)
print(result)
```

summary.xtbreakpoint *Summary Method for xtbreakpoint Objects*

Description

Summary method for objects of class "xtbreakpoint", providing detailed output including individual unit results.

Usage

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

Arguments

object An object of class "xtbreakpoint".
... Additional arguments (ignored).

Value

Invisibly returns object.

See Also

[xtbreakpoint](#), [print.xtbreakpoint](#)

Examples

```
# Generate example panel data
set.seed(42)
N <- 5
T <- 30

panel_data <- data.frame(
  id = rep(1:N, each = T),
  time = rep(1:T, N),
  y = rnorm(N * T),
  x = rnorm(N * T)
)

result <- xtbreakpoint(y ~ x, data = panel_data, id = "id", time = "time",
                      max_factors = 0)
summary(result)
```

xtbreakpoint *Panel Cointegration Test with Structural Breaks*

Description

Implements the panel cointegration test of Banerjee and Carrion-i-Silvestre (2015), allowing for structural breaks and cross-section dependence through common factors.

Usage

```
xtbreakpoint(
  formula,
  data,
  id,

  time,
  model = "trendshift",
  max_factors = 5,
  max_lag = 4,

  lag_method = c("auto", "fixed"),
  trim = 0.15,
  max_iter = 20,
  tolerance = 0.001
)
```

Arguments

formula	A formula of the form $y \sim x_1 + x_2 + \dots$ specifying the cointegrating relationship.
data	A data frame containing panel data with columns for the panel identifier, time identifier, and all variables in the formula.
id	Character string naming the panel (cross-section) identifier.
time	Character string naming the time identifier.
model	Model specification for deterministic components. One of: "constant" (1), "trend" (2), "levelshift" (3), "trendshift" (4, default), or "regimeshift" (5). Can also specify as integer 1-5.
max_factors	Maximum number of common factors to estimate (default: 5). Set to 0 to skip factor estimation.
max_lag	Maximum lag order for ADF tests (default: 4).
lag_method	Method for selecting ADF lag order: "auto" for automatic selection via BIC (default) or "fixed" to use max_lag.
trim	Trimming parameter for break estimation, proportion of sample excluded from endpoints (default: 0.15). Must be in (0, 0.5).
max_iter	Maximum iterations for factor-break estimation (default: 20).
tolerance	Convergence tolerance for iterative estimation (default: 0.001).

Details

This function tests for panel cointegration in the presence of structural breaks and cross-sectional dependence. The methodology follows these steps:

1. **Iterative Factor-Break Estimation:** Jointly estimates common factors and individual break dates using an iterative procedure.
2. **Individual ADF Tests:** Applies ADF tests to the defactored (idiosyncratic) residuals for each cross-section unit.
3. **Panel Test Statistic:** Combines individual ADF statistics into a standardized panel statistic using Monte Carlo moments.
4. **MQ Test:** If factors are detected, tests whether they are stationary or represent stochastic trends (Bai & Ng, 2004).

Value

An object of class "xtbreakcoint" containing:

Z_t Panel test statistic (standard normal under H0)

p_value One-sided p-value for Z_t

tbar Average of individual ADF t-statistics

mean_t Expected value of t-statistic under H0

var_t Variance of t-statistic under H0

N Number of cross-section units

T Number of time periods

n_factors Number of estimated common factors

n_trends Number of stochastic trends (from MQ test)

MQ_np Non-parametric MQ test statistic

MQ_p Parametric MQ test statistic

iterations Number of iterations for factor-break convergence

reject_pct Percentage of individual units rejecting H0 at 5%

adf_stats Vector of individual ADF t-statistics

lag_orders Vector of selected lag orders for each unit

breaks Vector of estimated break dates (periods from start)

factors Matrix of estimated common factors (T-1 x n_factors)

model Model specification used

call The matched call

Model Specifications

1 - constant Constant only

2 - trend Constant plus linear trend

3 - levelshift Constant plus level shift at break

4 - trendshift Constant, trend, plus level shift (default)

5 - regimeshift Constant, trend, level shift, plus slope shift

Author(s)

Muhammad Alkhalaf

References

- Banerjee, A., & Carrion-i-Silvestre, J. L. (2015). Cointegration in panel data with structural breaks and cross-section dependence. *Journal of Applied Econometrics*, 30(1), 1-22. doi:10.1002/jae.2348
- Bai, J., & Ng, S. (2004). A PANIC attack on unit roots and cointegration. *Econometrica*, 72(4), 1127-1177. doi:10.1111/j.14680262.2004.00528.x

Examples

```
# Generate example panel data
set.seed(42)
N <- 10 # panels
T <- 50 # time periods

# Create cointegrated data with a structural break
panel_data <- data.frame(
  id = rep(1:N, each = T),
  time = rep(1:T, N),
  y = NA,
  x = NA
)

for (i in 1:N) {
  idx <- panel_data$id == i
  x <- cumsum(rnorm(T))
  u <- rnorm(T, sd = 0.5)
  # Cointegrating relationship with break at t=25
  beta <- ifelse(1:T <= 25, 1, 1.5)
  y <- 1 + beta * x + u
  panel_data$x[idx] <- x
  panel_data$y[idx] <- y
}

# Test for cointegration
result <- xtbreakpoint(y ~ x, data = panel_data, id = "id", time = "time")
print(result)
```

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