

# Package ‘ecic’

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**Title** Extended Changes-in-Changes

**Version** 0.0.4

**Description** Extends the Changes-in-Changes model a la Athey and Imbens (2006) <[doi:10.1111/j.1468-0262.2006.00668.x](https://doi.org/10.1111/j.1468-0262.2006.00668.x)> to multiple cohorts and time periods, which generalizes difference-in-differences estimation techniques to the entire distribution. Computes quantile treatment effects for every possible two-by-two combination in `ecic()`. Then, aggregating all bootstrap runs adds the standard errors in `summary_ecic()`. Results can be plotted with `plot_ecic()` aggregated over all cohort-group combinations or in an event-study style for either individual periods or individual quantiles.

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**URL** <https://frederickluser.github.io/ecic/>

**BugReports** <https://github.com/frederickluser/ecic/issues>

**Depends** R (>= 2.10)

**Imports** furrr, future, ggplot2, patchwork, progress, progressr, stats

**Suggests** tinytest

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 7.3.2

**NeedsCompilation** no

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**Repository** CRAN

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dat	<i>Simulated sample data</i>
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### Description

A simulated sample panel data with heterogeneous treatment effects across cohorts and groups.

### Usage

dat

### Format

A simulated data frame with 60,000 rows and 5 columns:

**countyreal** Unit ID

**first.treat** Cohort

**year** Period

**time\_to\_treat** Period - Cohort

**lemp** dependent variable

### Source

Simulation data

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ecic	<i>Estimate a changes-in-changes model with multiple periods and cohorts</i>
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### Description

Calculates a changes-in-changes model as in Athey and Imbens (2006) for multiple periods and cohorts.

### Usage

```
ecic(
  yvar = NULL,
  gvar = NULL,
  tvar = NULL,
  ivar = NULL,
  dat = NULL,
  myProbs = seq(0.1, 0.9, 0.1),
  nMin = 40,
  boot = c("weighted", "normal", "no"),
  nReps = 10,
  weight_n0 = c("n1", "n0"),
  weight_n1 = c("n1", "n0"),
  quant_algo = 1,
  es = FALSE,
  n_digits = NULL,
  periods_es = NULL,
  save_to_temp = FALSE,
  progress_bar = c("progress", "void", "cli"),
  nCores = 1
)
```

### Arguments

yvar	Dependent variable.
gvar	Group variable. Can be either a string (e.g., "first_treated") or an expression (e.g., first_treated). In a staggered treatment setting, the group variable typically denotes treatment cohort.
tvar	Time variable. Can be a string (e.g., "year") or an expression (e.g., year).
ivar	Individual Index variable. Can be a string (e.g., "country") or an expression (e.g., country). Only needed to check cohort sizes.
dat	The data set.
myProbs	Quantiles that the quantile treatment effects should be calculated for.
nMin	Minimum observations per groups. Small groups are deleted.

boot	Bootstrap. Resampling is done over the entire data set ("normal"), but might be weighted by period-cohort size ("weighted"). If you do not want to calculate standard error, set boot = "no".
nReps	Number of bootstrap replications.
weight_n0	Weight for the aggregation of the CDFs in the control group. n1 uses cohort sizes (Alternative: n0).
weight_n1	Weight for the aggregation of the CDFs in the treatment group. n1 uses cohort sizes (Alternative: n0).
quant_algo	Quantile algorithm (see Wikipedia for definitions).
es	Event Study (Logical). If TRUE, a quantile treatment effect is estimated for each event-period.
n_digits	Rounding the dependent variable before aggregating the empirical CDFs reduces the size of the imputation grid. This can significantly reduce the amount of RAM used in large data sets and improve running time, while reducing precision (Use with caution).
periods_es	Periods of the event study.
save_to_temp	Logical. If TRUE, results are temporarily saved. This reduces the RAM needed, but increases running time.
progress_bar	Whether progress bar should be printed (select "void" for no progress bar or "cli" for another type of bar).
nCores	Number of cores used. If set > 1, bootstrapping will run in parallel.

### Value

An ecic object.

### References

Athey, Susan and Guido W. Imbens (2006). *Identification and Inference in Nonlinear Difference-in-Differences Models*. doi:10.1111/j.14680262.2006.00668.x

### Examples

```
# Example 1. Using the small mpdta data in the did package
data(dat, package = "ecic")
dat = dat[dat$first.treat <= 1983 & dat$countyreal <= 1000,] # small data for fast run

mod_res =
  summary(
    ecic(
      yvar = lemp,          # dependent variable
      gvar = first.treat,  # group indicator
      tvar = year,         # time indicator
      ivar = countyreal,  # unit ID
      dat = dat,           # dataset
      boot = "normal",    # bootstrap procedure ("no", "normal", or "weighted")
      nReps = 3           # number of bootstrap runs
    )
  )
```

```

    )
  )

# Basic Plot
ecic_plot(mod_res)

# Example 2. Load some larger sample data
data(dat, package = "ecic")

# Estimate a basic model with the package's sample data
mod_res =
  summary(
    ecic(
      yvar = lemp,          # dependent variable
      gvar = first.treat,  # group indicator
      tvar = year,         # time indicator
      ivar = countyreal,  # unit ID
      dat = dat,           # dataset
      boot = "weighted",  # bootstrap procedure ("no", "normal", or "weighted")
      nReps = 20           # number of bootstrap runs
    )
  )

# Basic Plot
ecic_plot(mod_res)

# Example 3. An Event-Study Example
mod_res =
  summary(
    ecic(
      es = TRUE,           # aggregate for every event period
      yvar = lemp,        # dependent variable
      gvar = first.treat, # group indicator
      tvar = year,        # time indicator
      ivar = countyreal, # unit ID
      dat = dat,          # dataset
      boot = "weighted",  # bootstrap procedure ("no", "normal", or "weighted")
      nReps = 20          # number of bootstrap runs
    )
  )

# Plots
ecic_plot(mod_res) # aggregated in one plot
ecic_plot(mod_res, es_type = "for_quantiles") # individually for every quantile
ecic_plot(mod_res, es_type = "for_periods") # individually for every period

```

**Description**

Plots the results of the ecic model, either along the percentiles or in an event-study fashion.

**Usage**

```
ecic_plot(
  object,
  es_type = c("aggregated", "for_quantiles", "for_periods"),
  perc_plot = NULL,
  periods_plot = NULL,
  xlab = NULL,
  ylab = "QTE \n",
  ylim = NULL,
  size = 2,
  zero_line = FALSE,
  legend_title = "Percentiles"
)
```

**Arguments**

<code>object</code>	An <code>ecic_table</code> object.
<code>es_type</code>	If an event study was estimated with <code>ecic</code> , you can choose the style of the ES plot. "aggregated" puts everything in one plot. "for_quantiles" generates one plot for each percentile. "for_periods" generates one plot for each period.
<code>perc_plot</code>	Which percentiles to plot.
<code>periods_plot</code>	Which periods to plot.
<code>xlab</code>	Alternative x-axis label
<code>ylab</code>	Alternative y-axis label.
<code>ylim</code>	Define the y-axis limits.
<code>size</code>	Size of the point estimates.
<code>zero_line</code>	Add a horizontal line at zero.
<code>legend_title</code>	Change the title of the legend.

**Value**

A `ggplot2` object.

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print.ecic	<i>Print ecic objects</i>
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**Description**

Prints an ecic model while making attributes invisible.

**Usage**

```
## S3 method for class 'ecic'
print(x, ..., details = FALSE)
```

**Arguments**

x	An ecic object.
...	further arguments
details	logical. Set to TRUE to print background information for every bootstrap run and Changes-in-Changes model.

**Value**

An ecic print object.

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summary.ecic	<i>Summary for a changes-in-changes regression with multiple periods and cohorts</i>
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**Description**

Summarizes an ecic object by aggregating the bootstrap runs. Works also in an event-study fashion.

**Usage**

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

**Arguments**

object	An ecic object.
...	further arguments.

**Value**

An ecic\_table object.

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