

Package ‘trade’

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Description A collection of tools for trade practitioners, including the ability to calibrate different consumer demand systems and simulate the effects of tariffs and quotas under different competitive regimes. These tools are derived from Anderson et al. (2001) <[doi:10.1016/S0047-2727\(00\)00085-2](https://doi.org/10.1016/S0047-2727(00)00085-2)> and Froeb et al. (2003) <[doi:10.1016/S0304-4076\(02\)00166-5](https://doi.org/10.1016/S0304-4076(02)00166-5)>.

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'QuotaClasses.R' 'summary-methods.R' 'bargaining_tariff.R'
'SimFunctions.R' 'TariffCournot-methods.R'
'TariffMonComRUM-methods.R' 'auction2nd_tariff.R'
'bertrand_quota.R' 'bertrand_tariff.R' 'cournot_tariff.R'
'initialize-methods.R' 'logit_cournot_tariff.R'
'monopolistic_competition_tariff.R' 'reexports.R'
'trade-deprecated.R' 'trade-utils.R' 'trade_shiny.R'

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Contents

antitrust-reexports	2
auction2nd_tariff	3
bargaining_tariff	5
bertrand_quota	8
bertrand_tariff	10
cournot_tariff	13
defineMarketTools-methods	16
initialize-methods	17
logit_cournot_tariff	18
monopolistic_competition_tariff	20
ps-methods	22
Quota-classes	23
Sim-Functions	23
summary-methods	26
Tariff-classes	28
TariffCournot-methods	29
TariffMonComRUM-methods	29
Index	31

antitrust-reexports	<i>Re-exported antitrust diagnostics and accessors</i>
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Description

These functions are implemented in **antitrust** and re-exported by **trade** because they are useful for inspecting calibrated tariff and quota simulations.

Usage

```
calcPriceDelta(
  object,
  levels = FALSE,
  market = FALSE,
  party = FALSE,
  isMax = FALSE,
  index = c("paasche", "laspeyres"),
  ...
)

calcShares(object, ...)

calcRevenues(object, ...)

calcMC(object, ...)
```

```

CV(object, ...)

elast(object, ...)

diversion(object, ...)

calcDiagnostics(object, ...)

ownerToMatrix(object, ...)

ownerToVec(object, ...)

```

Arguments

object	An instance of a supported simulation class.
levels	If TRUE, report changes in levels. If FALSE, report proportional changes.
market	If TRUE, report a market-level result when supported.
party	If TRUE, report a party-level result when supported.
isMax	If TRUE, run the underlying local maximum check when supported.
index	Price index to use for aggregate price changes.
...	Additional arguments passed to the underlying antitrust method.

auction2nd_tariff	<i>Tariff Simulation With A Second Score Procurement Auction Game</i>
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Description

Simulate the effect of tariffs when firms play a second score procurement auction game and consumer demand is Logit.

Usage

```

auction2nd_tariff(
  demand = c("logit"),
  prices,
  quantities,
  margins,
  owner = NULL,
  mktElast = NA_real_,
  diversions,
  tariffPre = rep(0, length(quantities)),
  tariffPost = rep(0, length(quantities)),
  priceStart,
  parmStart,
  control.slopes,

```

```

    control.equ,
    labels = paste("Prod", 1:length(quantities), sep = ""),
    ...
)

```

Arguments

demand	A character vector indicating which demand system to use. Currently allows logit (default).
prices	A length k vector product prices.
quantities	A length k vector of product quantities.
margins	A length k vector of product margins. All margins must be in levels (not w.r.t to price), or NA.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the tariff OR a k x k matrix of pre-tariff ownership shares.
mktElast	A negative number equal to the industry pre-merger price elasticity. Default is NA .
diversions	A k x k matrix of diversion ratios with diagonal elements equal to -1. Default is missing, in which case diversion according to revenue share is assumed.
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
priceStart	A vector of length k whose elements equal initial guesses for prices. Default is prices.
parmStart	A vector of starting values for demand calibration.
control.slopes	A list of optim control parameters passed to the calibration routine optimizer (typically the calcSlopes method).
control.equ	A list of BBsolve control parameters passed to the non-linear equation solver (typically the calcPrices method).
labels	A k-length vector of labels.
...	Additional options to feed to the BBsolve optimizer used to solve for equilibrium prices.

Details

Let k denote the number of products produced by all firms. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `auction2nd_tariff` is able to recover the slopes and intercepts of a Logit demand system. These parameters are then used to simulate the price effects of an *ad valorem* tariff under the assumption that the firms are playing a 2nd score auction.

Value

auction2nd_tariff returns an instance of class [Tariff2ndLogit](#)

References

Simon P. Anderson, Andre de Palma, Brent Kreider, Tax incidence in differentiated product oligopoly, Journal of Public Economics, Volume 81, Issue 2, 2001, Pages 173-192.

See Also

[bertrand_tariff](#) to simulate the effects of a tariff under a Bertrand pricing game and [monopolistic_competition_tariff](#) to simulate the effects of a tariff under monopolistic competition.

Examples

```
## Calibration and simulation results from a 10% tariff on non-US beers "OTHER-LITE"
## and "OTHER-REG"
## Source: Epstein/Rubinfeld 2004, pg 80

prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
owner <- c("BUD", "OLD STYLE", "MILLER", "MILLER", "OTHER-LITE", "OTHER-REG")
price <- c(.0441, .0328, .0409, .0396, .0387, .0497)
quantities <- c(.066, .172, .253, .187, .099, .223)*100
margins <- c(.3830, .5515, .5421, .5557, .4453, .3769) # margins in terms of price
margins <- margins*price # dollar margins
tariff <- c(0,0,0,0,.1,.1)

names(price) <-
names(quantities) <-
names(margins) <-
prodNames

result.2nd <- auction2nd_tariff(demand = "logit", prices=price, quantities=quantities,
                               margins = margins, owner=owner,
                               tariffPost = tariff, labels=prodNames)

print(result.2nd)          # return predicted price change
summary(result.2nd)        # summarize merger simulation
```

bargaining_tariff

Tariff Simulation With A Nash Bargaining Game

Description

Simulate the effect of tariffs when firms play a Nash Bargaining game and consumer demand is Logit.

Usage

```

bargaining_tariff(
  demand = c("logit"),
  prices,
  shares,
  margins,
  owner = NULL,
  mktElast = NA_real_,
  insideSize = NA_real_,
  diversions,
  tariffPre = rep(0, length(shares)),
  tariffPost = rep(0, length(shares)),
  bargpowerPre = rep(0.5, length(prices)),
  bargpowerPost = bargpowerPre,
  normIndex = ifelse(isTRUE(all.equal(sum(shares), 1, check.names = FALSE)), 1, NA),
  priceOutside = ifelse(demand == "logit", 0, 1),
  priceStart,
  control.slopes,
  control.equ,
  labels = paste("Prod", 1:length(shares), sep = ""),
  ...
)

```

Arguments

demand	A character vector indicating which demand system to use. Currently allows logit (default).
prices	A length k vector product prices.
shares	A length k vector of product shares. Values must be between 0 and 1.
margins	A length k vector of product margins. All margins must be in levels (not w.r.t to price), or NA.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the tariff OR a k x k matrix of pre-tariff ownership shares.
mktElast	A negative number equal to the industry pre-merger price elasticity. Default is NA .
insideSize	An integer equal to total pre-merger units sold. If shares sum to one, this also equals the size of the market.
diversions	A k x k matrix of diversion ratios with diagonal elements equal to -1. Default is missing, in which case diversion according to revenue share is assumed.
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.

bargpowerPre	A length k vector of pre-tariff bargaining power parameters. Values must be between 0 (sellers have the power) and 1 (buyers the power). NA values are allowed, though must be calibrated from additional margin and share data. Default is 0.5.
bargpowerPost	A length k vector of post-tariff bargaining power parameters. Values must be between 0 (sellers have the power) and 1 (buyers the power). NA values are allowed, though must be calibrated from additional margin and share data. Default is 'bargpowerPre'.
normIndex	An integer equalling the index (position) of the inside product whose mean valuation will be normalized to 1. Default is 1, unless 'shares' sum to less than 1, in which case the default is NA and an outside good is assumed to exist.
priceOutside	price of the outside good. Equals 0 for logit and 1 for ces. Not used for aids.
priceStart	For aids, a vector of length k who elements equal to an initial guess of the proportional change in price caused by the merger. The default is to draw k random elements from a [0,1] uniform distribution. For ces and logit, the default is prices.
control.slopes	A list of optim control parameters passed to the calibration routine optimizer (typically the <code>calcSlopes</code> method).
control.equ	A list of BBSolve control parameters passed to the non-linear equation solver (typically the <code>calcPrices</code> method).
labels	A k-length vector of labels.
...	Additional options to feed to the BBSolve optimizer used to solve for equilibrium prices.

Details

Let k denote the number of products produced by all firms. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `bargaining_tariff` is able to recover the slopes and intercepts of a Logit demand system. These parameters are then used to simulate the price effects of an *ad valorem* tariff under the assumption that the firms are playing a Nash Bargaining game.

Value

`bargaining_tariff` returns an instance of class [TariffBargainingLogit](#)

References

Simon P. Anderson, Andre de Palma, Brent Kreider, Tax incidence in differentiated product oligopoly, Journal of Public Economics, Volume 81, Issue 2, 2001, Pages 173-192.

See Also

[bertrand_tariff](#) to simulate the effects of a tariff under a Bertrand pricing game and [monopolistic_competition_tariff](#) to simulate the effects of a tariff under monopolistic competition.

Examples

```
## Calibration and simulation results from a 10% tariff on non-US beers "OTHER-LITE"
## and "OTHER-REG"
## Source: Epstein/Rubinfeld 2004, pg 80

prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
owner <- c("BUD", "OLD STYLE", "MILLER", "MILLER", "OTHER-LITE", "OTHER-REG")
price <- c(.0441, .0328, .0409, .0396, .0387, .0497)
shares <- c(.066, .172, .253, .187, .099, .223)
margins <- c(.3830, .5515, .5421, .5557, .4453, .3769) # margins in terms of price
tariff <- c(0, 0, 0, 0, .1, .1)

names(price) <-
names(shares) <-
names(margins) <-
prodNames

result.barg <- bargaining_tariff(demand = "logit", prices=price, shares=shares,
                                margins = margins, owner=owner,
                                tariffPost = tariff, labels=prodNames)

print(result.barg)          # return predicted price change
summary(result.barg)        # summarize merger simulation
```

bertrand_quota

quota Simulation With A Bertrand Pricing Game

Description

Simulate the effect of quotas when firms play a Bertrand pricing game and consumer demand is Logit.

Usage

```
bertrand_quota(
  demand = c("logit"),
  prices,
  quantities,
  margins,
  owner = NULL,
  mktElast = NA_real_,
  diversions,
  quotaPre = rep(Inf, length(quantities)),
  quotaPost = rep(Inf, length(quantities)),
  priceOutside = ifelse(demand == "logit", 0, 1),
  priceStart,
```

```

    isMax = FALSE,
    parmStart,
    control.slopes,
    control.equ,
    labels = paste("Prod", 1:length(quantities), sep = ""),
    ...
)

```

Arguments

demand	A character vector indicating which demand system to use. Currently allows logit (default).
prices	A length k vector product prices. Default is missing, in which case demand intercepts are not calibrated.
quantities	A length k vector of product quantities.
margins	A length k vector of product margins. All margins must be either be between 0 and 1, or NA.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the quota OR a k x k matrix of pre-quota ownership shares.
mktElast	A negative number equal to the industry pre-merger price elasticity. Default is NA .
diversions	A k x k matrix of diversion ratios with diagonal elements equal to -1. Default is missing, in which case diversion according to revenue share is assumed.
quotaPre	A vector of length k where each element equals the current quota (expressed as a proportion of pre-merger quantities) imposed on each product. Default is Inf, which assumes no quota.
quotaPost	A vector of length k where each element equals the new quota (expressed as a proportion of pre-merger quantities) imposed on each product. Default is Inf, which assumes no quota.
priceOutside	price of the outside good. Equals 0 for logit.
priceStart	A vector of length k whose elements equal initial guesses for prices.
isMax	If TRUE, checks to see whether computed price equilibrium locally maximizes firm profits and returns a warning if not. Default is FALSE.
parmStart	A vector of starting values for demand calibration.
control.slopes	A list of optim control parameters passed to the calibration routine optimizer (typically the calcSlopes method).
control.equ	A list of BBSolve control parameters passed to the non-linear equation solver (typically the calcPrices method).
labels	A k-length vector of labels.
...	Additional options to feed to the BBSolve optimizer used to solve for equilibrium prices.

Details

Let k denote the number of products produced by all firms. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `bertrand_quota` is able to recover the slopes and intercepts of the Logit, demand system. These parameters are then used to simulate the price effects of a quota under the assumption that the firms are playing a simultaneous price setting game.

Value

`bertrand_quota` returns an instance of class `QuotaLogit`.

References

Simon P. Anderson, Andre de Palma, Brent Kreider, Tax incidence in differentiated product oligopoly, Journal of Public Economics, Volume 81, Issue 2, 2001, Pages 173-192.

Examples

```
## Calibration and simulation results from a 80% quota on non-US beers "OTHER-LITE"
## and "OTHER-REG"
## Source: Epstein/Rubinfeld 2004, pg 80

prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
owner <- c("BUD", "OLD STYLE", "MILLER", "MILLER", "OTHER-LITE", "OTHER-REG")
price <- c(.0441, .0328, .0409, .0396, .0387, .0497)
quantities <- c(.066, .172, .253, .187, .099, .223)*100
margins <- c(.3830, .5515, .5421, .5557, .4453, .3769)
quota <- c(Inf, Inf, Inf, Inf, .8, .8)

names(price) <-
  names(quantities) <-
  names(margins) <-
  prodNames

result.logit <- bertrand_quota(demand = "logit", prices=price, quantities=quantities,
                              margins = margins, owner=owner, quotaPost = quota, labels=prodNames)

print(result.logit)      # return predicted price change
summary(result.logit)    # summarize merger simulation
```

bertrand_tariff

Tariff Simulation With A Bertrand Pricing Game

Description

Simulate the effect of tariffs when firms play a Bertrand pricing game and consumer demand is either Logit, CES, or AIDS

Usage

```
bertrand_tariff(
  demand = c("logit", "ces", "aids"),
  prices,
  quantities,
  margins,
  owner = NULL,
  mktElast = NA_real_,
  diversions,
  tariffPre = rep(0, length(quantities)),
  tariffPost = rep(0, length(quantities)),
  priceOutside = ifelse(demand == "logit", 0, 1),
  priceStart,
  isMax = FALSE,
  parmStart,
  control.slopes,
  control.equ,
  labels = paste("Prod", 1:length(quantities), sep = ""),
  ...
)
```

Arguments

demand	A character vector indicating which demand system to use. Currently allows logit (default), ces, or aids.
prices	A length k vector product prices. Default is missing, in which case demand intercepts are not calibrated.
quantities	A length k vector of product quantities.
margins	A length k vector of product margins. All margins must be either be between 0 and 1, or NA.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the tariff OR a k x k matrix of pre-tariff ownership shares.
mktElast	A negative number equal to the industry pre-merger price elasticity. Default is NA .
diversions	A k x k matrix of diversion ratios with diagonal elements equal to -1. Default is missing, in which case diversion according to revenue share is assumed.
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
priceOutside	price of the outside good. Equals 0 for logit and 1 for ces. Not used for aids.
priceStart	For aids, a vector of length k who elements equal to an initial guess of the proportional change in price caused by the merger. The default is to draw k

	random elements from a [0,1] uniform distribution. For ces and logit, the default is prices.
isMax	If TRUE, checks to see whether computed price equilibrium locally maximizes firm profits and returns a warning if not. Default is FALSE.
parmStart	aids only. A vector of length 2 whose elements equal to an initial guess for each "known" element of the diagonal of the demand matrix and the market elasticity.
control.slopes	A list of optim control parameters passed to the calibration routine optimizer (typically the <code>calcSlopes</code> method).
control.equ	A list of BBSolve control parameters passed to the non-linear equation solver (typically the <code>calcPrices</code> method).
labels	A k-length vector of labels.
...	Additional options to feed to the BBSolve optimizer used to solve for equilibrium prices.

Details

Let k denote the number of products produced by all firms. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `bertrand_tariff` is able to recover the slopes and intercepts of either a Logit, CES, or AIDS demand system. These parameters are then used to simulate the price effects of an *ad valorem* tariff under the assumption that the firms are playing a simultaneous price setting game.

Value

`bertrand_tariff` returns an instance of class [TariffLogit](#), [TariffCES](#), or [TariffAIDS](#), depending upon the value of the “demand” argument.

References

Simon P. Anderson, Andre de Palma, Brent Kreider, Tax incidence in differentiated product oligopoly, *Journal of Public Economics*, Volume 81, Issue 2, 2001, Pages 173-192.

See Also

[monopolistic_competition_tariff](#) to simulate the effects of a tariff under monopolistic competition.

Examples

```
## Calibration and simulation results from a 10% tariff on non-US beers "OTHER-LITE"
## and "OTHER-REG"
## Source: Epstein/Rubenfeld 2004, pg 80

prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
owner <- c("BUD", "OLD STYLE", "MILLER", "MILLER", "OTHER-LITE", "OTHER-REG")
price <- c(.0441, .0328, .0409, .0396, .0387, .0497)
quantities <- c(.066, .172, .253, .187, .099, .223)*100
margins <- c(.3830, .5515, .5421, .5557, .4453, .3769)
tariff <- c(0, 0, 0, 0, .1, .1)
```

```

names(price) <-
names(quantities) <-
names(margins) <-
prodNames

result.logit <- bertrand_tariff(demand = "logit",prices=price,quantities=quantities,
                              margins = margins,owner=owner,
                              tariffPost = tariff, labels=prodNames)

print(result.logit)          # return predicted price change
summary(result.logit)        # summarize merger simulation
calcDiagnostics(result.logit) # compare calibrated and observed inputs

```

cournot_tariff

Tariff Simulation With A Cournot Quantity Setting Game

Description

Simulate the effect of tariffs when firms play a cournot quantity setting game and consumer demand is either linear or log-linear

Usage

```

cournot_tariff(
  prices,
  quantities,
  margins = matrix(NA_real_, nrow(quantities), ncol(quantities)),
  demand = rep("linear", length(prices)),
  cost = rep("linear", nrow(quantities)),
  tariffPre = matrix(0, nrow = nrow(quantities), ncol = ncol(quantities)),
  tariffPost = tariffPre,
  mcfunPre = list(),
  mcfunPost = mcfunPre,
  vcfunPre = list(),
  vcfunPost = vcfunPre,
  capacitiesPre = rep(Inf, nrow(quantities)),
  capacitiesPost = capacitiesPre,
  productsPre = !is.na(quantities),
  productsPost = productsPre,
  owner = NULL,
  mktElast = rep(NA_real_, length(prices)),
  quantityStart = as.vector(quantities),
  control.slopes,
  control.equ,
  labels,

```

...
)

Arguments

prices	A length k vector product prices.
quantities	An n x k matrix of product quantities. All quantities must either be positive, or if the product is not produced by a plant, NA
margins	An n x k matrix of product margins. All margins must be either be between 0 and 1, or NA.
demand	A length k character vector equal to "linear" if a product's demand curve is assumed to be linear or "log" if a product's demand curve is assumed to be log-linear.
cost	A length k character vector equal to "linear" if a plant's marginal cost curve is assumed to be linear or "constant" if a plant's marginal curve is assumed to be constant. Returns an error if a multi-plant firm with constant marginal costs does not have capacity constraints.
tariffPre	An n x k matrix where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	An n x k matrix where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of consumer price) imposed on each product. Default is 0, which assumes no tariff.
mcfunPre	a length n list of functions that calculate a plant's marginal cost under the current tariff structure. If empty (the default), assumes quadratic costs.
mcfunPost	a length n list of functions that calculate a plant's marginal cost under the new tariff structure. If empty (the default), assumes quadratic costs.
vcfunPre	a length n list of functions that calculate a plant's variable cost under the current tariff structure. If empty (the default), assumes quadratic costs.
vcfunPost	a length n list of functions that calculate a plant's variable cost under the new tariff structure. If empty (the default), assumes quadratic costs.
capacitiesPre	A length n numeric vector of plant capacities under the current tariff regime. Default is Inf.
capacitiesPost	A length n numeric vector of plant capacities under the new tariff regime. Default is Inf.
productsPre	An n x k matrix that equals TRUE if under the current tariff regime, a plant produces a product. Default is TRUE if 'quantities' is not NA.
productsPost	An n x k matrix that equals TRUE if under the new tariff regime, a plant produces a product. Default equals 'productsPre'.
owner	Required. EITHER a vector of length n whose values indicate which plants are commonly owned OR an n x n matrix of ownership shares.
mktElast	A length k vector of product elasticities. Default is a length k vector of NAs
quantityStart	A length k vector of quantities used as the initial guess in the nonlinear equation solver. Default is 'quantities'.

<code>control.slopes</code>	A list of optim control parameters passed to the calibration routine optimizer (typically the <code>calcSlopes</code> method).
<code>control.equ</code>	A list of BBSolve control parameters passed to the non-linear equation solver (typically the <code>calcPrices</code> method).
<code>labels</code>	A k-length vector of labels.
<code>...</code>	Additional options to feed to the BBSolve optimizer used to solve for equilibrium quantities.

Details

Let k denote the number of products and n denote the number of plants. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `cournot_tariff` is able to recover the slopes and intercepts of either a Linear or Log-linear demand system. These parameters are then used to simulate the price effects of a tariff under the assumption that the firms are playing a homogeneous products simultaneous quantity setting game.

Value

`cournot_tariff` returns an instance of [Cournot-class](#) from package **antitrust**, depending upon the value of the “demand” argument.

References

Simon P. Anderson, Andre de Palma, Brent Kreider, The efficiency of indirect taxes under imperfect competition, Journal of Public Economics, Volume 81, Issue 2, 2001, Pages 231-251.

Examples

```
## Simulate the effect of a 75% ad valorem tariff in a
## 5-firm, single-product market with linear demand and quadratic costs
## Firm 1 is assumed to be foreign, and so subject to a tariff

n <- 5 #number of firms in market
cap <- rnorm(n, mean = .5, sd = .1)
int <- 10
slope <- -.25
tariffPre <- tariffPost <- rep(0, n)
tariffPost[1] <- .75

B.pre.c = matrix(slope, nrow=n, ncol=n)
diag(B.pre.c) = 2* diag(B.pre.c) - 1/cap
quantity.pre.c = rowSums(solve(B.pre.c) * -int)
price.pre.c = int + slope * sum(quantity.pre.c)
mc.pre.c = quantity.pre.c/cap
vc.pre.c = quantity.pre.c^2/(2*cap)
margin.pre.c = 1 - mc.pre.c/price.pre.c

#prep inputs for Cournot
```

```

owner.pre <- diag(n)

result.c <- cournot_tariff(prices = price.pre.c, quantities = as.matrix(quantity.pre.c),
                          margins=as.matrix(margin.pre.c),
                          owner=owner.pre,
                          tariffPre = as.matrix(tariffPre),
                          tariffPost = as.matrix(tariffPost))

summary(result.c, market = TRUE)      # summarize tariff (high-level)
summary(result.c, market = FALSE)    # summarize tariff (detailed)

```

defineMarketTools-methods

Methods For Implementing The Hypothetical Monopolist Test

Description

An adaptation of the Hypothetical Monopolist Test described in the 2010 Horizontal Merger Guidelines for use in non-merger settings.

[HypoMonTest](#) implements the Hypothetical Monopolist Test for a given ‘ssnip’. ‘...’ may be used to pass arguments to the optimizer.

Usage

```

## S4 method for signature 'TariffBertrand'
HypoMonTest(object, prodIndex, ssnip = 0.05, ...)

## S4 method for signature 'TariffCournot'
HypoMonTest(object, plantIndex, prodIndex, ssnip = 0.05, ...)

```

Arguments

object	An instance of one of the classes listed above.
prodIndex	A vector of product indices that are to be placed under the control of the Hypothetical Monopolist.
ssnip	A number between 0 and 1 that equals the threshold for a “Small but Significant and Non-transitory Increase in Price” (SSNIP). Default is .05, or 5%.
...	Pass options to the optimizer used to solve for equilibrium prices.
plantIndex	A vector of plant indices that are to be placed under the control of the Hypothetical Monopolist (Cournot).

Details

HypoMonTest is an implementation of the Hypothetical Monopolist Test on the products indexed by 'prodIndex' for a 'ssnip'. The Hypothetical Monopolist Test determines whether a profit-maximizing Hypothetical Monopolist who controls the products indexed by 'prodIndex' would increase the price of at least one of the products in 'prodIndex' by a small, significant, and non-transitory amount (i.e. impose a SSNIP). The main difference between this implementation and [HypoMonTest](#) is this implementation does not check to see if 'prodIndex' contains a merging party's product.

Value

HypoMonTest returns TRUE if a profit-maximizing Hypothetical Monopolist who controls the products indexed by 'prodIndex' would increase the price of at least one of the products in 'prodIndex' by a 'ssnip', and FALSE otherwise.

References

U.S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines*. Washington DC: U.S. Department of Justice, 2010. <https://www.justice.gov/atr/horizontal-merger-guidelines-081920> (accessed July 29, 2011).

initialize-methods	<i>Initialize Methods</i>
--------------------	---------------------------

Description

Initialize methods for the TariffBertrand and TariffCournot classes

Usage

```
## S4 method for signature 'TariffBertrand'
initialize(.Object, ...)

## S4 method for signature 'QuotaBertrand'
initialize(.Object, ...)

## S4 method for signature 'TariffLogitCournotModels'
initialize(.Object, ...)

## S4 method for signature 'TariffCournot'
initialize(.Object, ...)
```

Arguments

.Object	an instance of class TariffBertrand or TariffCournot
...	arguments to pass to initialize

logit_cournot_tariff *Tariff Simulation With A Differentiated-Product Logit Cournot Game*

Description

Simulate the effect of tariffs when firms play a differentiated-product Cournot quantity game and demand is Logit.

Usage

```
logit_cournot_tariff(
  prices,
  quantities,
  shares,
  margins,
  owner = NULL,
  diversions,
  mktElast = NA_real_,
  calibration = c("auto", "diversion", "alm"),
  tariffPre,
  tariffPost,
  weights,
  normIndex,
  subset,
  insideSize,
  priceOutside = 0,
  priceStart,
  isMax = FALSE,
  parmsStart,
  control.slopes,
  control.equ,
  labels,
  output = TRUE,
  ...
)
```

Arguments

prices	A length k vector of product prices.
quantities	A length k vector of product quantities. Used to calculate shares when shares is missing and to set insideSize when insideSize is missing.
shares	A length k vector of product quantity shares. If missing, shares are calculated as quantities / sum(quantities).
margins	A length k vector of product margins. All margins must be positive or NA.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the tariff OR a k x k matrix of pre-tariff ownership shares.

diversions	A $k \times k$ matrix of diversion ratios with diagonal elements equal to -1. Used for the LogitCournot calibration.
mktElast	A negative number equal to the industry pre-tariff price elasticity. Used for the LogitCournotALM calibration.
calibration	Which antitrust Logit Cournot calibration to use. "diversion" creates a TariffLogitCournot object. "alm" creates a TariffLogitCournotALM object. "auto" uses "alm" when mktElast is supplied and diversions is missing; otherwise it uses "diversion".
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff, expressed as a proportion of the consumer price, imposed on each product. Default is 0.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff, expressed as a proportion of the consumer price, imposed on each product. Default is 0.
weights	A length k vector of non-negative product weights used in minimum-distance calibration.
normIndex	An integer specifying the product index against which the mean values of all other products are normalized. Use NA when an outside good is included.
subset	A vector of length k where each element equals TRUE if the product indexed by that element should be included in the post-tariff simulation and FALSE if it should be excluded.
insideSize	A positive number equal to total pre-tariff quantities for all products included in the simulation.
priceOutside	Price of the outside good. Default is 0.
priceStart	A length k vector of starting values used to solve for equilibrium prices. Default is prices.
isMax	If TRUE, checks to see whether computed price equilibrium locally maximizes firm profits and returns a warning if not. Default is FALSE.
parmsStart	A length 2 vector whose first element equals an initial guess of the price coefficient and whose second element equals an initial guess of the outside share. Used only for calibration = "alm".
control.slopes	A list of optim control parameters passed to the calibration routine optimizer.
control.equ	A list of BBSolve control parameters passed to the non-linear equation solver.
labels	A k -length vector of labels.
output	A length 1 logical vector equal to TRUE if the simulation is for an output market. Default is TRUE.
...	Additional options to feed to the optimizer used to solve for equilibrium prices.

Details

This function extends [logit.cournot](#) and [logit.cournot.alm](#) with the same *ad valorem* tariff treatment used by the other differentiated-product tariff simulations in this package. The tariff scales the conduct matrix by $1 - \text{tariff}$ and changes marginal cost by $(\text{tariffPost} - \text{tariffPre}) / (1 - \text{tariffPost})$.

Unlike [cournot_tariff](#), which models homogeneous-product Cournot competition with plant-level quantities, this function models differentiated products with Logit demand.

Value

logit_cournot_tariff returns an instance of class [TariffLogitCournot](#) or [TariffLogitCournotALM](#), depending on calibration.

Examples

```
prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
owner <- c("BUD", "OLD STYLE", "MILLER", "MILLER", "OTHER-LITE", "OTHER-REG")
price <- c(.0441, .0328, .0409, .0396, .0387, .0497)
quantities <- c(.066, .172, .253, .187, .099, .223) * 100
margins <- c(.3830, .5515, .5421, .5557, .4453, .3769)
tariff <- c(0, 0, 0, 0, .1, .1)

result <- logit_cournot_tariff(prices = price, quantities = quantities,
                              margins = margins, owner = owner,
                              tariffPost = tariff, labels = prodNames)

print(result)
summary(result)
calcDiagnostics(result)
```

monopolistic_competition_tariff

Tariff Simulation With A Monopolistic Competition Pricing Game

Description

Simulate the effect of tariffs when firms play a Monopolistic Competition game and consumer demand is either Logit or CES

Usage

```
monopolistic_competition_tariff(
  demand = c("logit", "ces"),
  prices,
  quantities,
  margins,
  mktElast = NA_real_,
  mktSize,
  tariffPre = rep(0, length(quantities)),
  tariffPost = rep(0, length(quantities)),
  priceOutside = ifelse(demand == "logit", 0, 1),
  labels = paste("Prod", 1:length(quantities), sep = "")
)
```

Arguments

demand	A character vector indicating which demand system to use. Currently allows “logit” or “ces” .
prices	A length k vector product prices. Default is missing, in which case demand intercepts are not calibrated.
quantities	A length k vector of product quantities.
margins	A length k vector of product margins. All margins must be either be between 0 and 1, or NA.
mktElast	A negative number no greater than -1 equal to the industry pre-tariff price elasticity. Default is NA .
mktSize	A positive number equal to the industry pre-tariff market size. Market size equals total quantity sold, <i>including sales to the outside good</i> .
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
priceOutside	price of the outside good. Default 0 for logit and 1 for ces. Not used for aids.
labels	A k-length vector of labels.

Details

Let k denote the number of products produced by all firms. Using price, and quantity, information for all products in each market, as well as margin information for at least one products in each market, `monopolistic_competition_tariff` is able to recover the slopes and intercepts of a Logit demand system. These parameters are then used to simulate the price effects of an *ad valorem* tariff under the assumption that the firms are playing a monopolistically competitive pricing game

Value

`monopolistic_competition_tariff` returns an instance of class `TariffMonComLogit` , depending upon the value of the “demand” argument.

References

Simon P. Anderson, Andre de Palma, Brent Kreider, Tax incidence in differentiated product oligopoly, *Journal of Public Economics*, Volume 81, Issue 2, 2001, Pages 173-192. Anderson, Simon P., and Andre De Palma. Economic distributions and primitive distributions in monopolistic competition. Centre for Economic Policy Research, 2015.

See Also

[bertrand_tariff](#) to simulate the effects of a tariff under a Bertrand pricing game.

Examples

```
## Calibration and simulation results from a 10% tariff on non-US beers "OTHER-LITE"
## and "OTHER-REG"
## Source: Epstein/Rubenfeld 2004, pg 80

prodNames <- c("BUD", "OLD STYLE", "MILLER", "MILLER-LITE", "OTHER-LITE", "OTHER-REG")
price      <- c(.0441, .0328, .0409, .0396, .0387, .0497)
quantities <- c(.066, .172, .253, .187, .099, .223)*100
margins    <- c(.3830, .5515, .5421, .5557, .4453, .3769)
tariff     <- c(0, 0, 0, 0, .1, .1)

names(price) <-
  names(quantities) <-
  names(margins) <-
  prodNames

result.logit <- monopolistic_competition_tariff(demand = "logit", prices=price, quantities=quantities,
                                                margins = margins,
                                                tariffPost = tariff, labels=prodNames)

print(result.logit)      # return predicted price change
summary(result.logit)    # summarize merger simulation

result.ces <- monopolistic_competition_tariff(demand = "ces", prices=price, quantities=quantities,
                                              margins = margins,
                                              tariffPost = tariff, labels=prodNames)

print(result.ces)      # return predicted price change
summary(result.ces)    # summarize merger simulation
```

ps-methods

Methods To Calculate Producer Surplus

Description

Producer Surplus methods for the `TariffBertrand` and `TariffCournot` classes

Usage

```
## S4 method for signature 'TariffBertrand'
calcProducerSurplus(object, preMerger = TRUE)

## S4 method for signature 'TariffLogitCournotModels'
calcProducerSurplus(object, preMerger = TRUE)

## S4 method for signature 'TariffCournot'
calcProducerSurplus(object, preMerger = TRUE)
```

Arguments

object	an instance of class <code>TariffBertrand</code> or <code>TariffCournot</code>
preMerger	when TRUE, calculates producer surplus under the existing tariff regime. When FALSE, calculates tariffs under the new tariff regime. Default is TRUE.

Value

product-level (or in the case of Cournot, plant-level) producer surplus

Quota-classes	<i>S4 classes to model quotas</i>
---------------	-----------------------------------

Description

Extend classes from the **antitrust** package to accomodate quotas.

Slots

- quotaPre For QuotaCournot, a matrix containing **current** plant-level (rows) AND product-level (columns) quotas. Default is a matrix of 0s. For all other classes, a vector containing **current** product-level quotas. Quotas are expressed as a proportion of pre-merger output. Default is a vector of Infs.
- quotaPost a For QuotaCournot, a matrix containing **new** plant-level (rows) AND product-level (columns) quotas. Default is a matrix of Infs. For all other classes, a vector containing **new** product-level quotas. quotas are expressed as a proportion of pre-merger output. Default is a vector of Infss.

Sim-Functions	<i>Tariff Simulation With User-Supplied Demand Parameters</i>
---------------	---

Description

Simulates the price effects of an ad valorem tariff with user-supplied demand parameters under the assumption that all firms in the market are playing either a differentiated products Bertrand pricing game, 2nd price auction, or bargaining game.

Let k denote the number of products produced by all firms below.

Usage

```

sim(
  prices,
  supply = c("moncom", "bertrand", "auction2nd", "bargaining"),
  demand = c("logit", "ces"),
  demand.param,
  owner,
  tariffPre = rep(0, length(prices)),
  tariffPost = rep(0, length(prices)),
  subset = rep(TRUE, length(prices)),
  insideSize = 1,
  priceOutside,
  priceStart,
  bargpowerPre = rep(0.5, length(prices)),
  bargpowerPost = bargpowerPre,
  labels = paste("Prod", 1:length(prices), sep = ""),
  ...
)

```

Arguments

prices	A length k vector of product prices.
supply	A character string indicating how firms compete with one another. Valid values are "moncom" (monopolistic competition), "bertrand" (Nash Bertrand), "auction2nd" (2nd score auction), or "bargaining".
demand	A character string indicating the type of demand system to be used in the merger simulation. Supported demand systems are logit ('Logit') or ces ('CES').
demand.param	See Below.
owner	Required. EITHER a vector of length k whose values indicate which firm produced a product before the tariff OR a k x k matrix of pre-merger ownership shares.
tariffPre	A vector of length k where each element equals the current <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
tariffPost	A vector of length k where each element equals the new <i>ad valorem</i> tariff (expressed as a proportion of the consumer price) imposed on each product. Default is 0, which assumes no tariff.
subset	A vector of length k where each element equals TRUE if the product indexed by that element should be included in the post-merger simulation and FALSE if it should be excluded. Default is a length k vector of TRUE.
insideSize	A length 1 vector equal to total units sold if 'demand' equals "logit", or total revenues if 'demand' equals "ces".
priceOutside	A length 1 vector indicating the price of the outside good. This option only applies to the 'Logit' class and its child classes Default for 'Logit', 'LogitNests', and 'LogitCap' is 0, and for 'CES' and 'CesNests' is 1.

<code>priceStart</code>	A length k vector of starting values used to solve for equilibrium price. Default is the ‘prices’ vector for all values of demand except for ‘AIDS’, which is set equal to a vector of 0s.
<code>bargpowerPre</code>	A length k vector of pre-merger bargaining power parameters. Values must be between 0 (sellers have the power) and 1 (buyers the power). Ignored if ‘supply’ not equal to "bargaining".
<code>bargpowerPost</code>	A length k vector of post-merger bargaining power parameters. Values must be between 0 (sellers have the power) and 1 (buyers the power). Default is ‘bargpowerPre’. Ignored if ‘supply’ not equal to "bargaining".
<code>labels</code>	A k -length vector of labels. Default is “Prod#”, where ‘#’ is a number between 1 and the length of ‘prices’.
<code>...</code>	Additional options to feed to the optimizer used to solve for equilibrium prices.

Details

Using user-supplied demand parameters, `sim` simulates the effects of a merger in a market where firms are playing a differentiated products pricing game.

If ‘demand’ equals ‘Logit’ then ‘demand.param’ must equal a list containing

alpha The price coefficient.

meanval A length- k vector of mean valuations ‘meanval’. If none of the values of ‘meanval’ are zero, an outside good is assumed to exist.

If demand equals ‘CES’ then ‘demand.param’ must equal a list containing

gamma The price coefficient,

alpha The coefficient on the numeraire good. May instead be calibrated using ‘shareInside’,

meanval A length- k vector of mean valuations ‘meanval’. If none of the values of ‘meanval’ are zero, an outside good is assumed to exist,

shareInside The budget share of all products in the market. Default is 1, meaning that all consumer wealth is spent on products in the market. May instead be specified using ‘alpha’.

Value

`sim` returns an instance of the class specified by the ‘demand’ argument.

Author(s)

Charles Taragin <ctaragin+trader@gmail.com>

See Also

The S4 class documentation for: [Logit](#) and [CES](#),

Examples

```
## Calibration and simulation results from a merger between Budweiser and
## Old Style. Note that the in the following model there is no outside
## good; BUD's mean value has been normalized to zero.

## Source: Epstein/Rubinfeld 2004, pg 80

prodNames <- c("BUD","OLD STYLE","MILLER","MILLER-LITE","OTHER-LITE","OTHER-REG")
owner <-c("BUD","OLD STYLE","MILLER","MILLER","OTHER-LITE","OTHER-REG")
tariff <- c(0,0,0,0,.1,.1)

price <- c(.0441,.0328,.0409,.0396,.0387,.0497)

# a list containing price coefficient and mean valuations
demand.param=list(alpha=-48.0457,
                  meanval=c(0,0.4149233,1.1899885,0.8252482,0.1460183,1.4865730)
)

sim.logit <- sim(price,demand="logit",supply="bertrand", demand.param,
                owner=owner,tariffPost=tariff,labels=prodNames)

print(sim.logit)          # return predicted price change
summary(sim.logit)        # summarize merger simulation

elast(sim.logit,TRUE)      # returns premerger elasticities
elast(sim.logit,FALSE)     # returns postmerger elasticities

diversion(sim.logit,TRUE)  # return premerger diversion ratios
diversion(sim.logit,FALSE) # return postmerger diversion ratios

antitrust::cmcr(sim.logit)      #calculate compensating marginal cost reduction
antitrust::upp(sim.logit)       #calculate Upwards Pricing Pressure Index

CV(sim.logit)                #calculate representative agent compensating variation
```

Description

Summary methods for the `TariffBertrand`, `QuotaBertrand`, `TariffLogitCournotModels`, and `TariffCournot` classes

Usage

```
## S4 method for signature 'TariffBertrand'
summary(
  object,
  revenue = FALSE,
  levels = FALSE,
  parameters = FALSE,
  market = FALSE,
  insideOnly = TRUE,
  digits = 2
)

## S4 method for signature 'TariffLogitCournotModels'
summary(
  object,
  revenue = FALSE,
  levels = FALSE,
  parameters = FALSE,
  market = FALSE,
  insideOnly = TRUE,
  digits = 2
)

## S4 method for signature 'QuotaBertrand'
summary(
  object,
  revenue = FALSE,
  levels = FALSE,
  parameters = FALSE,
  market = FALSE,
  insideOnly = TRUE,
  digits = 2
)

## S4 method for signature 'TariffCournot'
summary(
  object,
  market = FALSE,
  revenue = FALSE,
  levels = FALSE,
  parameters = FALSE,
  digits = 2
)
```

Arguments

object	an instance of class TariffBertrand, QuotaBertrand, TariffLogitCournotModels, or TariffCournot
--------	--

revenue	When TRUE, returns revenues, when FALSE returns quantities. Default is FALSE.
levels	When TRUE returns changes in levels rather than percents and quantities rather than shares, when FALSE, returns changes as a percent and shares rather than quantities. Default is FALSE.
parameters	When TRUE, displays demand and cost parameters. Default is FALSE.
market	When TRUE, displays aggregate information about the effect of a tariff. When FALSE displays product-specific (or in the case of Cournot, plant-specific) effects. Default is FALSE
insideOnly	When TRUE, rescales shares on inside goods to sum to 1. Default is FALSE.
digits	Number of digits to report. Default is 2.

Value

Prints either market or product/plant-level summary and invisibly returns a data frame containing the same information.

Tariff-classes	<i>S4 classes to model tariffs</i>
----------------	------------------------------------

Description

Extend classes from the **antitrust** package to accomodate tariffs.

Slots

tariffPre For TariffCournot, a matrix containing **current** plant-level (rows) AND product-level (columns) tariffs. Default is a matrix of 0s. For all other classes, a vector containing **current** product-level tariffs. *ad valorem* taxes are expressed as a proportion of the consumer price. Default is a vector of 0s.

tariffPost a For TariffCournot, a matrix containing **new** plant-level (rows) AND product-level (columns) tariffs. Default is a matrix of 0s. For all other classes, a vector containing **new** product-level tariffs. *ad valorem* taxes are expressed as a proportion of the consumer price. Default is a vector of 0s.

TariffCournot-methods *Additional methods for TariffCournot Class*

Description

Producer Surplus methods for the TariffBertrand and TariffCournot classes

Usage

```
## S4 method for signature 'TariffCournot'
calcSlopes(object)

## S4 method for signature 'TariffCournot'
calcQuantities(object, preMerger = TRUE, market = FALSE)
```

Arguments

object	an instance of class TariffCournot
preMerger	when TRUE, computes result under the existing tariff regime. When FALSE, calculates tariffs under the new tariff regime. Default is TRUE.
market	when TRUE, computes market-wide results. When FALSE, calculates plant-specific results.

Value

calcSlopes return a TariffCournot object containing estimated slopes. CalcQuantities returns a matrix of equilibrium quantities under either the current or new tariff.

TariffMonComRUM-methods

Additional methods for TariffMonComLogit, TariffMonComCES Classes

Description

calcSlopes, Prices, Margins methods for the TariffMonComLogit and TariffMonComCES classes

Usage

```
## S4 method for signature 'TariffMonComLogit'
calcSlopes(object)

## S4 method for signature 'TariffMonComCES'
calcSlopes(object)
```

```
## S4 method for signature 'TariffMonComLogit'  
calcMargins(object, preMerger = TRUE, level = FALSE)
```

```
## S4 method for signature 'TariffMonComCES'  
calcMargins(object, preMerger = TRUE, level = FALSE)
```

```
## S4 method for signature 'TariffMonComLogit'  
calcPrices(object, preMerger = TRUE, ...)
```

```
## S4 method for signature 'TariffMonComCES'  
calcPrices(object, preMerger = TRUE, ...)
```

Arguments

object	an instance of class <code>TariffMonComLogit</code> or class <code>TariffMonComCES</code>
preMerger	when TRUE, computes result under the existing tariff regime. When FALSE, calculates tariffs under the new tariff regime. Default is TRUE.
level	when TRUE, computes margins in dollars. When FALSE, calculates margins as a proportion of prices. Default is FALSE.
...	harmlessly pass the arguments used in other <code>calcPrices</code> methods to methods for <code>TariffMonComLogit</code> and <code>TariffMonComCES</code> .

Value

`calcSlopes` return a `TariffMonComLogit` or `TariffMonComCES` object containing estimated slopes. `CalcQuantities` returns a matrix of equilibrium quantities under either the current or new tariff.

Index

* methods

- defineMarketTools-methods, 16
- antitrust-reexports, 2
- auction2nd_tariff, 3
- bargaining_tariff, 5
- BBsolve, 4, 7, 9, 12, 15, 19
- bertrand_quota, 8
- bertrand_tariff, 5, 7, 10, 21
- calcDiagnostics (antitrust-reexports), 2
- calcMargins, TariffMonComCES-method (TariffMonComRUM-methods), 29
- calcMargins, TariffMonComLogit-method (TariffMonComRUM-methods), 29
- calcMC (antitrust-reexports), 2
- calcPriceDelta (antitrust-reexports), 2
- calcPrices, TariffMonComCES-method (TariffMonComRUM-methods), 29
- calcPrices, TariffMonComLogit-method (TariffMonComRUM-methods), 29
- calcProducerSurplus, TariffBertrand-method (ps-methods), 22
- calcProducerSurplus, TariffCournot-method (ps-methods), 22
- calcProducerSurplus, TariffLogitCournotModels-method (ps-methods), 22
- calcQuantities, TariffCournot-method (TariffCournot-methods), 29
- calcRevenues (antitrust-reexports), 2
- calcShares (antitrust-reexports), 2
- calcSlopes, TariffCournot-method (TariffCournot-methods), 29
- calcSlopes, TariffMonComCES-method (TariffMonComRUM-methods), 29
- calcSlopes, TariffMonComLogit-method (TariffMonComRUM-methods), 29
- CES, 25
- Cournot-class, 15
- cournot_tariff, 13, 19
- CV (antitrust-reexports), 2
- defineMarketTools-methods, 16
- diversion (antitrust-reexports), 2
- elast (antitrust-reexports), 2
- HypoMonTest, 16, 17
- HypoMonTest (defineMarketTools-methods), 16
- HypoMonTest, TariffBertrand-method (defineMarketTools-methods), 16
- HypoMonTest, TariffCournot-method (defineMarketTools-methods), 16
- initialize, QuotaBertrand-method (initialize-methods), 17
- initialize, TariffBertrand-method (initialize-methods), 17
- initialize, TariffCournot-method (initialize-methods), 17
- initialize, TariffLogitCournotModels-method (initialize-methods), 17
- initialize-methods, 17
- Logit, 25
- logit.cournot, 19
- logit.cournot.alm, 19
- logit_cournot_tariff, 18
- monopolistic_competition_tariff, 5, 7, 12, 20
- optim, 4, 7, 9, 12, 15, 19
- ownerToMatrix (antitrust-reexports), 2
- ownerToVec (antitrust-reexports), 2
- ps-methods, 22
- Quota-classes, 23

QuotaBertrand-class (Quota-classes), [23](#)
 QuotaCournot-class (Quota-classes), [23](#)
 QuotaLogit, [10](#)
 QuotaLogit-class (Quota-classes), [23](#)

 sim (Sim-Functions), [23](#)
 Sim-Functions, [23](#)
 summary, QuotaBertrand-method
 (summary-methods), [26](#)
 summary, TariffBertrand-method
 (summary-methods), [26](#)
 summary, TariffCournot-method
 (summary-methods), [26](#)
 summary, TariffLogitCournotModels-method
 (summary-methods), [26](#)
 summary-methods, [26](#)

 Tariff-classes, [28](#)
 Tariff2ndLogit, [5](#)
 Tariff2ndLogit-class (Tariff-classes),
 [28](#)
 TariffAIDS, [12](#)
 TariffAIDS-class (Tariff-classes), [28](#)
 TariffBargainingLogit, [7](#)
 TariffBargainingLogit-class
 (Tariff-classes), [28](#)
 TariffBertrand-class (Tariff-classes),
 [28](#)
 TariffCES, [12](#)
 TariffCES-class (Tariff-classes), [28](#)
 TariffCournot-class (Tariff-classes), [28](#)
 TariffCournot-methods, [29](#)
 TariffLogit, [12](#)
 TariffLogit-class (Tariff-classes), [28](#)
 TariffLogitCournot, [19](#), [20](#)
 TariffLogitCournot-class
 (Tariff-classes), [28](#)
 TariffLogitCournotALM, [19](#), [20](#)
 TariffLogitCournotALM-class
 (Tariff-classes), [28](#)
 TariffLogitCournotModels-class
 (Tariff-classes), [28](#)
 TariffMonComCES-class (Tariff-classes),
 [28](#)
 TariffMonComLogit, [21](#)
 TariffMonComLogit-class
 (Tariff-classes), [28](#)
 TariffMonComRUM-methods, [29](#)