





STAGE_t: Macroeconomic Closures


1

Single Country CGE, 2024

© cgemod

1





Outline

- Modelling principle
- The Real Exchange Rate
- Equation and Variable counts
- Market clearing
- Macroeconomic Closures
 - Numéraire
 - Foreign exchange market closure
 - Investment-Savings closure
 - Government account closure
 - Tax accounts
 - Government expenditures


2

Single Country CGE, 2024

© cgemod

2





Modelling Principle

Different applications and users require different closure settings. Therefore, the model should allow

- Multiple different closure settings
- Sensitivity testing of closure choices
- Acknowledgment of the tensions between (Walrasian) Microeconomic and Macroeconomic ‘visions’
- Be simple to change


3

Single Country CGE, 2024 © cgemod

3





The Real Exchange Rate


4

Single Country CGE, 2024 © cgemod

4

cgemod

Exchange Rate in CGE Models

STAGE

- Nominal Exchange rate, ER = local currency/foreign currency
- Uses in the model code
 - Current account balance denominated in foreign currency in the model

```
KAPEQUIL..
KAPWOR =E= SUM(cm, PWM(cm) *QM(cm))
           - SUM(ce, PWE(ce) *QE(ce)) ;
```

Single Country CGE, 2024

© cgemod



5

5

cgemod

Exchange Rate in CGE Models

STAGE

- Uses in the model code
 - Domestic prices of imports and exports report the prices in local currency units, using ER

```
PMDEF(c) $cm(c) ..
PM(c) =E= (PWM(c) * (1 + (TMADJ * tm(c)))) * ER
           + [TMSADJ * tms(c)] ;

PEDEF(c) $ce(c) ..
PE(c) =E= PWE(c) * ER * (1 - (TEADJ * te(c))) ;

TOTSAREQ..
TOTSAV =E= SUM(h, YH(h) * (1 - (TYHADJ * tyh(h)))
            * (SADJ * shh(h)))
            + SUM(f, deprec(f) * YF(f))
            + KAPGOV + (KAPWOR * ER) ;
```

Single Country CGE, 2024

© cgemod



6

6

STAGE

Exchange Rate in CGE Models

- Real Exchange Rate = $P_{tradable} / P_{nontradable}$
- Armington assumption → imports and domestic goods are imperfect substitutes, so ‘semi-tradable’ goods rather than a pure non-traded good
- Price (index) of the ‘non-traded’/‘semi-traded’ goods is a weighted average of the price of domestically produced goods sold on the domestic market, i.e., PPI

$$\therefore RER = ER / PPI$$

Single Country CGE, 2024© cgemod7

7

STAGE

Exchange Rate in CGE Models

- The (nominal and real) exchange rates are not financial variables
 - No financial assets in the model
 - No inter-temporal equilibrium concept
- The (nominal and real) exchanges rate are determined by the prices of tradable and non/semi tradable goods and services

Single Country CGE, 2024© cgemod8

8

cgemod

STAGE

Macroeconomic Closures

Single Country CGE, 2024

© cgemod

9

9

cgemod

STAGE

SAMs & Macroeconomy: Counting

$$t_{jk} = t_{jk}(y; p, f, \lambda) \longrightarrow \text{VARS} = [y] + [p] + [f] + [\lambda]$$
$$p = p(y; p, f, \lambda) \searrow$$
$$y = n + x \nearrow \text{EQNS} = [y] + [p] - 1$$
$$\text{Degrees of Freedom} = [f] + \lambda + 1$$

Single Country CGE, 2024

© cgemod

10

10





Numéraire

$$CPI = \overline{CPI}$$

OR

$$PPI = \overline{PPI}$$



Single Country CGE, 2024

© cgemod

11

11





Numéraire

- * ## MISCELLANEOUS FIXED VARIABLES
- * To use CPI as the numeraire fix CPI

$$CPI.FX = CPI0 * numerchk ;$$

- * To fix the real exchange rate fix ER and PPI

$$* PPI.FX = PPI0 * numerchk ;$$



Single Country CGE, 2024

© cgemod

12

12

cgemod

Foreign Exchange Account

STAGE

$$ER = \overline{ER} \quad \text{OR} \quad CAPWOR = \overline{CAPWOR}$$

Small country assumption on import demand and selected export commodities (those defined in the set **cedn(c)**)

$$PWM_c = \overline{PWM_c} \quad PWE_{cedn} = \overline{PWE_{cedn}}$$

Export demand curve for selected commodities (those defined in set **ced(c)**) so **PWE_{ced}** is a variable for those commodities

Single Country CGE, 2024

© cgemod


13

13

cgemod

Foreign Exchange Account

STAGE

- * ## FOREIGN EXCHANGE MARKET CLOSURE
- * In this MODEL the exchange rate is fixed
- * and the current account balance is the
- * equilibrating variable.

- * $ER.FX = ER0$;

- * alternatively the external balance is fixed

- * $CAPWOR.FX = CAPWOR0$;

- * Fixing of world prices
- * $PWM.FX(c) = PWM0(c)$;
- * $PWE.FX(cedn) = PWE0(cedn)$;

Single Country CGE, 2024

© cgemod


14

14

cgemod

STAGE

Capital Account Closure

$$SADJ = \overline{SADJ}$$

OR

$$IADJ = \overline{IADJ}$$

OR

$$INVEST = \overline{INVEST}$$

OR

$$INVESTSH = \overline{INVESTSH}$$

Single Country CGE, 2024

© cgemod

15

15

cgemod

STAGE

Capital Account Closure

* ## INVESTMENT-SAVINGS CLOSURE

* Aggregate investment is determined by aggregate savings

* i.e., the model is savings driven, then fix SADJ

* SADJ.FX	= SADJ0 ;
SHADJ.FX	= SADJ0 ;
SEADJ.FX	= SADJ0 ;
DSHH.FX	= DSHH0 ;
DS.FX	= DS0 ;
DSEN.FX	= DSEN0 ;

Single Country CGE, 2024

© cgemod

16

16

cgemod

STAGE

Capital Account Closure

* ## INVESTMENT-SAVINGS CLOSURE

* IF the model is investment driven fix the investment scaling factor

IADJ.FX = IADJ0 ;

* OR the value or share of domestic final demand of investment is fixed

* INVEST.FX = INVEST0 ;

* INVESTSH.FX = INVESTSH0 ;

Single Country CGE, 2024

© cgemod

17

17

cgemod

STAGE

Enterprise Account Closure

*## ENTERPRISE CLOSURE RULES

\$ontext

ONE of the volume, value or share of final demand should be fixed

IF qedconst(c,e) = 0.0, then QEDADJ.FX

\$offtext

QEDADJ.FX = QEDADJ0 ;

* VED.FX = VED0 ;

* VEDSH.FX = VEDSH0 ;

* Enterprise transfers to households

HEADJ.FX = HEADJ0 ;

Single Country CGE, 2024

© cgemod

18

18

cgemod

STAGE

Government Closure: Taxes

$$TMADJ = \overline{TMADJ}$$
$$TEADJ = \overline{TEADJ}$$
$$TSADJ = \overline{TSADJ}$$
$$TSSADJ = \overline{TSSADJ}$$
$$TEXADJ = \overline{TEXADJ}$$
$$TVADJ = \overline{TVADJ}$$

Single Country CGE, 2024

© cgemod

19

19

cgemod

STAGE

Government Closure: Taxes

$$TXADJ = \overline{TXADJ}$$
$$TFADJ = \overline{TFADJ}$$
$$TYFADJ = \overline{TYFADJ}$$
$$TYHADJ = \overline{TYHADJ}$$
$$TYEADJ = \overline{TYEADJ}$$

Single Country CGE, 2024

© cgemod

20

20



cgemod

STAGE

Government Closure: Taxes

* ## GOVT CLOSURE RULES

* All the tax rates are fixed

* Government consumption expenditure is also fixed

* Hence the equilibrating variable is Government Savings

* Tax rate scaling factors

TEADJ.FX = TEADJ0 ;

TMADJ.FX = TMADJ0 ;

TSADJ.FX = TSADJ0 ;

TSSADJ.FX = TSSADJ0 ;

TEXADJ.FX = TEXADJ0 ;

TVADJ.FX = TVADJ0 ;

TXADJ.FX = TXADJ0 ;

TFADJ.FX = TFADJ0 ;

TYFADJ.FX = TFHADJ0 ;

TYHADJ.FX = TYHADJ0 ;

TYEADJ.FX = TYEADJ0 ;

Single Country CGE, 2024

© cgemod

21

21

cgemod

STAGE

Government Closure: Taxes

* ## GOVT CLOSURE RULES

* All the tax rates are fixed

* Government consumption expenditure is also fixed

* Hence the equilibrating variable is Government Savings

* Tax rate scaling factors

DTE.FX = DTE0 ;

DTM.FX = DTM0 ;

DTS.FX = DTS0 ;

DTSS.FX = DTSS0 ;

DTV.FX = DTV0 ;

DTEX.FX = DTEX0 ;

DTX.FX = DTX0 ;

DTF.FX = DTF0 ;

DTYF.FX = DTYF0 ;

DTYH.FX = DTYH0 ;

DTY.FX = DTY0 ;

DTYE.FX = DTYE0 ;

Single Country CGE, 2024

© cgemod

22

22

cgemod

11

cgemod

STAGE

Government Closure: Taxes

* ## GOVT CLOSURE RULES

* Tax revenues fixed

* Tax revenues (real relative to numeraire)

* ETAX.FX

= ETAX0

;

* MTAX.FX

= MTAX0

;

* STAX.FX

= STAX0

;

* SSTAX.FX

= SSTAX0

;

* EXTAX.FX

= EXTAX0

;

* VTAX.FX

= VTAX0

;

* FYTAX.FX

= FYTAX0

;

* ITAX.FX

= ITAX0

;

* FTAX.FX

= FTAX0

;

* DTAX.FX

= DTAX0

;

Single Country CGE, 2024

© cgemod

23

23

cgemod

STAGE

Government Closure: Expenditure

$QGDADJ = \overline{QGDADJ}$

$VGD = \overline{VGD}$

$VGDSH = \overline{VGDSH}$

$EGADJ = \overline{EGADJ}$

$HGADJ = \overline{HGADJ}$

$KAPGOV = \overline{KAPGOV}$

Government demand

Government transfers

Internal balance

Single Country CGE, 2024

© cgemod

24

24

STAGE

Government Closure: Expenditure

- * Government expenditure scaling factor
- * EITHER volume, value or share of demand should be fixed

$$\begin{aligned} * \text{ QGDADJ.FX} &= \text{ QGDADJ0} ; \\ * \text{ VGD.FX} &= \text{ VGD0} ; \\ \text{ VGDSH.FX} &= \text{ VGDSH0} ; \end{aligned}$$

- * Government transfers scaling factors are fixed

$$\begin{aligned} \text{ HGADJ.FX} &= \text{ HGADJ0} ; \\ \text{ EGADJ.FX} &= \text{ EGADJ0} ; \end{aligned}$$

- * alternatively the internal balance can be fixed

$$* \text{ KAPGOV.FX} = \text{ KAPGOV0} ;$$

Single Country CGE, 2024© cgemod25

25

STAGE

Tax Replacement: Theory

Fixed internal balance and government spending
Other agents adjust to the policy shock:

Direct taxes adjust → a lump sum change in household income, consumption changes, ‘no’ price distortions

OR

Indirect taxes change → distort price signals and alter consumption patterns

Single Country CGE, 2024© cgemod26

26





Tax Replacement: Practice

Household income taxes adjust (other tax adjustors held constant at one)

$$\begin{aligned} \text{KAPGOV.FX} &= \text{KAPGOV0} ; \\ \text{TYHADJ.LO} &= -\text{INF} ; \\ \text{TYHADJ.UP} &= +\text{INF} ; \end{aligned}$$

Sales taxes adjust (other tax adjustors held constant at one)

$$\begin{aligned} \text{KAPGOV.FX} &= \text{KAPGOV0} ; \\ \text{TSADJ.LO} &= -\text{INF} ; \\ \text{TSADJ.UP} &= +\text{INF} ; \end{aligned}$$


27

Single Country CGE, 2024 © cgemod

27





Macroeconomic Closures

The End


28

Single Country CGE, 2024 © cgemod

28