A Two Sector Closed Economy CGE Model: Part 3

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Outline

- *Introduction*
- *Economic Data & Behaviour*
- *The Model in Algebra and GAMS*
  - *Prices*
  - *Production*
  - *Factors*
  - Households
  - Government
  - Saving-Investment
  - Other Equations
- Model Closure & Market Clearing

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Institutions

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Household Incomes

$$YH_h = \sum_f WF_f * FSH_{h,f} \qquad \forall h$$

Household Income

In GAMS ➡

$$YH_h = \sum_f hvash_{h,f} * YF_f$$

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YH(h) =E= SUM(f,hvash(h,f)*YF(f)) ;
```

Functional distribution of income unchanged

$$YH_h = \sum_f hvash_{h,f} * YF_f \qquad \forall h$$

where

Fixed Endowments

$$hvash_{h,f} = \frac{WF_f * FSH_{h,f}}{\sum_h WF_f * FSH_{h,f}} = \frac{FSH_{h,f}}{\sum_h FSH_{h,f}} \qquad \forall h, f$$

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Household Expenditures

$$SAM_{h,'total'} = \sum_c SAM_{c,h} + SAM_{'govt',h} + SAM_{'i\_s',h}$$ **Acc^g Identity**

$$SAM_{'govt',h} = (YH_h * ty_h)$$
$$SAM_{'i\_s',h} = \left[(YH_h * (1 - ty_h)) * shh_h\right]$$ **Behavioural assumptions**

$$HEXP_h = YH_h - \left\{(YH_h * ty_h) + \left[(YH_h * (1 - ty_h)) * shh_h\right]\right\}$$ **Consumption expenditure**

In GAMS ➞

$$HEXP_h = YH_h - \left\{(YH_h * ty_h) + \left[(YH_h * (1 - ty_h)) * (SADJ * shh_h)\right]\right\}$$

HEXP(h) =E= (YH(h)*(1 - ty(h)))*(1 - (SADJ*shh(h))) ;

NB: the adjuster variables

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Utility Functions & Equations

Expenditure of ALL income to each household MUST be accounted for

$$\sum_c PQD_c * QCD_{c,h} = \sum_c \gamma_{c,h} * HEXP_h = HEXP_h$$ **Complete demand system**

In GAMS ➞

$$QCD_c = \frac{\sum_h comhav_{c,h} * HEXP_h}{PQD_c}$$

PQD(c)*QCD(c) =E= SUM(h,comhav(c,h)*HEXP(h)) ;

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Tax Revenues

$$COMTAX = \sum_c \left(ts_c * PQS_c * QQ_c \right)$$ **GST Revenue**

$$INDTAX = \sum_a \left(tx_a * PX_a * QX_a \right)$$ **Production tax Revenue**

$$HTAX = \sum_h \left(ty_h * YH_h \right)$$ **Income tax Revenue**

Equations NOT needed BUT can be useful for simulations

In GAMS ➡

```
COMTAX =E= SUM(c,ts(c)*PQS(c)*QQ(c)) ;
INDTAX =E= SUM(a,tx(a)*PX(a)*QX(a)) ;
HTAX =E= SUM(h,ty(h)*YH(h)) ;
```


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Government

$$SAM_{'govt','total'} = \sum_c SAM_{c,'govt'} + SAM_{'i\_s','govt'}$$ **Acc^g Identity**

$$YG = SAM_{'govt','total'}$$ **Government Income**

$$= \left(\sum_c ts_c * PQS_c * QQ_c \right) + \left(\sum_a tx_a * PX_a * QX_a \right) + \left(\sum_h YH_h * ty_h \right)$$

$$= COMTAX + INDTAX + HTAX$$

In GAMS ➡

$$YG = COMTAX + INDTAX + HTAX$$

```
YG =E= COMTAX + INDTAX + HTAX ;
```


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Government Expenditure

$$SAM_{'govt','total'} = \sum_c SAM_{c,'govt'} + SAM_{'i\_s','govt'}$$ **Acc^g Identity**

$$EG = \sum_c SAM_{c,'govt'} = \sum_c PQD_c * QGD_{c,'govt'}$$ **Government Expenditure**

In GAMS ➡

$$\sum_c SAM_{c,'govt'} = \sum_c PQD_c * QGD_{c,'govt'}$$

EG=SUM(c, PQD(c)*QGD(c)) ;

BUT what is the government's utility function?

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Government Demand

What is the government's utility function?

$$QGD_c = qgdconst_c * QGDADJ$$ **Behavioural assumptions**

Volumes

↓

qgdconst(c) = SAM(c,"GOVT")/PQD0(c) ;

In GAMS ➡

$$QGD_c = qgdconst_c * QGDADJ$$

QGD(c) =E= qgdconst(c)*QGDADJ ;

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Savings-Investment

$$SAM_{'i\_s','total'} = \sum_c SAM_{c,'i\_s'}$$ **Acc^g Identity**

$$\begin{aligned} TOTSAV &= SAM_{'i\_s','total'} \\ &= \left[\left(YH_h * (1-ty_h)\right) * \left(SADJ * shh_h\right)\right] + KAPGOV \\ &= \left[\left(YH_h * (1-ty_h)\right) * \left(SADJ * shh_h\right)\right] + \left(YG - EG\right) \end{aligned}$$ **Savings Income**

In GAMS ➞

$$TOTSAV = \left[\left(YH_h * (1-ty_h)\right) * \left(SADJ * shh_h\right)\right] + \left(YG - EG\right)$$

```
TOTSAV =E= SUM(h,(YH(h)*(1 - ty(h))) *(SADJ*shh(h))))
                                    + KAPGOV ;
```


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Savings-Investment

$$INVEST = \sum_c SAM_{c,'i\_s'} = \sum_c PQD_c * QINVD_c$$ **Investment Expenditure**

In GAMS ➞

$$INVEST = \sum_c SAM_{c,'i\_s'} = \sum_c PQD_c * QINVD_c$$

```
INVEST =E= SUM(c,PQD(c)*QINVD(c)) ;
```

BUT what is the investment account's utility function?

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Investment Demand

BUT what is the investment account's utility function?

$QINVD_c = IADJ * qinvdconst_c$ **Behavioural assumptions**

Volumes

qinvdconst(c) = SAM(c,"i_s")/PQD0(c) ;

In GAMS ➡ $QINVD_c = IADJ * qinvdconst_c$

QINVD(c) =E= IADJ*qinvdconst(c) ;

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Market Clearing Equations

$FS_f = \sum_a FD_{f,a}$ **Factor Demand = Supply**

In GAMS ➡ FS(f) =E= SUM(a,FD(f,a)) ;

$TOTSAV = INVEST + WALRAS$ **Savings = Investment**

In GAMS ➡ TOTSAV =E= INVEST + **WALRAS** ;

$QQ_c \equiv QX_a \quad \forall c = a$ **Supply = Production**

In GAMS ➡ QQ(c) =E= SUM(a,ioqqqx(a,c)*QX(a)) ;

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Other Equations

$$CPI = \sum_c comtotsh_c * PQD_c$$ ***Numéraire***

In GAMS ➡ CPI =E= SUM(c,comtotsh(c)*PQD(c)) ;

$$QQ_c = \left(QINTD_c + \sum_h QCD_{c,h} + QGD_c + QINVD_c \right)$$ **Commodity Supply = Demand**

In GAMS ➡

QQ(c) =E= QINTD(c)+SUM(h,QCD(c,h) +QGD(c)+QINVD(c) ;

$$GDP = \sum_{c,h} QCD_{c,h} * PQD_c + \sum_c \left((QGD_c + QINVD_c) * PQD_c \right)$$ **Optimand**

In GAMS ➡

GDP =E= SUM((c,h), QCD(c,h)*PQD(c))
+SUM(c,(QGD(c)+QINVD(c))*PQD(c)) ;

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Model Closure Equations

$$FS_f = \overline{FS}_f$$ **Full employment**

In GAMS ➡ FS.FX(f) = FS0(f) ;

$$CPI = \overline{CPI}$$ ***Numéraire***

In GAMS ➡ CPI.FX = CPI0 ;

$$KAPGOV = \overline{KAPGOV}$$ **Government Account**

In GAMS ➡ KAPGOV.FX = KAPGOV0 ;

$$SADJ = \overline{SADJ}$$ **Savings-Investment Account**

In GAMS ➡ SADJ.FX = SADJ0 ;

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Equation & Variable Counting 1

- Changes to Market Clearing or Macro Closures
  - Economics
    - Keynesian vv New Classical investment behaviour
    - Tax replacement
    - Short run factor mobility
    - Unemployment

Fix one Flex one

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The End

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