



# *STAGE\_t: Price & Accounting Identities Part 2*



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## *Outline*

- *Social Accounting Matrix*
- *Commodities*
  - *Value System*
  - *Accounting Identities & Prices*
    - *Domestic Demand*
    - *Imports & Exports*
- *Activities*
  - *Value System*
  - *Accounting Identities & Prices*
- *Factors*
- *Institutions*
  - *Household*
  - *Government*
  - *Savings & Investment*
  - *Rest of World*



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Activities System

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Activity: Value System

Unobserved values

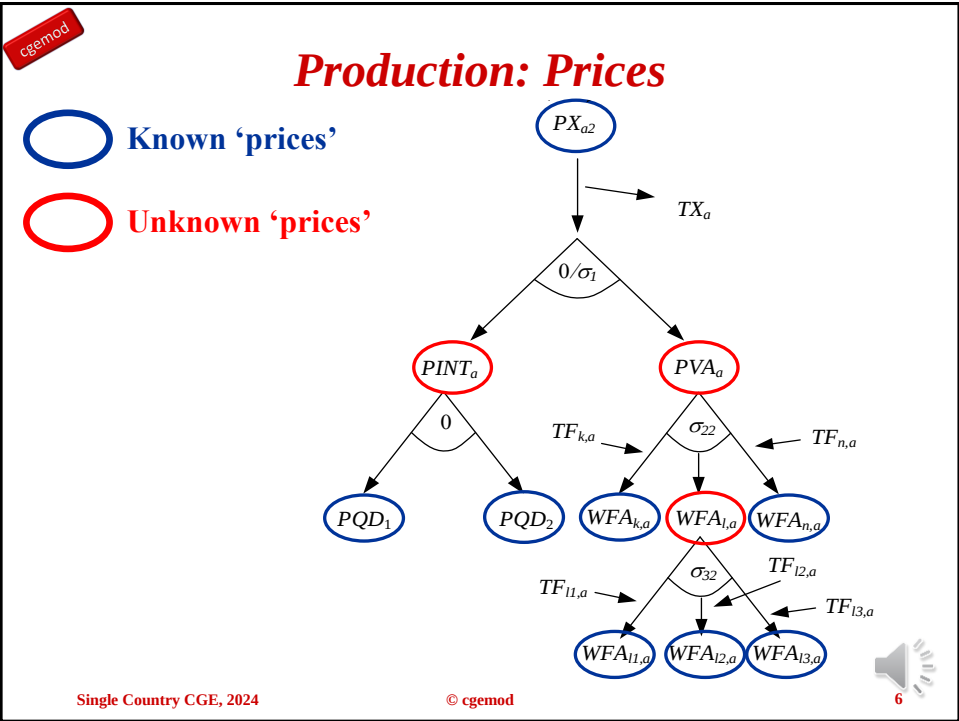
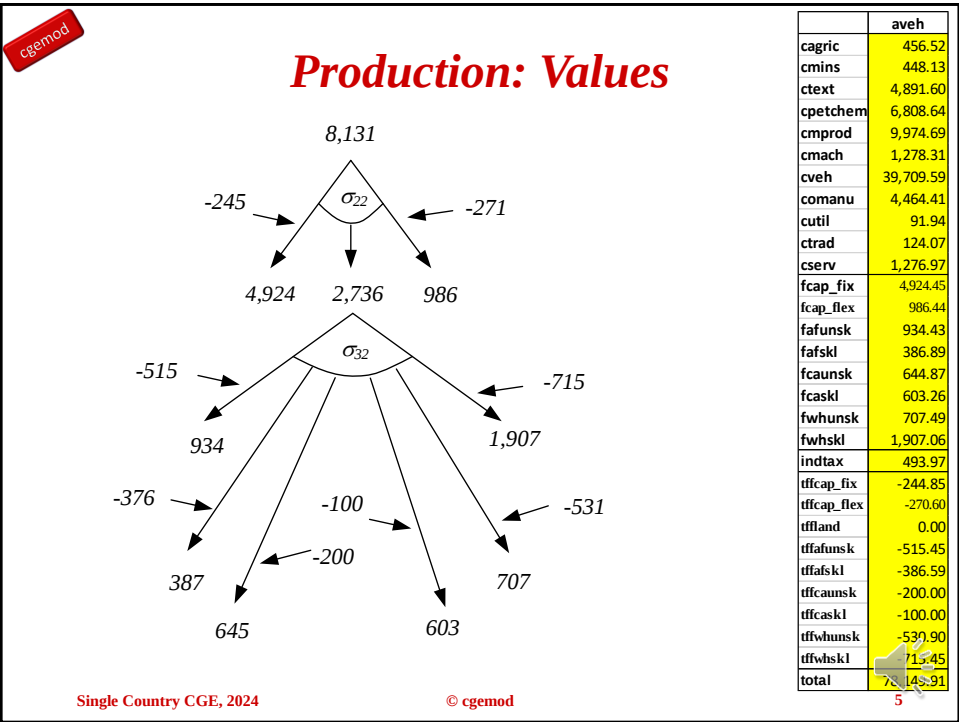
|             | aveh      |
|-------------|-----------|
| cagric      | 456.52    |
| cmins       | 448.13    |
| ctext       | 4,891.60  |
| cpetchem    | 6,808.64  |
| cmprod      | 9,974.69  |
| cmach       | 1,278.31  |
| cveh        | 39,709.59 |
| comanu      | 4,464.41  |
| cutil       | 91.94     |
| ctrad       | 124.07    |
| cserv       | 1,276.97  |
| fcap_fix    | 4,924.45  |
| fcap_flex   | 986.44    |
| fafunsk     | 934.43    |
| fafskl      | 386.89    |
| fcaunsk     | 644.87    |
| fcaskl      | 603.26    |
| fwhunsk     | 707.49    |
| fwhskl      | 1,907.06  |
| indtax      | 493.97    |
| tffcav_fix  | -244.85   |
| tffcav_flex | -270.60   |
| tffland     | 0.00      |
| tffafunsk   | -515.45   |
| tffafskl    | -386.59   |
| tffcunsk    | -200.00   |
| tffcaskl    | -100.00   |
| tffwhunsk   | -539.90   |
| tffwhskl    | 711.45    |
| total       | 7,145.91  |

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## Intermediate Input Prices

|          | aveh      |
|----------|-----------|
| cagric   | 456.52    |
| cmins    | 448.13    |
| ctext    | 4,891.60  |
| cpetchem | 6,808.64  |
| cmprod   | 9,974.69  |
| cmach    | 1,278.31  |
| cveh     | 39,709.59 |
| comanu   | 4,464.41  |
| cutil    | 91.94     |
| ctrad    | 124.07    |
| cserv    | 1,276.97  |

$$PINT_a * QINT_a = \sum_c SAM_{c,a}$$

$$QINTD_{c,a} = \frac{SAM_{c,a}}{PQD_c} \quad QINT_a = \sum_c \frac{SAM_{c,a}}{PQD_c}$$

$$ioqtdqd_{c,a} = \frac{SAM_{c,a} / PQD_c}{QINT_a} = \frac{QINTD_{c,a}}{QINT_a}$$

$$PINT_a = \sum_c \left[ \frac{SAM_{c,a} / PQD_c}{QINT_a} \right] * PQD_c$$

$$= \sum_c ioqtdqd_{c,a} * PQD_c$$

PINTDEF(a)..

PINT(a) = E = SUM[c,ioqtdqd(c,a) \* PQD(c)] ;

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## Price of Value Added

|            | aveh      |
|------------|-----------|
| fcap_fix   | 4,924.45  |
| fcap_flex  | 986.44    |
| fafunsk    | 934.43    |
| fafskl     | 386.89    |
| fcaunsk    | 644.87    |
| fcaskl     | 603.26    |
| fwhunsk    | 707.49    |
| fwhskl     | 1,907.06  |
| tfcap_fix  | -244.85   |
| tfcap_flex | -270.60   |
| tffland    | 0.00      |
| tfafunsk   | -515.45   |
| tfafskl    | -386.59   |
| tfcaunsk   | -200.00   |
| tfcaskl    | -100.00   |
| tfwhunsk   | -530.90   |
| tfwhskl    | -715.45   |
| total      | 78,149.91 |

$$PVA_a * QVA_a = \left[ \sum_f SAM_{f,a} + \sum_{tff} SAM_{tff,a} \right]$$

$$QVA_a = \sum_f SAM_{f,a}$$

$$PVA_a = \left[ \sum_f SAM_{f,a} + \sum_{tff} SAM_{tff,a} \right] / QVA_a$$

PVADEF(a).. (PX(a)\*(1 - TX(a)) \* QX(a))

=E= [(PVA(a)\*QVA(a)) + (PINT(a)\*QINT(a))] ;

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## Quantity of Output

$$PX_a * (1 - TX_a) * QX_a = [PVA_a * QVA_a] + [PINT_a * QINT_a]$$

**Behavioural assumption – ad valorem**

$$PX_a * QX_a = \sum_{sac} SAM_{sac,a} = VX_a$$

$$QX_a = \frac{\sum_{sac} SAM_{sac,a}}{PX_a} = VX_a$$

↓

$PX_a * (1 - TX_a) * QX_a = [PX_a * QX_a] - [TX_a * PX_a * QX_a]$

$$TX_a = \frac{VTX_a}{VX_a} = \frac{TX_a * PX_a * QX_a}{PX_a * QX_a}$$

PVADEF(a)..  $(PX(a) * (1 - TX(a)) * QX(a))$   
 $= E = [(PVA(a) * QVA(a)) + (PINT(a) * QINT(a))]$  ;

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|             | aveh      |
|-------------|-----------|
| cagric      | 456.52    |
| cmims       | 448.13    |
| ctext       | 4,891.60  |
| cpetchem    | 6,808.64  |
| cmprod      | 9,974.69  |
| cmach       | 1,278.31  |
| cveh        | 39,709.59 |
| comanu      | 4,464.41  |
| cutil       | 91.94     |
| ctrad       | 124.07    |
| cserv       | 1,276.97  |
| fcap_fix    | 4,924.45  |
| fcap_flex   | 986.44    |
| fafunsk     | 934.43    |
| fafskl      | 386.89    |
| fcaunsk     | 644.87    |
| fcaskl      | 603.26    |
| fwhunsk     | 707.49    |
| fwhskl      | 1,907.06  |
| indtax      | 493.97    |
| tffcap_fix  | -244.85   |
| tffcap_flex | -270.60   |
| tffland     | 0.00      |
| tffafunsk   | -515.45   |
| tffafskl    | -386.59   |
| tffcaunsk   | -200.00   |
| tffcaskl    | -100.00   |
| tffwhunsk   | -530.90   |
| tffwhskl    | -715.45   |
| total       | 78,149.91 |

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## Primary Factor Prices

$$\sum_f VFD_{f,a} = \sum_f WFA_{f,a} * FD_{f,a} \quad WFA_{f,a} = \frac{VFD_{f,a}}{FD_{f,a}}$$

$$WF_f = \frac{\sum_a SAM_{f,a}}{FS_f} \quad WFDIST_{f,a} = \frac{SAM_{f,a}}{FD_{f,a} / WF_f}$$

$$WFA_f = WF_f * WFDIST_{f,a} = \left( \frac{\sum_a SAM_{f,a}}{FS_f} \right) * \left( \frac{SAM_{f,a}}{FD_{f,a} / WF_f} \right)$$

WF0 (f) \$ (FS0 (f)) = SUM(a, SAM(f, a)) / FS0 (f) ;

WFDIST0 (f, a) \$ FD0 (f, a) = (SAM(f, a) / FD0 (f, a)) / WF0 (f) ;

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|           | aveh     |
|-----------|----------|
| fcap_fix  | 4,924.45 |
| fcap_flex | 986.44   |
| fafunsk   | 934.43   |
| fafskl    | 386.89   |
| fcaunsk   | 644.87   |
| fcaskl    | 603.26   |
| fwhunsk   | 707.49   |
| fwhskl    | 1,907.06 |

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## *‘Unnatural’ Factor Prices*

$$\begin{aligned} VFD_{fag,a} &= \sum_{ff \$map\_fagg\_ff(fag, ff, a)} VFD_{ff,a} \\ &= \sum_a WF_{fag} * FD_{fag,a} \\ &= WF_{fag} * WFDIST_{fag,a} * FD_{fag,a} \end{aligned}$$

|           | aveh     |
|-----------|----------|
| fcap_fix  | 4,924.45 |
| fcap_flex | 986.44   |
| fafunsk   | 934.43   |
| fafskl    | 386.89   |
| fcaunsk   | 644.87   |
| fcaskl    | 603.26   |
| fwhunsk   | 707.49   |
| fwhskl    | 1,907.06 |

$$\mathcal{V}_{\text{FD0}}(f, a) = \{ \text{SAM}(f, a) + \text{SUM}[\text{tff}\$map \ f \ \text{tff}(f, \text{tff}), \text{SAM}(\text{tff}, a)] \} ;$$

$$V_{FD0}(fag, a) = \text{SUM}[ff\$map \ fagg \ ff(fag, ff, a), V_{FD0}(ff, a)] ;$$

$$\text{FD0}(\text{fag}, a) = V \text{ FD0}(\text{fag}, a) \quad ;$$

$$FS0(fag) = SUM(a, FD0(fag, a)) ;$$

$$WF0(fag) \$ (FS0(fag)) = \text{SUM}(a, V \text{ FD0}(fag, a)) / \text{SUM}(a, \text{FD0}(fag, a));$$

$$\text{WFDIST0}(\text{fag}, a) \$ \text{FD0}(\text{fag}, a) = \text{VFD0}(\text{fag}, a) / \text{FD0}(\text{fag}, a) / \text{WF0}(\text{fag});$$



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## Equilibrating Variables



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## *Equilibrating Variables*

- All accounts must clear: **required**
  - Mechanisms for clearing accounts
  - Equilibrating variables
- Commodity & Activity accounts
  - Flexible prices
- Factor accounts
  - Institutional shares of disposable factor income
- Institutional accounts & Rest of the World
  - Multiple mechanisms
    - Macroeconomic closure mechanisms
  - Multiple equilibrating variables
    - Macroeconomic closure variables

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## *Factor Accounts*

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SAM: Factors

| RSA      | aagric   | amins    | afood    | atext   | apetchem | amprod   | amach   | aveh    | aomanu   | autil    | acns    | atrad    | aserv     | fcap_fix  | fafskl   | row      |
|----------|----------|----------|----------|---------|----------|----------|---------|---------|----------|----------|---------|----------|-----------|-----------|----------|----------|
| fcap_fix | 15,016.2 | 32,480.5 | 10,614.1 | 1,952.3 | 17,389.8 | 18,270.5 | 1,714.2 | 5,674.5 | 11,416.9 | 16,355.3 | 7,377.8 | 72,107.2 | 116,333.0 |           |          | 13,905.1 |
| fafskl   | 806.3    | 5,998.1  | 1,194.6  | 443.0   | 936.2    | 1,039.6  | 289.9   | 386.9   | 1,322.4  | 1,214.9  | 1,057.7 | 14,670.0 | 76,370.2  |           |          | 388.3    |
| hafflow  |          |          |          |         |          |          |         |         |          |          |         |          |           | 5,814.7   | 5,713.0  | 27.4     |
| haffmed  |          |          |          |         |          |          |         |         |          |          |         |          |           | 2,944.8   | 3,976.5  | 15.6     |
| haffhigh |          |          |          |         |          |          |         |         |          |          |         |          |           | 2,151.7   | 18,925.6 | 9.7      |
| hafmlow  |          |          |          |         |          |          |         |         |          |          |         |          |           | 8,406.4   | 13,277.8 | -14.7    |
| hafmmed  |          |          |          |         |          |          |         |         |          |          |         |          |           | 7,986.5   | 12,211.5 | -10.3    |
| hafmhigh |          |          |          |         |          |          |         |         |          |          |         |          |           | 9,456.7   | 51,127.8 | 11.9     |
| hcalow   |          |          |          |         |          |          |         |         |          |          |         |          |           | 1,381.9   | 79.1     | 6.9      |
| hcahigh  |          |          |          |         |          |          |         |         |          |          |         |          |           | 5,146.1   | 103.2    | 5.8      |
| hwhlow   |          |          |          |         |          |          |         |         |          |          |         |          |           | 3,850.8   | 0.0      | 13.2     |
| hwhhigh  |          |          |          |         |          |          |         |         |          |          |         |          |           | 28,897.1  | 0.0      | 66.3     |
| ent      |          |          |          |         |          |          |         |         |          |          |         |          |           | 128,852.0 | 0.0      | -80.0    |
| i_s      |          |          |          |         |          |          |         |         |          |          |         |          |           | 103,689.0 | 0.0      | 2,368.6  |
| row      |          |          |          |         |          |          |         |         |          |          |         |          |           | 32,030.0  | 703.7    |          |

Accounting identities hold

1. All factor incomes go to institutions & depreciation

2. What behaviour determines depreciation?

- Assumption – fixed share of factor income

3. Disposable factor income by shares of factor ownership

- Sums of shares of factor ownership equal ONE

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Factor Account Clearing

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* ##### FACTOR BLOCK

YFEQ(f) ..          YF(f) =E= SUM(a,WF(f)*WFDIST(f,a)*FD(f,a))
                        + (factwor(f)*ER) ;

YFDISPEQ(f) .. YFDISP(f) =E= (YF(f) * (1-deprec(f)))*(1-TYF(f)) ;

YFINSEQ(f) ..      YFINS(f) =E= YFDISP(f) ;

FSISHEQ(insw,f)$SUM(inswp,fsia(inswp,f)) ..
    FSISH(insw,f) =E= FSI(insw,f)/SUM(inswp,FSI(inswp,f)) ;

FSISH.FX(insw,f)$ (NOT FSISH0(insw,f)) = 0.0 ;

INSVAEQ(insw,f) ..   INSVA(insw,f) =E= FSISH(insw,f) * YFINS(f) ;

INSVA.FX(insw,f)$ (NOT INSVA0(insw,f)) = 0.0 ;
```

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Institutional Accounts

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SAM: Household

| RSA      | fcap_fix  | fcap_flex | filand  | fafunsk  | fafskl    | fcaunsk  | haffmed  | Other HH | govt      | ent       | row       |
|----------|-----------|-----------|---------|----------|-----------|----------|----------|----------|-----------|-----------|-----------|
| cagric   |           |           |         |          |           |          | 1,802.0  |          |           |           |           |
| cmns     |           |           |         |          |           |          | 44.1     |          |           |           |           |
| cfood    |           |           |         |          |           |          | 5,490.0  |          |           |           |           |
| ctext    |           |           |         |          |           |          | 2,110.6  |          |           |           |           |
| cpetchem |           |           |         |          |           |          | 1,640.4  |          |           |           |           |
| cmprod   |           |           |         |          |           |          | 102.3    |          |           |           |           |
| cmach    |           |           |         |          |           |          | 238.8    |          |           |           |           |
| cveh     |           |           |         |          |           |          | 72.6     |          |           |           |           |
| comanu   |           |           |         |          |           |          | 1,142.6  |          |           |           |           |
| cutil    |           |           |         |          |           |          | 692.0    |          |           |           |           |
| ccns     |           |           |         |          |           |          | 51.1     |          |           |           |           |
| ctrad    |           |           |         |          |           |          | 1,884.0  |          |           |           |           |
| cserv    |           |           |         |          |           |          | 4,359.7  |          |           |           |           |
| haffmed  | 2,944.8   | 519.7     | 91.2    | 6,807.6  | 3,976.5   | 12.9     | 0.0      | 3,772.0  | 1,528.9   | 1,243.9   | 15.6      |
| Other HH |           |           |         |          |           |          | 323.061  |          |           |           |           |
| dirtax   |           |           |         |          |           |          | 902.4    |          |           | 33,074.6  |           |
| i_s      |           |           |         |          |           |          | 57.5     |          | -20,286.4 | 40,158.6  | 2,368.6   |
| total    | 340,607.0 | 44,589.2  | 3,456.1 | 95,151.9 | 106,118.0 | 27,919.3 | 20,913.0 |          | 214,103.0 | 184,262.0 | 268,676.0 |

We will need:

1. Income tax rate – variable or fixed

2. Savings rate – variable or fixed

3. Determinants of demand – utility function

4. Method to ensure the account clears – complete demand system

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**Household Account Clearing**

\* ## Household Income

$$\text{YHEQ}(h) \dots \text{YH}(h) = \text{E} = \text{SUM}(f, \text{INSVA}(h, f)) + \text{SUM}(hp, \text{HOHO}(h, hp)) + \text{SUM}(e, \text{HOENT}(h, e)) + (\text{HGADJ} * \text{hogovconst}(h) * \text{CPI}) + (\text{howor}(h) * \text{ER}) ;$$

\* Household Expenditure

$$\text{HOHOEQ}(h, hp) \dots \text{HOHO}(h, hp) = \text{E} = \text{hohosh}(h, hp) * \{ [\text{YH}(h) * (1 - \text{TYH}(h))] * [1 - \text{SHH}(h)] \} ;$$

$$\text{HEXPEQ}(h) \dots \text{HEXP}(h) = \text{E} = \{ [\text{YH}(h) * (1 - \text{TYH}(h))] * [1 - \text{SHH}(h)] \} - \text{SUM}(hp, \text{HOHO}(hp, h)) ;$$

$$\text{QCDEQ}(c, h) \dots \text{PQCD}(c) * \text{QCD}(c, h) = \text{E} = (\text{PQCD}(c) * \text{qcdconst}(c, h)) + \text{beta}(c, h) * (\text{HEXP}(h) - \text{SUM}(cp, \text{PQCD}(cp) * \text{qcdconst}(cp, h))) ;$$

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**SAM: Government**

| RSA      | imptax  | saltax  | ssaltax | vattax   | ectax    | indtax  | FTAX      | dirtax    | govt      | ent       | row       |
|----------|---------|---------|---------|----------|----------|---------|-----------|-----------|-----------|-----------|-----------|
| cserv    |         |         |         |          |          |         |           |           | 163,047.0 |           | 17,748.4  |
| hafflow  |         |         |         |          |          |         |           |           | 7,599.3   | 4,037.1   | 27.4      |
| haffmed  |         |         |         |          |          |         |           |           | 1,528.9   | 1,243.9   | 15.6      |
| haffhigh |         |         |         |          |          |         |           |           | 939.7     | 3,428.0   | 9.7       |
| hafmlow  |         |         |         |          |          |         |           |           | 6,278.5   | 5,111.3   | -14.7     |
| hafmmed  |         |         |         |          |          |         |           |           | 1,509.3   | 6,886.8   | -10.3     |
| hafmhigh |         |         |         |          |          |         |           |           | 1,619.7   | 7,396.0   | 11.9      |
| hcalow   |         |         |         |          |          |         |           |           | 2,493.5   | 4,232.1   | 6.9       |
| hcahigh  |         |         |         |          |          |         |           |           | 959.9     | 6,747.6   | 5.8       |
| hwhlow   |         |         |         |          |          |         |           |           | 1,305.9   | 12,099.8  | 13.2      |
| hwhhigh  |         |         |         |          |          |         |           |           | 3,760.6   | 59,846.3  | 66.3      |
| govt     | 8,311.2 | 5,264.1 | -385.2  | 78,928.2 | 24,277.0 | 3,058.6 | -18,351.4 | 119,510.0 |           |           | -6,509.4  |
| ent      |         |         |         |          |          |         |           |           | 43,347.6  |           | -80.0     |
| i s      |         |         |         |          |          |         |           |           | -20,286.4 | 40,158.6  | 2,368.6   |
| total    | 8,311.2 | 5,264.1 | -385.2  | 78,928.2 | 24,277.0 | 3,058.6 | -4,491.8  | 119,510.0 | 214,103.0 | 184,262.0 | 268,676.0 |

Accounting identities hold

We will need:

1. Savings – fixed or flexible
2. Determinants of demand – ‘demand function’
3. Method to ensure the account clears
  - Tax rates
  - Savings

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## Government Account Clearing

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* ## Government Income

YGEQ..      YG =E= MTAX + ETAX + EXTAX + STAX + SSTAX + VTAX
              + FTAX + ITAX + FYTAX + DTAX
              + SUM(e,GOVENT(e)) + (govwor*ER) ;

* #### Government Expenditure Block

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

EGEQ..      EG =E= SUM(c,QGD(c)*PQD(c))
              + SUM(h,hogovconst(h)*CPI*HGADJ)
              + SUM(e,EGADJ*entgovconst(e)*CPI) ;

VGDEQ..      VGD =E= SUM(c,QGD(c)*PQD(c)) ;

* ### Institutional account (market) clearing

GOVEQUIL..  KAPGOV =E= YG - EG ;
  
```

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## SAM: Savings & Investment

| RSA      | FACTORS   | HHOLD    | govt      | ent       | i_s       | i_fix     | i_flex   | row       |
|----------|-----------|----------|-----------|-----------|-----------|-----------|----------|-----------|
| cagric   |           |          |           |           |           | 0.0       | 1,641.4  |           |
| cfood    |           |          |           |           |           | 0.0       | 951.1    |           |
| ctext    |           |          |           |           |           | 0.0       | 309.5    |           |
| cpetchem |           |          |           |           |           | 92.3      | 1,408.1  |           |
| cmprod   |           |          |           |           |           | 2,733.6   | 1,024.7  |           |
| cmach    |           |          |           |           |           | 30,880.3  | 4,685.6  |           |
| cveh     |           |          |           |           |           | 5,410.5   | 15,722.9 |           |
| comanu   |           |          |           |           |           | 10,553.8  | 12,481.5 |           |
| ccns     |           |          |           |           |           | 55,464.4  | 0.0      |           |
| ctrad    |           |          |           |           |           | 0.0       | 0.0      |           |
| cserv    |           |          |           |           |           | 2,869.2   | 2,469.2  |           |
| i_s      | 119,527.8 | 6,929.1  | -20,286.4 | 40,158.6  |           |           |          | 2,368.6   |
| i_fix    |           |          |           |           | 108,004.0 |           |          |           |
| i_flex   |           |          |           |           | 40,693.8  |           |          |           |
| total    | 340,607.0 | 47,754.6 | 214,103.0 | 184,262.0 | 148,698.0 | 108,004.0 | 40,693.8 | 268,676.0 |

Accounting identities hold

**We will need:**

1. Determinants of demand – production functions for capital goods
2. Method to ensure the account clears
  - Savings
  - Investment

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### Savings & Investment Account

```
* ## Savings Block

HHSAVEQ(h).. HHSAV(h) =E= [YH(h) * (1 - TYH(h))] * SHH(h) ;

ENTSAVEQ(e).. ENTSAV(e) =E= [YE(e) * (1 - TYE(e))] * SEN(e) ;

TOTSAVEQ.. TOTSAV =E= SUM[f,(deprec(f)*YF(f))] + SUM(h,HHSAV(h))
                    + SUM(e,ENTSAV(e)) + KAPGOV + (CAPWOR*ER) ;

* ## Investment Block

QINVDEQ(c,i)$in(i).. QINVD(c,i) =E= (QINV(i)*ioqinvd(c,i)) ;

QINVEQ(i)$in(i)..      QINV(i) =E= qinvb(i) * IADJ ;

INVSH_IEQ(i)$in(i).. INVSH_I(i) =E= SUM(c,PQD(c)*QINVD(c,i))
                                   /SUM((cp,ip),PQD(cp)*QINVD(cp,ip)) ;

INVESTEQ..      INVEST =E= SUM(c,PQD(c)
                               *(SUM[in,QINVD(c,in)] + dstocconst(c))) ;

WALRASEQ..      TOTSAV =E= INVEST + WALRAS ;
```

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### SAM: Rest of World

| RSA         | COMMODITIES | FACTORS | HHOLD | govt | ent | row     |
|-------------|-------------|---------|-------|------|-----|---------|
| COMMODITIES |             |         |       |      |     | 255,375 |
| FACTORS     |             |         |       |      |     | 17,390  |
| HHOLD       |             |         |       |      |     | 132     |
| govt        |             |         |       |      |     | -6,509  |
| ent         |             |         |       |      |     | -80     |
| i_s         |             |         |       |      |     | 2,369   |
| row         | 228,959     | 39,717  |       |      |     |         |

Accounting identities hold

We will need:

- Determinants of import demand – relative prices
- Determinants of export supply – relative prices
- Method to ensure the account clears
  - Trade balance
  - Exchange rate

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Rest of the World Account

CAEQUIL..

CAPWOR

=E=

SUM(cm,PWM(cm)\*QM(cm))

+ (SUM(f,YFWOR(f))/ER)

- SUM(ce,PWE(ce)\*QE(ce))

- SUM(h,howor(h))

- SUM(e,entwor(e))

- govwor

- SUM(f, factwor(f)) ;

TOTSAVEQ..

TOTSAV

=E=

SUM[f,(deprec(f)\*YF(f))]

+ SUM(h,HHSAV(h))

+ SUM(e,ENTSAV(e))

+ KAPGOV

+ (CAPWOR \* ER) ;

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STAGE

STAGE\_t: Price & Accounting Identities:  
Part 2

The End

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