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ANARRES

ANARRES_t: Market Clearing Options

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Outline

- Equation and Variable Counting
- Market Clearing
- Factor Market Clearing Options
  - Full Factor Mobility and Employment
    - '(new) classical' assumption
  - Factor Immobility
    - Short run market clearing
  - Surplus labour (aka unemployment) Closures
    - What is surplus labour?
  - Activity Inspired Restrictions on Factor Markets
    - 'Realism'!!
- Technology Closures

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Market Clearing

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Market Clearing

- Commodity markets
  - Commodity supply = commodity demand
- Factor markets
  - Factor supply = factor demand
- *Government account*
  - *Internal 'balance'*
- *Trade accounts*
  - *Trade (external) 'balance'*
- *Savings-investment account*
  - *'Walras' law*

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Market Clearing

```
* ## Domestic Commodity Accounts

QEQUIL(c,r)$((cd(c,r) or cm(c,r)) AND rgn(r))..
   QQ(c,r) =E= QINTD(c,r) +
               SUM(h,QCD(c,h,r))+QGD(c,r)+QINVD(c,r) ;

* ## Commodity Trade Accounts

 KAPREQUIL(w,r)$wgn(w)..
    KAPREG(w,r) =E= SUM(c, PWMFOB(w,c,r)*QMR(w,c,r))
                  - SUM(c, PWE(c,w,r)*QER(c,w,r)) ;

 KAPREQUIL2(w,r)$(NOT wgn(w))..
    KAPREG(w,r) =E= SUM((c,wp),PT(c,r)*QT(wp,c,r))
                  - SUM(c,PWE(c,w,r)*QER(c,w,r)) ;

 KAPEQUIL(r)..
      KAPWOR(r) =E= SUM(w, KAPREG(w,r)) ;
```


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Market Clearing

```
* ## Globe and Margin Trade Accounts

COMTRADE(c,r)$(ct2(c) and not rgn(r))..
  SUM(w, PWM(w,c,r) * QMR(w,c,r))
       =E= SUM(w, PWE(c,w,r) * QER(c,w,r))
           + GLOBESLACK ;


GLOBEQUIL(c,r)$(ct2(c) AND rgn(r))..
 SUM(w, QT(w,c,r))
   =E= SUM(wp$map_w_r(wp,r),QER(c,wp,"glo")) ;
```


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Factor Market Clearing

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Factor Market Clearing

- Standard Options in ANARRES_t
  - Long-run
    - All factors fully employed and fully mobile
  - Short-run
    - Some factors fixed in activities
  - Surplus labour
  - Activity specific clearing
- Alternative model specifications
  - Imperfect factor mobility
  - Upward sloping labour-supply curves
  - Activities outside the SNA production boundary
    - Labour-Leisure trade-offs
    - Social reproduction

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SAMs & Macroeconomy - Counting

$$t_{jk} = t_{jk}(y; p, f, \lambda) \longrightarrow \mathbf{VARS} = [y] + [p] + [f] + [\lambda]$$

$$p = p(y; p, f, \lambda)$$

$$y = n + x$$

$$\mathbf{EQNS} = [y] + [p] - 1$$

$$\text{Degrees of Freedom} = [f] + \lambda + 1$$

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Factor Market Clearing Options

```
*# Base Factor Market Closure

FS.FX(f,r)         = FS0(f,r) ;
WFDIST.FX(f,a,r)   = WFDIST0(f,a,r) ;
WF.LO(f,r)         = -inf ;
WF.UP(f,r)         = +inf ;
FD.LO(f,a,r)       = -inf ;
FD.UP(f,a,r)       = +inf ;
```

Indexed on ALL
- f(actors)
- a(ctivities)
- r(egions)

The term 'Base Factor Market Clearing' does not imply any presumption that an assumption that 'all factors are mobile and fully employed' is either correct or appropriate

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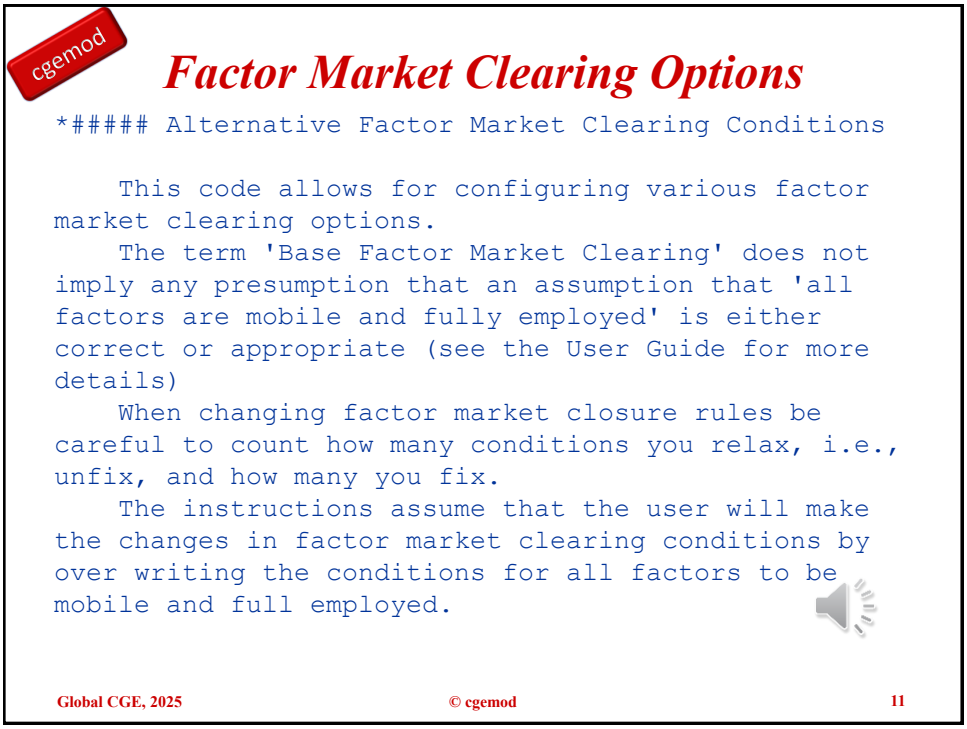
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Factor Market Clearing Options
*##### Alternative Factor Market Clearing Conditions
This code allows for configuring various factor market clearing options.
The term 'Base Factor Market Clearing' does not imply any presumption that an assumption that 'all factors are mobile and fully employed' is either correct or appropriate (see the User Guide for more details)
When changing factor market closure rules be careful to count how many conditions you relax, i.e., unfix, and how many you fix.
The instructions assume that the user will make the changes in factor market clearing conditions by over writing the conditions for all factors to be mobile and full employed.
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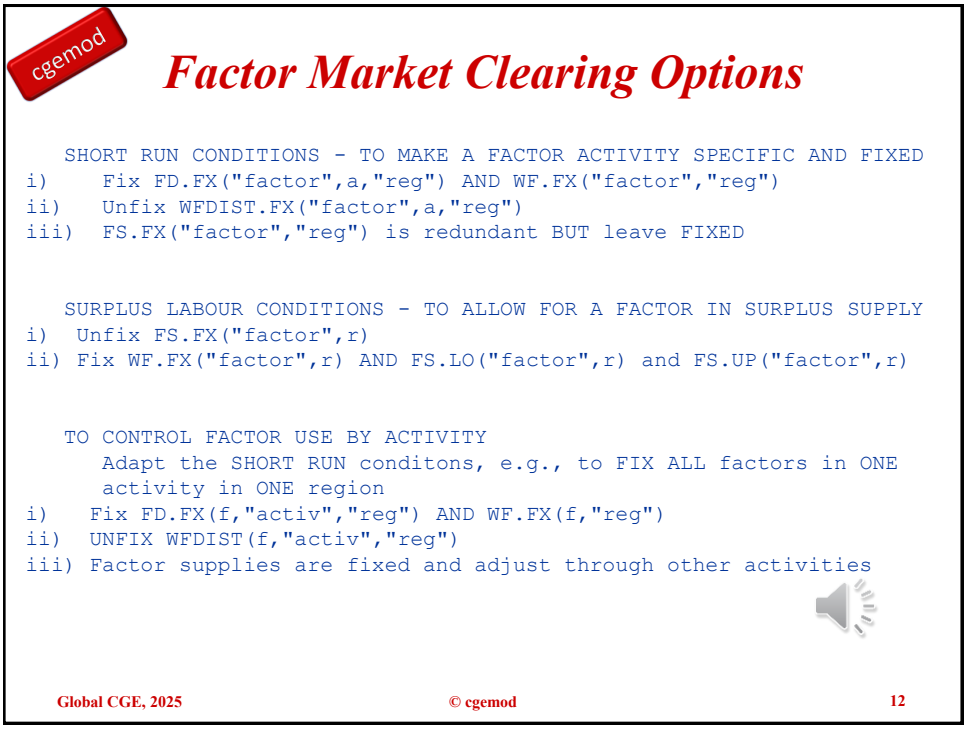
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Factor Market Clearing Options
SHORT RUN CONDITIONS - TO MAKE A FACTOR ACTIVITY SPECIFIC AND FIXED
i) Fix FD.FX("factor",a,"reg") AND WF.FX("factor","reg")
ii) Unfix WFDIST.FX("factor",a,"reg")
iii) FS.FX("factor","reg") is redundant BUT leave FIXED
SURPLUS LABOUR CONDITIONS - TO ALLOW FOR A FACTOR IN SURPLUS SUPPLY
i) Unfix FS.FX("factor",r)
ii) Fix WF.FX("factor",r) AND FS.LO("factor",r) and FS.UP("factor",r)
TO CONTROL FACTOR USE BY ACTIVITY
Adapt the SHORT RUN conditons, e.g., to FIX ALL factors in ONE activity in ONE region
i) Fix FD.FX(f,"activ","reg") AND WF.FX(f,"reg")
ii) UNFIX WFDIST(f,"activ","reg")
iii) Factor supplies are fixed and adjust through other activities
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Full Factor Mobility & Employment

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Full Factor Mobility and Employment

Factor market equilibrium, in theory

$$FS_{f,r} \geq \sum_{a} FD_{f,a,r}$$

In ANARRES_t

$$FS_{f,r} = \sum_{a} FD_{f,a,r}$$

```
FMEQUIL(f,r)$rgn(r)..
     FS(f,r)  =E= SUM(a,FD(f,a,r)) ;

FD.FX(f,a,r)$(NOT SAMG(f,a,r))     = 0.0 ;
```

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Full Factor Mobility and Employment

In theory, the payment for a factor = value of the marginal product of that factor

In ANARRES_t, the cost of factor *f* to activity *a* is:

```
WF(f,r)*WFDIST(f,a,r)*(1 + TF(f,a,r))

WF.FX(f,r)$(NOT WF0(f,r)) = 0.0 ;
```

Where

```
WF(f,r)       = economy-wide average price of factor f in
WFDIST(f,a,r) = activity specific factor proportionality pay't
TF(f,a,r)     = factor use tax by activity
```


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Full Factor Mobility and Employment

$FS_{f,r} = \overline{FS}_{f,r}$	`FS.FX(f,r) = FS0(f,r) ;`
$WFDIST_{f,a,r} = \overline{WFDIST}_{f,a,r}$	`WFDIST.FX(f,a,r)= WFDIST0(f,a,r);`
Min $WF_{f,r} = -$ infinity	`WF.LO(f,r) = -inf ;`
Max $WF_{f,r} = +$ infinity	`WF.UP(f,r) = +inf ;`
Min $FD_{f,a,r} = -$ infinity	`FD.LO(f,a,r) = -inf ;`
Max $FD_{f,a,r} = +$ infinity	`FD.UP(f,a,r) = +inf ;`

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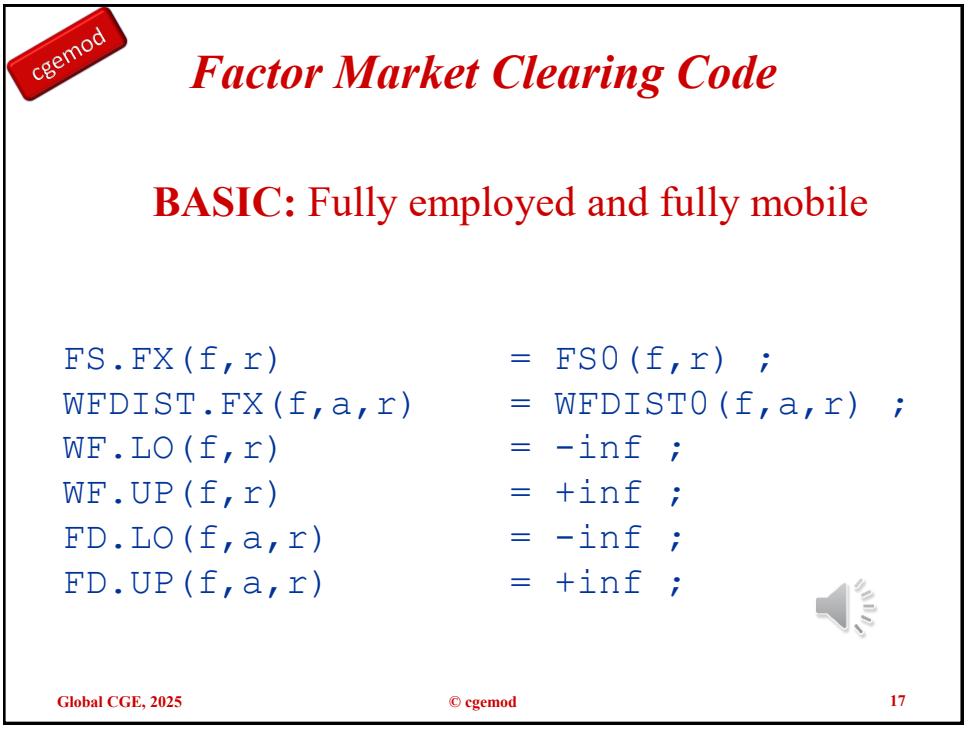
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Factor Market Clearing Code
BASIC: Fully employed and fully mobile
FS.FX(f,r) = FS0(f,r) ;
WFDIST.FX(f,a,r) = WFDIST0(f,a,r) ;
WF.LO(f,r) = -inf ;
WF.UP(f,r) = +inf ;
FD.LO(f,a,r) = -inf ;
FD.UP(f,a,r) = +inf ;
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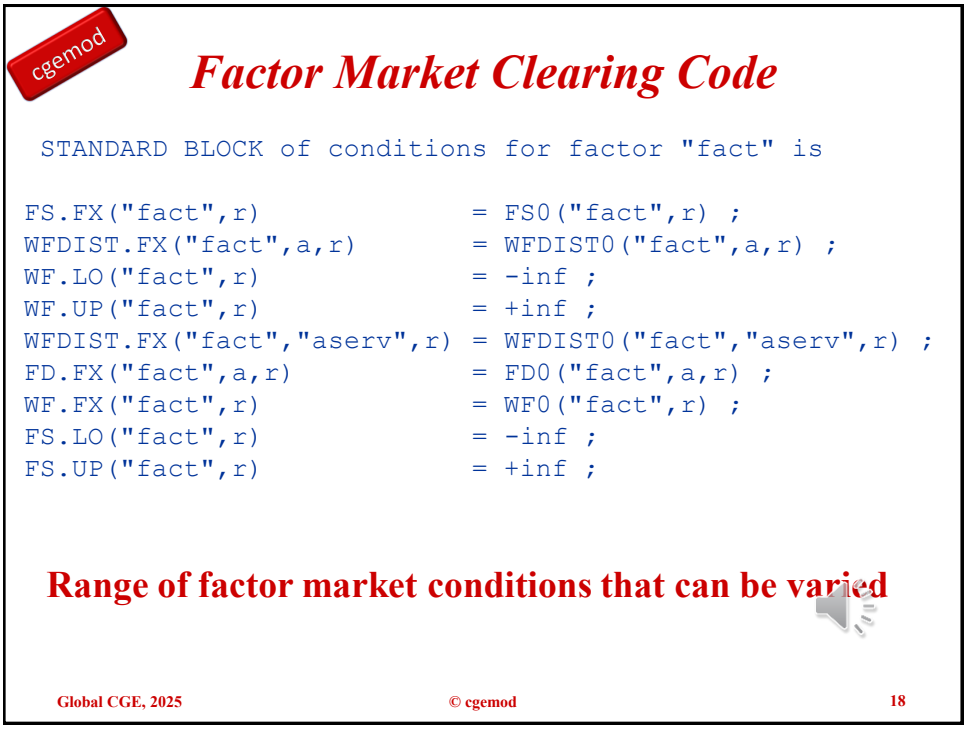
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Factor Market Clearing Code
STANDARD BLOCK of conditions for factor "fact" is
FS.FX("fact",r) = FS0("fact",r) ;
WFDIST.FX("fact",a,r) = WFDIST0("fact",a,r) ;
WF.LO("fact",r) = -inf ;
WF.UP("fact",r) = +inf ;
WFDIST.FX("fact","aserv",r) = WFDIST0("fact","aserv",r) ;
FD.FX("fact",a,r) = FD0("fact",a,r) ;
WF.FX("fact",r) = WF0("fact",r) ;
FS.LO("fact",r) = -inf ;
FS.UP("fact",r) = +inf ;
Range of factor market conditions that can be varied
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Factor Immobility – Short Run

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Factor Immobility – Short Run

$$FD_{fact,a,r} = \overline{FD}_{fact,a,r}$$

Fix the factor demand by activity, for all activities in r

$$WFDIST.LO_{fact,a,r} = -\inf$$
$$WFDIST.UP_{fact,a,r} = +\inf$$

Allow factor returns to vary by activity in *r*

$$FS_{fact,r} = \overline{FS}_{fact,r}$$

Factor supply constraint in *r* (now redundant)

$$WF_{fact,r} = \overline{WF}_{fact,r}$$

Drop the equilibrating variable in *r*

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Factor Immobility – Short Run

```
* 1. Short run - activity specific capital all a AND r
 FD.FX(k,a,rgn)          = FD0(k,a,rgn) ;
 WFDIST.LO(k,a,rgn)      = -inf ;
 WFDIST.UP(k,a,rgn)      = +inf ;

* Fix AVERAGE wage (WF) so all adjustment via WFDIST
 WF.FX(k,rgn)            = WF0(k,rgn) ;

* factor market clearing for k is redundant (so no harm)
 FS.FX(k,rgn)            = FS0(k,rgn) ;
```

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Surplus Labour

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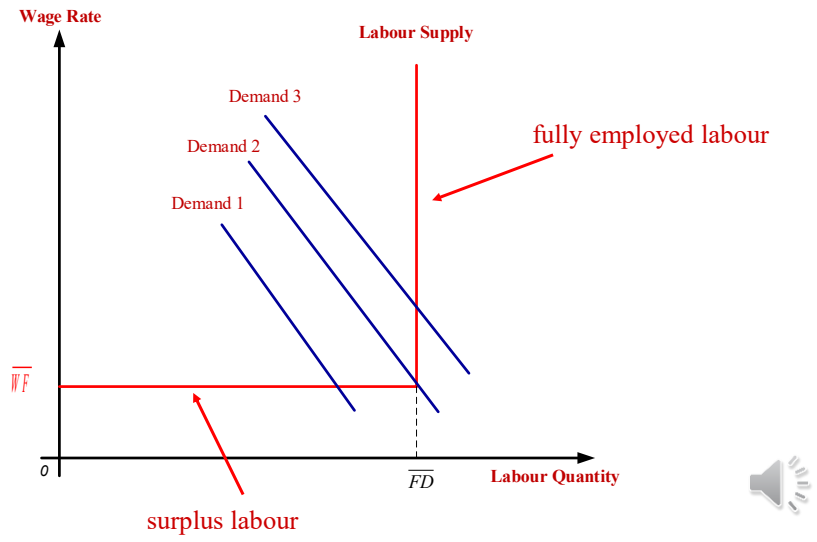
Surplus Labour



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Surplus Labour

The term 'unemployment' not preferred

$WF_{fact,r} = \overline{WF_{fact,r}}$ — **Fix the factor wage rate in *r***

$\text{Min } FS_{fact,r} = -\text{infinity}$
$\text{Max } FS_{fact,r} = +\text{infinity}$ — **Unfix the factor supply bounds in *r***

$WFDIST_{fact,a,r} = \overline{WFDIST_{fact,a,r}}$ — **Leave the sectoral proportion for factor price in r Fixed**

$\text{Min } FD_{fact,a,r} = -\text{ infinity}$
$\text{Max } FD_{fact,a,r} = +\text{ infinity}$ — **Leave the factor demand by activity bounds in *r* flexible**

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Surplus Labour

```
* * ## Surplus labour factor market closure examples
* 1. Surplus labour closure - ONE factor and ALL regions
 WF.FX("fUskil",rgn)        = WF0("fUskil",rgn) ;
 FS.LO("fUskil",rgn)        = -inf ;
 FS.UP("fUskil",rgn)        = +inf ;

*2. Surplus labour closure - SEVERAL factors & ONE region
$ontext
 WF.FX(l,"afr")             = WF0(l,"afr") ;
 FS.LO(l,"afr")             = -inf ;
 FS.UP(l,"afr")             = +inf ;
$offtext
```


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Other Factor Market Clearing Options

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Activity Inspired Restrictions

- Assume that the mining activity ("anres") cannot expand production in the 'solution period'
  - New mines typically takes a long time to establish
  - There may be an optimal extraction rate
  - Exports may be dominated by the output of the activity and it may be small
    - Diamonds in Botswana; Oil in Saudi Arabia
- Knowledge of what makes sense is important

DO NOT USE TO PROVE YOUR PRICK ASSUMPTIONS

Activity Inspired Restrictions

```
* 1. Fixed factor demand for Mining in Africa
FD.FX(f,"anres","afr")  = FD0(f,"anres","afr") ;
WFDIST.LO(f,"anres","afr") = -inf ;
WFDIST.UP(f,"anres","afr") = +inf ;
```

Is this enough?

NO

CES at top-level allows extra inputs through increased use of intermediates

Set top-level to Leontief

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Activity Inspired Restrictions

Resolving an oddity in the course simulations

- Land is used by BOTH 'agriculture' (aagr) and 'mining' (anres).
- Fully mobile and fully employed assumes that farmland and mines are substitutes.
- It therefore is sensible to fix the supply of 'mines' (use short run clearing on land), which will fixed the quantity of farmland

```
FD.FX(lnd,"anres","reg")      = FD0(lnd,"anres","reg") ;
WFDIST.LO(lnd,"anres","reg")  = -inf ;
WFDIST.UP(lnd,"anres","reg")  = +inf ;
```

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Technology Closures

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Technology in CGE Models

- Time
  - Comparative statics - usually fixed
  - Recursive dynamics – usually exogenous
- Types
  - Hicks neutral
  - Harrod neutral
  - Solow neutral
  - Intermediate input changes
- Exogenous changes !!!!!
- Endogenous changes
  - Behaviourally driven
  - Target variables

Technology change is NOT costless
'manna from heaven'

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Technology Closure

```
*## TECHNOLOGY CLOSURES
$ontext
 NB SHIFT factors fixed indirectly through the adjustment variables
 Technology for CES production functions at Level 1 production nest
 To FIX ADX fix BOTH ADXADJ and DADX
 NB DADX needs to be used in conjunction with adx01
$offtext

 ADXADJ.FX(r)          = ADXADJ0(r) ;
 DADX.FX(r)            = DADX0(r) ;

$ontext
 Technology for CES aggregation functions at Level 2 production nest
 To FIX ADVA fix BOTH ADVAADJ and DADVA
 NB DADVA needs to be used in conjunction with adva01
$offtext


 ADVAADJ.FX(r)         = ADVAADJ0(r) ;
 DADVA.FX(r)           = DADVA0(r) ;
```


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Technology Closure

```
$ontext
   Technology for activity & region specific factor
Efficiency
   ADFDfADJ(f), ADFDaADJ(a) and ADFDrADJ(r) allow
adjustment of factor specific productivity by f and/or
a and/or r
   Fix all of ADFDfADJ(f), ADFDaADJ(a) and ADFDrADJ(r)
to fix ADFD(f,a,r)
$offtext

 ADFD.FX(f,a,r)        = ADFD0(f,a,r) ;

 ADFDfADJ.fX(f)         = ADFDfADJ0(f) ;
 ADFDaADJ.FX(a)         = ADFDaADJ0(a) ;
 ADFDrADJ.FX(r)         = ADFDrADJ0(r) ;
```

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ANARRES_t: Market Clearing Options

The End

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