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ANARRES

Tax and Efficiency Adjustments

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Outline

- Tax rate Adjustment
  - ALL tax rates defined as variables
  - ALL tax rates have a common adjustment mechanism
    - Multiplicative changes
    - Additive changes
- Efficiency changes
  - ALL efficiency factors defined as variables
  - ALL efficiency factors have a common adjustment mechanism
    - Multiplicative changes
    - Additive changes
- Hence, we have added a lot of variables – some without equations

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Why add so many variables?

- We can only shock parameters
- Additional variables allow us to
  - change multiple parameters with one target
    - e.g., change ALL tariffs for a target internal balance and/or identify optimal tax rates
  - simplify the coding of simulations
  - **BUT** it makes the code less transparent
- This method means that we have
  - endogenous 'variables' – flexed in the closure
  - exogenous 'variables' – fixed in the closure

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Tax Rate Adjustment

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Import Duties

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                      + {DTM(r)*tm01(w,c,r)} ;
```

- $tmb_{w,c,r}$ - vector of import duties in the base solution.
- $dabtm_{w,c,r}$ - vector of absolute changes in the vector of import duties taxes – initial values ZERO.
- $TMADJ_r$ - region specific variable whose initial value is ONE (parameter).
- DTM_r is a region specific variable whose initial value is ONE (parameter).
- $tm01_{w,c,r}$ - vector of zeros and non zeros – initial values ZERO.

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Import Duties - Multiplicative

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r) }
                      + {DTM(r)*tm01(w,c,r)} ;
```

- If *TMADJ* for one region is made a variable, then the solution value for *TMADJ* yields the optimum equiproportionate change in the import duty rates necessary to satisfy model constraints.

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Import Duties - Multiplicative

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                    + {DTM(r)*tm01(w,c,r) } ;
```

- If *TMADJ* for one region is made a variable, and any elements of *dabtm* are non zero, then the solution value for *TMADJ* yields the optimum equiproportionate change in the ***applied*** import duty rates, i.e., (*tmb* + *dabtm*).

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Import Duties – Fixed Additive

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                    + {DTM(r)*tm01(w,c,r) } ;
```

- If any element of *dabtm* is not zero, then an absolute change in the initial import duty rate for the relevant commodity and trade partner is imposed.

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Import Duties – Additive

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                      + {DTM(r)*tm01(w,c,r) } ;
```

- If *DTM* for one region is made a variable, and ALL elements of *tm*01 are 'ONE' then ALL the elements of *tmb* increase (additively) by an equal absolute amount determined by the solution value for *DTM*.

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Import Duties – Additive

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                      + {DTM(r)*tm01(w,c,r) } ;
```

- If *DTM* for one region is made a variable, AND at least **one** element of *tm*01 is 'ONE' then the subset of elements of *tmb* identified by *tm*01 are allowed to (additively) increase by an equal absolute amount determined by the solution value for *DTM* so as to satisfy the model.

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Import Duties – Additive

```
TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= {(tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r)}
                      + {DTM(r)*tm01(w,c,r) } ;
```

- If the change in the applied tax rates is to be other than equal then values of *tm*01 other than 'one' can be applied.
- Typically the values for *tm*01 will be bounded by ZERO and ONE.

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Model Variables & Equations

- Variables added to the model with equations
  - *T***(. .)
  - T**DEF(..)
- Variables added to the model w/o equations
  - *T**ADJ(. .)
  - *DT**(. .)
- Increases the number of variables that **must** be fixed

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Commodity Taxes

```
TEDEF(c,w,r)$cer(c,w,r)..
  TE(c,w,r) =E= ((teb(c,w,r) + dabte(c,w,r))* TEADJ(r))
                          + (DTE(r)*te01(c,w,r)) ;

TMDEF(w,c,r)$cmr(w,c,r)..
  TM(w,c,r) =E= ((tmb(w,c,r) + dabtm(w,c,r))* TMADJ(r))
                          + (DTM(r)*tm01(w,c,r)) ;

TSDEF(c,r)$((cd(c,r) OR cm(c,r)) AND rgn(r))..
    TS(c,r) =E= ((tsb(c,r) + dabts(c,r))* TSADJ(r))
                          + (DTS(r)*ts01(c,r)) ;

TVDEF(c,r)$((cd(c,r) OR cm(c,r)) AND rgn(r))..
    TV(c,r) =E= ((tvb(c,r) + dabtv(c,r))* TVADJ(r))
                          + (DTV(r)*tv01(c,r)) ;
```


Activity Taxes

```
TXDEF(a,r)$rgn(r)..
    TX(a,r) =E= ((txb(a,r) + dabtx(a,r))* TXADJ(r))
                          + (DTX(r)*tx01(a,r)) ;

TFDEF(f,a,r)$rgn(r)..
  TF(f,a,r) =E= ((tfb(f,a,r) + dabtf(f,a,r))* TFADJ(r))
                          + (DTF(r)*tf01(f,a,r)) ;
```

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Direct Taxes

```
TYFDEF(f,r)$rgn(r)..
 TYF(f,r) =E= ((tyfb(f,r) + dabtyf(f,r))* TYFADJ(r))
                          + (DTYF(r)*tyf01(f,r)) ;

TYHDEF(h,r)$rgn(r)..
 TYH(h,r) =E= ((tyhb(h,r) + dabtyh(h,r))* TYHADJ(r))
                          + (DTYH(r)*tyh01(h,r)) ;
```

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Efficiency factors

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Standard Format

```
ADXEQ(a,r)..
  ADX(a,r) =E= {(adxb(a,r) + dabadx(a,r)) * ADXADJ(r)}
                      + {DADX(r) * adx01(a,r)} ;
```

- $adxb_{a,r}$ - vector of efficiency parameters.
- $dabadx_{a,r}$ - vector of absolute changes in the vector of efficiency parameters – initial values ZERO.
- $ADXADJ_r$ - region specific variable whose initial value is ONE.
- $DADX_r$ is a region specific variable whose initial value is ZERO.
- $adx01_{a,r}$ - vector of zeros and non zeros – initial values ZERO.

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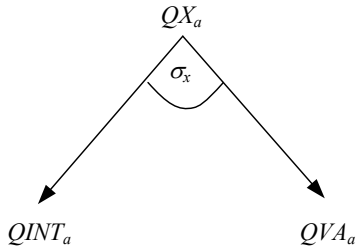
Production System – Sample Activity




```
QXPRODFN(a,r)$(aqx(a,r) AND rgn(r))..
  QX(a,r) =E= ADX(a,r)
              *(deltax(a,r) *QVA(a,r)**(-rhox(a,r))
              + (1-deltax(a,r))*QINT(a,r)
                **(-rhox(a,r)))**(-1/rhox(a,r)) ;
```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Top Level - Multiplicative

```
ADXEQ(a,r)..
  ADX(a,r) =E= {(adxb(a,r) + dabadx(a,r)) * ADXADJ(r)}
                       + {DADX(r) * adx01(a,r)} ;
```

- If *ADXADJ* is made a variable, then the solution value for *ADXADJ* yields the optimum equiproportionate change in the top level efficiency factors necessary to satisfy model constraints.
- If *ADXADJ* is made a variable, and any elements of *dabadx* are non zero, then the solution value for *ADXADJ* yields the optimum equiproportionate change in the ***applied*** efficiency factors, i.e., *adxb* + *dabadx*.

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Top Level - Additive

```
ADXEQ(a,r)..
  ADX(a,r) =E= {(adxb(a,r) + dabadx(a,r)) * ADXADJ(r)}
                       + {DADX(r) * adx01(a,r)} ;
```

- If any element of *dabadx* is not zero, then an absolute change in the initial efficiency factors for the relevant activities are imposed.
- If *DADX* for one region is made a variable, and ALL elements of *adx*01 are ONE then ALL the elements of *adxb* increase (additively) by an equal absolute amount determined by the solution value for *DADX*.
- If the change in the applied efficiency rates is to be other than equal then values of *adx*01 other than one can be applied.

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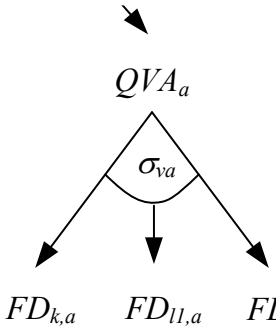
Value Added Production System




```
QVAPRODFN(a,r)$rgn(r)..
QVA(a,r)  =E= ADVA(a,r)
              *(SUM(f$deltava(f,a,r),deltava(f,a,r)
                *(ADFD(f,a,r)*FD(f,a,r))**(-rhova(a,r))))
                      **(-1/rhova(a,r))  ;
```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Value Added Production System

```
ADVAEQ(a,r)..
  ADVA(a,r)  =E= {(advab(a,r) + dabadva(a,r)) * ADVAADJ(r)}
                          + {DADVA(r) * adva01(a,r)} ;
```

- If *ADVAADJ* for one region is made a variable, then the solution value for *ADVAADJ* yields the optimum equiproportionate change in the Second Level efficiency factors necessary to satisfy model constraints.
- If *ADVAADJ* for one region is made a variable, and any elements of *dabadva* are non zero, then the solution value for *ADVAADJ* yields the optimum equiproportionate change in the ***applied*** efficiency factors, i.e., *advab* + *dabadva*.
- If any element of *dabadva* is not zero, then an absolute change in the initial efficiency factors for the relevant activities are imposed.
- If *DADVA* for one region is made a variable, and ALL elements of *adva*01 are ONE then ALL the elements of *advab* increase (additively) by an equal absolute amount determined by the solution value for *DADVA*.
- If *DADVA* for one region is made a variable, AND at least one element of *adva*01 is ONE then the subset of elements of *advab* identified by *adva*01 are allowed to (additively) increase by an equal absolute amount determined by the solution value for *DADVA* so as to satisfy the model.
- If the change in the applied efficiency rates is to be other than equal then values of *adva*01 other than one can be applied.

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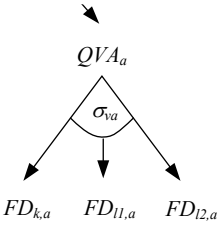
Value Added Production System




```
QVAPRODFN(a,r)$rgn(r)..
QVA(a,r) =E= ADVA(a,r)
             *(SUM(f$deltava(f,a,r),deltava(f,a,r)
               *(ADFD(f,a,r)*FD(f,a,r))**(-rhova(a,r))))
                 **(-1/rhova(a,r)) ;
```

Stock/flow relationship

No standard equation in the model

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The End

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