





STAGE_t: Tax and Efficiency Adjustments



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1

1





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 Tax Rate Adjusters?

- The **base** tax rates are parameters in this model
 - therefore, **base** tax rates cannot be target variables
 - but ‘optimal’ tax rates are policy objectives
- **Applied** tax rates are variables
- Models are square - variable & equation counts equate
 - multiple tax rates
 - single target variables
 - must maintain equation and variable counts
- Simplify simulations
 - tax rate adjusters exist **SOLELY** to aid simulations
- Adjusters are links between **base** and **applied** tax rates


3

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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 (c) . .

$$TM(c) =E= [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

- tmb_c - vector of import duties in the base solution.
- $dabtm_c$ - vector of absolute changes in the vector of import duties taxes – initial values ZERO.
- $TMADJ$ – specific variable whose initial value is ONE (parameter).
- DTM - specific variable whose initial value is ZERO (parameter).
- $tm01_c$ - vector of zeros and non zeros – initial values ZERO.

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Import Duties: Multiplicative

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

- If *TMADJ* 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: Fixed Additive

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

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

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Import Duties: Multiplicative

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

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

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Import Duties: Additive

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

- If *DTM* is made a variable, and ALL elements of *tm01(c)* are 'ONE' then ALL the elements of *tmb(c)* increase (additively) by an equal absolute amount determined by the solution value for *DTM*.

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Import Duties: Additive 2

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

- If *DTM* is made a variable, AND at least **one** element of *tm01(c)* is 'ONE' then the subset of elements of *tmb(c)* identified by *tm01(c)* 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 3

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TMDEF (c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + [DTM * tm01(c)] ;$$

- If the change in the applied tax rates is to be other than equal, then values of *tm01(c)* other than 'one' can be applied.
- Typically, the values for *tm01(c)* 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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Tax Rates


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Commodity Taxes

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TEDEF(c) ..

$$TE(c) = E = [(teb(c) + dabte(c)) * TEADJ] + (DTE * te01(c)) ;$$

TMDEF(c) ..

$$TM(c) = E = [(tmb(c) + dabtm(c)) * TMADJ] + (DTM * tm01(c)) ;$$

TSDEF(c) \$(cd(c) OR cm(c)) ..

$$TS(c) = E = [(tsb(c) + dabts(c)) * TSADJ] + (DTS * ts01(c)) ;$$

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Commodity Taxes

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TSSDEF(c) \$(cd(c) OR cm(c)) ..

$$TSS(c) = E = [(tssb(c) + dabtss(c)) * TSSADJ] + [DTSS * tss01(c)] ;$$

TEXDEF(c) \$(cd(c) OR cm(c)) ..

$$TEX(c) = E = [(texb(c) + dabtex(c)) * TEXADJ] + [DTEX * tex01(c)] ;$$

TVDEF(c) \$(cd(c) OR cm(c)) ..

$$TV(c) = E = [(tvb(c) + dabtv(c)) * TVADJ] + [DTV * tv01(c)] ;$$

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Activity Taxes

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TXDEF(a) ..

$$TX(a) =E= [(txb(a) + dabtx(a)) * TXADJ] + [DTX * tx01(a)] ;$$

TFDEF(f,a) ..

$$TF(f,a) =E= [(tfb(f,a) + dabtf(f,a)) * TFADJ] + [DTF * tf01(f,a)] ;$$

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Direct Taxes

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TYFDEF(f) ..

$$TYF(f) =E= [(tyfb(f) + dabtyf(f)) * TYFADJ] + [DTYF * tyf01(f)] ;$$

TYHDEF(h) ..

$$TYH(h) =E= [(tyhb(h) + dabtyh(h)) * TYHADJ * TYADJ] + [DTYH * DTY * tyh01(h)] ;$$

TYEDEF(e) ..

$$TYE(e) =E= [(tyeb(e) + dabtye(e)) * TYEADJ * TYADJ] + [DTYE * DTY * tye01(e)] ;$$

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Tax Closure Options

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Tax Closure Options

- Target Rates
 - Fixed rates
 - Constant/base or shocked/changed
 - Variable rates
 - Constrained or unconstrained
- Target Revenues
 - Fixed revenues
 - Variable rates to satisfy target revenue
 - Variable revenues
 - Constrained or unconstrained

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Efficiency factors

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Standard Format

ADXEQ (a) . .
ADX (a) =E= [(**adxb (a)** + dabadx (a)) * ADXADJ]
+ [DADX * adx01 (a)] ;

- *adxb_a* - vector of efficiency parameters.
- *dabadx_a* - vector of absolute changes in the vector of efficiency parameters – initial values ZERO.
- *ADXADJ* - specific variable whose initial value is ONE.
- *DADX* is a specific variable whose initial value is ZERO.
- *adx01_a* - vector of zeros and non zeros – initial values ZERO.

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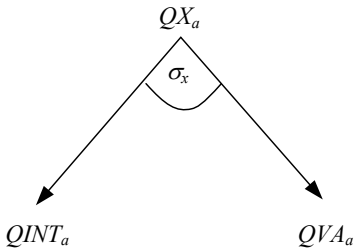
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Production System: Sample Activity



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$QXPRODFN(a) \$aqx(a) \dots$
 $QX(a) = E = \text{ADX}(a) * (deltax(a) * QVA(a) ** (-rhocx(a)) + (1 - deltax(a)) * QINT(a) ** (-rhocx(a))) ** (-1/rhocx(a)) ;$

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Top Level: Multiplicative

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$ADXEQ(a) \dots$
 $ADX(a) = E = [(adxb(a) + dabadx(a)) * ADXADJ] + [DADX * adx01(a)] ;$

- 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

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ADXEQ (a) . .

$$ADX(a) = E = [(adxb(a) + dabadx(a)) * ADXADJ] + [DADX * adx01(a)] ;$$

- 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* is made a variable, and ALL elements of *adx01* 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 *adx01* other than one can be applied.

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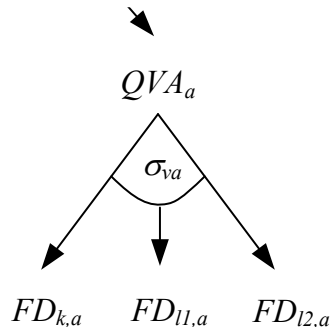
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Value Added Production System

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QVAPRODFN (a) . .

$$QVA(a) = E = ADVA(a) * \{ \text{SUM}[f\$deltava(f,a), deltava(f,a) * (ADFD(f,a) * FD(f,a)) ** (-rhocva(a))] \} ** [-1/rhocva(a)] ;$$

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Value Added Production System

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ADVAEQ (a) . .

$$ADVA(a) = E = [(advab(a) + dabadva(a)) * ADVAADJ] + [DADVA * adva01(a)] ;$$

- If *ADVAADJ* 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* 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* is made a variable, and ALL elements of *adv01* are ONE then ALL the elements of *advab* increase (additively) by an equal absolute amount determined by the solution value for *DADVA*.
- If *DADVA* is made a variable, AND at least one element of *adv01* is ONE then the subset of elements of *advab* identified by *adv01* 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 *adv01* other than one can be applied.

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Value Added Production System

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QVAPRODFN (a) \$rhocva (a) . .

$$QVA(a) = E = ADVA(a) * (\text{SUM}(ff\$[map_va_ff(ff,a) \text{ AND } deltava(ff,a)], deltava(ff,a) * (ADFD(ff,a) * FD(ff,a) ** (-rhocva(a))) ** (-1/rhocva(a))) ;$$

Stock/flow relationship

28

No standard equation in the model

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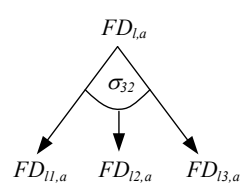
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Level 3 Production System



```
FDPRODFN(ff,a)$SUM[ffp,map_fagg_ff(ff,ffp,a)]..
FD(ff,a) =E= ADFAG(ff,a)
              *{SUM[ffp${map_fagg_ff(ff,ffp,a)
                    AND deltafd(ff,ffp,a)},
deltafd(ff,ffp,a) *FD(ffp,a)**(-rhofd(ff,a))]}
              **[-1/rhofd(ff,a)] ;
```

No standard equation in the model

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Tax and Efficiency Adjustments

The End



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