

\$TITLE M8-4a.GMS: Small open economy with a benchmark quota
 * *modeled as an endogenous tax rate*

\$ONTEXT

In this example, units are chosen such that all DOMESTIC prices equal one initially. Implied world price of import good X2: $P2 = 1/1.2$

	<i>Production Sectors</i>				<i>Consumer</i>		
<i>Markets</i>	/	<i>X1</i>	<i>X2</i>	<i>E1</i>	<i>M2</i>	<i>W</i>	<i>CONS</i>
<i>P1</i>	/	150		-50		-100	
<i>P2</i>	/		40		60	-100	
<i>PL</i>	/	-100	-20				120
<i>PK</i>	/	-50	-20				70
<i>PW</i>	/					200	-200
<i>PFX</i>	/			50	-50		
<i>Q (quota rent)</i>	/				-10		10

\$OFFTEXT

PARAMETERS

PE2 Export price of good 2
 PM1 Import price of good 1
 PE1 Export price of good 1

PM2 Import price of good 2
ENDOW Endowment multiplier (size of the economy);

PE1 = 1;
PM2 = 1 / (1.2);
PE2 = PM2 * 0.99;
PM1 = 1.01;
ENDOW = 1;

NONNEGATIVE VARIABLES

X1 Activity level for sector X1,
X2 Activity level for sector X2,
E1 Activity level for sector E1,
E2 Activity level for sector E2,
M1 Activity level for sector M1,
M2 Activity level for sector M2,
W Activity level for sector W,
P1 Price index for commodity X,
P2 Price index for commodity Y,
PL Price index for primary factor L,
PK Price index for primary factor K,
PW Price index for welfare (expenditure function),
PFX Read exchange rate index,
CONS Income definition for CONS
PQ Quota shadow price (ad valorem tariff equivalent);

EQUATIONS

PRF_X1 Zero profit for sector X1
 PRF_X2 Zero profit for sector X2
 PRF_E1 Zero profit for sector E1
 PRF_E2 Zero profit for sector E2
 PRF_M1 Zero profit for sector M1
 PRF_M2 Zero profit for sector M2
 PRF_W Zero profit for sector W

MKT_X1 Supply-demand balance for commodity X1
 MKT_X2 Supply-demand balance for commodity X2
 MKT_PFX Supply-demand balance for commodity PFX
 MKT_L Supply-demand balance for primary factor L
 MKT_K Supply-demand balance for primary factor L
 MKT_W Supply-demand balance for aggregate demand

I_CONS Income definition for CONS
 A_PQ Quota auxiliary (sets endogenous shadow tax PQ);

* *Zero profit conditions*

PRF_X1.. 150 * PL**(2/3) * PK**(1/3) =G= 150*P1;

PRF_X2.. 40 * PL**(0.5) * PK**(0.5) =G= 40*P2;

PRF_E1.. 50 * P1 =G= 50 * PFX * PE1;

$$\text{PRF_E2.. } 60 * P2 =G= 60 * \text{PFX} * \text{PE2};$$

$$\text{PRF_M1.. } 50 * \text{PFX} * \text{PM1} =G= 50 * P1;$$

$$\text{PRF_M2.. } 60 * \text{PFX} * \text{PM2} * (1+\text{PQ}) =G= 60 * P2;$$

$$\text{PRF_W.. } 200 * P1^{**0.5} * P2^{**0.5} =G= 200 * \text{PW};$$

* *Market clearance conditions*

$$\text{MKT_X1.. } 150 * X1 + 50 * M1 =G= 50 * E1 + 100 * W * \text{PW} / P1;$$

$$\text{MKT_X2.. } 40 * X2 + 60 * M2 =G= 60 * E2 + 100 * W * \text{PW} / P2 ;$$

$$\text{MKT_PFX.. } 60 * E2 * \text{PE2} + 50 * E1 * \text{PE1} =G= 60 * M2 * \text{PM2} + 50 * \text{PM1} * M1;$$

$$\text{MKT_W.. } 200 * W =G= \text{CONS} / \text{PW};$$

$$\text{MKT_L.. } 120 * \text{ENDOW} =G= 100 * X1 * P1 / \text{PL} + 20 * X2 * P2 / \text{PL};$$

$$\text{MKT_K.. } 70 * \text{ENDOW} =G= 50 * X1 * P1 / \text{PK} + 20 * X2 * P2 / \text{PK};$$

* *Income balance*

$$\text{I_CONS.. } \text{CONS} =E= 120 * \text{ENDOW} * \text{PL} + 70 * \text{ENDOW} * \text{PK} + 60 * \text{PFX} * \text{PM2} * M2 * \text{PQ};$$

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A_PQ..      1 =G= M2;
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```
MODEL SOE2 /PRF_X1.X1, PRF_X2.X2, PRF_E1.E1, PRF_E2.E2,  
            PRF_M1.M1, PRF_M2.M2,  
            PRF_W.W, MKT_X1.P1, MKT_X2.P2, MKT_PFX.PFX,  
            MKT_L.PL, MKT_K.PK, MKT_W.PW,  
            I_CONS.CONS, A_PQ.PQ /;
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*      Check the benchmark (again):
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```
X1.L      =1;  
X2.L      =1;  
E2.L      =0;  
M1.L      =0;  
E1.L      =1;  
M2.L      =1;  
W.L       =1;
```

```
P1.L      =1;  
P2.L      =1;  
PFX.L     =1;  
PK.L      =1;  
PW.FX     =1;  
PL.L      =1;
```

CONS.L = 200;

PQ.L = 0.20;

SOE2.ITERLIM = 0;

SOLVE SOE2 USING MCP;

SOE2.ITERLIM = 2000;

SOLVE SOE2 USING MCP;

** counterfactual: fixed PQ = 0 to calculate free trade*

PQ.FX = 0;

SOLVE SOE2 USING MCP;

** show that the quota becomes more restrictive*

** as the economy grows*

PQ.LO = 0;

PQ.UP = +**INF**;

ENDOW = 3;

SOLVE SOE2 USING MCP;

** show what would happen if there had been a fixed 0.20 tariff*

** instead of the quota*

```
PQ.FX = 0.20;  
SOLVE SOE2 USING MCP;
```

```
PQ.LO = 0;  
PQ.UP = +INF;
```

** show what would happen if the economy were smaller than the benchmark*

```
ENDOW = 0.25;  
SOLVE SOE2 USING MCP;
```