

\$TITLE M8-2.GMS: Small open economy 2x2

* *contrasts tariffs versus (iceberg) trade costs*

\$ONTEXT

*CALIBRATION: country exports X1, imports X2
in free-trade benchmark*

Markets	Production Sectors					Consumer
	X1	X2	E1	M2	W	CONS
P1	150		-50		-100	
P2		50		50	-100	
PL	-135	-5				140
PK	-15	-45				60
PW					200	-200
PFX			50	-50		

\$OFFTEXT

* *the first four parameters allow changes in (exogenous) world*

PARAMETERS

PE2	Export price of good 2	/0.999/
PM1	Import price of good 1	/1.001/

PE1	Export price of good 1	/1/
PM2	Import price of good 2	/1/
TR	Import tariff (gross basis)	/1/
TC	Trade costs (gross basis)	/1/
CONSX1	Consumption of X1	
CONSX2	Consumption of X2;	

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 (consumer price index)
PFX	Real exchange rate index
CONS	Income definition for CONS;

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 K
 MKT_W Supply-demand balance for aggregate demand

I_CONS Income definition for CONS;

* *Zero profit conditions*

PRF_X1.. $150 * PL^{0.9} * PK^{0.1} = G = 150 * P1;$

PRF_X2.. $50 * PL^{0.1} * PK^{0.9} = G = 50 * P2;$

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

$$\text{PRF_E2..} \quad 50 * P2 =G= 50 * PFX * PE2;$$

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

$$\text{PRF_M2..} \quad 50 * PFX * PM2 * TC * TR =G= 50 * P2;$$

$$\text{PRF_W..} \quad 100 * P1^{**0.5} * P2^{**0.5} =G= 100 * PW;$$

* *Market clearance conditions*

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

$$\text{MKT_X2..} \quad 50 * X2 + 50 * M2 / TC =G= 50 * E2 + 100 * W * PW / P2 ;$$

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

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

$$\text{MKT_L..} \quad 140 =G= 135 * X1 * P1 / PL + 5 * X2 * P2 / PL;$$

$$\text{MKT_K..} \quad 60 =G= 15 * X1 * P1 / PK + 45 * X2 * P2 / PK;$$

* *Income balance*

$$\text{I_CONS..} \quad \text{CONS} =E= 140 * PL + 60 * PK + 50 * PFX * PM2 * (TR - 1) * M2;$$

```
MODEL SOE /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 /;
```

```
*      set benchmark values:
```

```
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;  
PL.L      =1;  
CONS.L    =200;
```

```
* choose the real consumer price index as numeraire
```

```
PW.FX     =1;
```

** check for calibration and starting-value errors*

```
SOE.ITERLIM = 0;  
SOLVE SOE USING MCP;
```

```
SOE.ITERLIM = 2000;  
SOLVE SOE USING MCP;
```

** SHOW HOW TO DO MULTIPLE SCENARIOS*

** SHOW DIFFERENCE BETWEEN TARIFF AND TRADE COST OF EQUAL RATES*

```
SETS I indexes 25 different gross cost levels /I1*I25/  
      J indexes 2 scenarios: 1 = tariff 2 = trade cost /J1*J2/;
```

PARAMETERS

```
RATE(I)  
WELFARE(I,J)  
IMP2(I,J)  
TRATE(I,J)  
TCOST(I,J)  
RESULTS(I, *);
```

```
LOOP(J,  
LOOP(I,
```

```
TC = 1; TR = 1;
RATE(I) = 1 + .05*ORD(I) - 0.05;
TR$(ORD(J) EQ 1) = RATE(I);
TC$(ORD(J) EQ 2) = RATE(I);
```

```
SOLVE SOE USING MCP;
```

```
WELFARE(I,J) = W.L;
IMP2(I,J) = M2.L/TC;
```

```
);
```

```
);
```

```
RESULTS(I, "RATE") = RATE(I);
RESULTS(I, "WELTR") = WELFARE(I, "J1");
RESULTS(I, "WELTC") = WELFARE(I, "J2");
RESULTS(I, "IMP2TR") = IMP2(I, "J1");
RESULTS(I, "IMP2TC") = IMP2(I, "J2");
```

```
DISPLAY RESULTS;
```

```
* Write parameter RESULTS to an Excel file M8.XLS,
* starting in Sheet1
```

Execute_Unload 'M8.gdx' RESULTS

execute 'gdxxrw.exe M8.gdx par=RESULTS rng=SHEET1!'

** simpler but less sophisticated dump to excel*

\$LIBINCLUDE XLDUMP RESULTS M8.XLS SHEET2!