$TITLE: M6-6a.GMS: Modelling pollution as reducing the endowment of an environment public good

$ONTEXT
This model is a closed economy: two goods and one factor, one consumer. Pollution is generated by the production of X, pollution reduces utility. Pollution is modeled as a reduction in the endowment of CLEAN AIR. Initial endowment of clear air is 200, with 100 reduced by X pollution and 100 entering utility.

<table>
<thead>
<tr>
<th>Markets</th>
<th>X</th>
<th>Y</th>
<th>W</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PX</td>
<td>100</td>
<td>-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PY</td>
<td></td>
<td>100</td>
<td>-100</td>
<td></td>
</tr>
<tr>
<td>PW</td>
<td></td>
<td>300</td>
<td></td>
<td>-300</td>
</tr>
<tr>
<td>PL</td>
<td>-100</td>
<td>-100</td>
<td></td>
<td>200</td>
</tr>
</tbody>
</table>

| PCA       | -100 | (200 - 100) |

$OFFTEXT

PARAMETERS

TX ad-valorem tax rate for X sector inputs
POLINT pollution intensity multiplier;
TX = 0;
POLLINT = 1;

**POSITIVE VARIABLES**

X       activity level for X production
Y       activity level for Y production
W       activity level for the "production" of welfare from X Y

PX      price of good X
PY      price of good Y
PCA     price of clean air
PW      price of a unit of welfare (real consumer-price index)
PL      price of labor

CONS    income of the representative consumer
POL     pollution;

**EQUATIONS**

PRF_X   zero profit for sector X
PRF_Y   zero profit for sector Y
PRF_W   zero profit for sector W (Hicksian welfare index)

MKT_X   supply-demand balance for commodity X
MKT_Y  supply-demand balance for commodity Y
MKT_CA market for clean air (determines shadow value PCA)
MKT_L  supply-demand balance for primary factor L
MKT_W  supply-demand balance for aggregate demand

I_CONS income definition for CONS
PPOL pollution caused by production - consumption of X;

*     Zero profit inequalities

PRF_X..  100*PL*(1+TX) =G= 100*PX;
PRF_Y..  100*PL =G= 100*PY;
PRF_W..  300*(PX**(1/3) * PY**(1/3) * PCA**(1/3)) =G= 300*PW;

*     Market clearance inequalities

MKT_X..  100*X =G= 100 * W * PW / PX;
MKT_Y..  100*Y =G= 100 * W * PW / PY;
MKT_CA.. 200-100*POL =G= 100 * W * PW / PCA;
MKT_W..  300*W =E= CONS / PW;
MKT_L.. 200 =G= 100*X + 100*Y;

*  Income balance equations (don't forget tax revenue)

I_CONS.. CONS =E= 200*PL + (200-100*POL)*PCA + TX*100*X*PL;

PPOL.. 100*POL =G= POLINT*100*X;

MODEL POLLUTE /PRF_X.X, PRF_Y.Y, PRF_W.W,
  MKT_X.PX, MKT_Y.PY, MKT_CA.PCA, MKT_L.PL,
  MKT_W.PW, I_CONS.CONS, PPOL.POL /;

*  Chose a numeraire: real consumer price index

PW.FX = 1;

*  Set initial values of variables:

X.L=1; Y.L=1; W.L=1;
PX.L=1; PY.L=1; PL.L=1; POL.L = 1; PCA.L = 1;
CONS.L=300;

POLLUTE.ITERLIM = 0;
SOLVE POLLUTE USING MCP;
POLLUTE.ITERLIM = 1000;
SOLVE POLLUTE USING MCP;

* counterfactual 1: 50% tax

TX = 0.5;
SOLVE POLLUTE USING MCP;

TX = 0.75;
SOLVE POLLUTE USING MCP;