```
$TITLE  M6-6c.GMS: Pollution tax set optimally via a
*  "first-order condition"
*  TX is set by an equation equation the price of X to it's full cost:
*  PX = PL + PCA


$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.


                    Production Sectors              Consumers
    Markets    |    X        Y        W      |        CONS
    ------------------------------------------------------------
       PX    |   100                 -100    |
       PY    |            100        -100    |
       PW    |                        300    |        -300
       PL    | -100     -100                 |         200
    _____

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


$OFFTEXT
```

PARAMETERS

```
 POLINT      polution intensity multiplier
 WELOPT      welfare under the optimal tax
 TAXOPT      value of the optimal tax;


POLINT = 1;
```

NONNEGATIVE 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
 TX         pollution tax;
```

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
 ATX   sets pollution tax optimally;

*   *Zero profit inequalities*

PRF_X..   100*PL*(1+TX) =G= 100*PX;

PRF_Y..   100*PL =G= 100*PY;

PRF_W..   200*(PX**(1/3) * PY**(1/3) * PCA**(1/3)) =G= 200*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;

ATX..         PX =E= PL + PCA*POLINT;

MODEL ALGEBRAIC /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, ATX.TX /;


*        Chose a numeraire: real consumer price index

PW.FX = 1;
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*         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;

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


WELOPT = 100*W.L;
TAXOPT = TX.L;
DISPLAY WELOPT, TAXOPT;


POLINT = 1.5;


SOLVE ALGEBRAIC USING MCP;


WELOPT = 100*W.L;
TAXOPT = TX.L;
DISPLAY WELOPT, TAXOPT;
```