$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

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


POLINT = 1;
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NONNEGATIVE VARIABLES

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 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;


* or since PX = PL*(1 + TX), equivalently

*ATX..          TX =E= PCA*POLINT / PL;


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 /;
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*        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;

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;
```