```
$TITLE: M7-5.GMS: Small-Group Monopolistic Competition
* markup formula is 1/(sigma - (1/(1+N))(sigma - 1)
* to calibrate to the same data, sigma = 5, N = 1, a fudge-factor
* of 0.6 is used in the markup formula to reproduce the benchmark
* markup = 0.6/(sigma - (1/(1+N))(sigma - 1) = 0.20

$ONTEXT
                        Production Sectors          Consumers
  Markets    |   XC       N         Y         W    |  CONS    ENTR
--------------------------------------------------------------
       PX    |  100                        -100    |
       PY    |                   100       -100    |
       PN    |           20                        |            -20
       PW    |                              200    |  -200
       PL    |  -80     -20     -100               |   200

       MK    |  -20                                |             20

$OFFTEXT


PARAMETERS
  SI          SIGMA: elasticity of substitution among varieties
  FC          parameter setting the level of fixed costs
  ENDOWL      endowment of labor
  MODELSTAT   statistic indicating model solved: 0 = solved;
```

```
SI = 5;
FC = 20;
ENDOWL = 200;
```

NONNEGATIVE VARIABLES

```
  X     Activity level for X (output per firm)
  XC    Composite X (utility value of agg X sector output)
  N     Number of X sector firms (variety measure)
  Y     Activity level of Y output
  W     Activity level for welfare

  PX    Price of an individual X variety
  PE    Price index (unit expenditure function): cost of XC = 1
  PN    Price of fixed costs (price of entering)
  PY    Price of Y
  PW    Price index for utility (consumer price index)

  PL    Price of labor

  MK    Markup

  CONS  Income of the representative consumer;
```

```
EQUATIONS

  PRICEX    MR = MC in X (associated with X output per firm)
  PINDEX    Price index for X sector goods
  PRICEN    Zero profits - free entry in X (associated with N)
  PRICEY    Zero profit condition for Y (PY = MC)
  PRICEW    Zero profit condition for W (PW = MC of utility)

  DX        Supply-demand balance for X (individual variety)
  DXC       Supply-demand balance for XC
  DN        Supply-demand for firms N: markup rev = fexed cost
  DY        Supply-demand balance for Y
  DW        Supply-demand balance for utility W (welfare)

  LAB       Supply-demand balance for unskilled labor

  MARKUP    Markup equation

  INCOME    National income;


PRICEX..   PL =G= PX*(1 - MK);

PINDEX..   (N*PX**(1-SI))**(1/(1-SI)) =G= PE;

PRICEN..   PL =G= PN;
```

```
PRICEY..    PL =G= PY;

PRICEW..    (PE**0.5)*(PY**0.5) =G= PW;

DX..        X*80  =G=  PX**(-SI)*(PE**(SI-1))*CONS/2;

DXC..       XC =G= N**(SI/(SI-1))*X;

DN..        N*FC  =G= (PX*MK)*X*80*N/PN;

DY..        Y*100 =G= CONS/(2*PY);

DW..        200*W =G= (1.25**0.5)*CONS/PW;

LAB..       ENDOWL =E= Y*100 + N*X*80 + N*FC;

MARKUP..    MK =E= 0.6/(SI - 1/(N+1)*(SI - 1));

INCOME..    CONS =E= PL*ENDOWL;


MODEL M62 /PRICEX.X, PRICEY.Y, PRICEW.W, PRICEN.N, PINDEX.XC,
           DX.PX, DXC.PE, DN.PN, DY.PY, DW.PW,
           LAB.PL, MARKUP.MK, INCOME.CONS/;
```

```
*       set benchmark values:

PE.L = 1.25;
CONS.L = 200;
X.L = 1;
XC.L = 1;
Y.L = 1;
N.L = 1;
W.L = 1;
PX.L = 1.25;
PN.L = 1;
PY.L = 1;

PL.L = 1;
PW.L = 1.25**0.5;
MK.L = 0.20;
* choose the price of good Y as numeraire

PY.FX = 1;

* check for calibration and starting-value errors

M62.ITERLIM = 0;
SOLVE M62 USING MCP;

M62.ITERLIM = 1000;
```

```
SOLVE M62 USING MCP;

MODELSTAT = M62.MODELSTAT - 1.;

DISPLAY MODELSTAT;

* Counterfactual: expand the size of the economy

*ENDOWL = 400;

*SOLVE M62 USING MCP;



* show welfare as a function of the economy's size

SETS J scenario 1 = small-group mc 2 = large-group /J1*J2/;
SETS I indexes 25 different size levels  /I1*I25/;

PARAMETERS
 SIZE(I)
 WELFARE(I,J)
 WELFCAP(I,J)
 MARKUPS(I,J)
 NUMBERF(I,J)
 RESULTS(I,*);
```

```
MK.L = 0.2;

LOOP(I,
LOOP(J,

SIZE(I) =  5.2 - 0.2*ORD(I);
ENDOWL = 200*SIZE(I);

MK.UP = +INF;
MK.LO = 0;
MK.FX$(ORD(J) EQ 2) = 0.20;

SOLVE M62 USING MCP;

WELFARE(I,J) = W.L;
WELFCAP(I,J) = WELFARE(I,J)/SIZE(I);
MARKUPS(I,J) = MK.L;
NUMBERF(I,J) = N.L;

);
);

RESULTS(I, "SIZE") = SIZE(I);
RESULTS(I, "WELFCAP-L") = WELFCAP(I, "J2");
RESULTS(I, "WELFCAP-S") = WELFCAP(I, "J1");
```

```
RESULTS(I, "NUMBERF-L") = NUMBERF(I, "J2");
RESULTS(I, "NUMBERF-S") = NUMBERF(I, "J1");
RESULTS(I, "MARKUP-S")  = MARKUPS(I,"J1");


DISPLAY RESULTS;

* Write parameter RESULTS to an Excel file MCOMP2.XLS,
* starting in Sheet1, cell A3

Execute_Unload 'M7.gdx' RESULTS
execute 'gdxxrw.exe M7.gdx par=RESULTS rng=SHEET4!A3'
```