$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

<table>
<thead>
<tr>
<th>Markets</th>
<th>XC</th>
<th>N</th>
<th>Y</th>
<th>W</th>
<th>CONS</th>
<th>ENTR</th>
</tr>
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<tbody>
<tr>
<td>PX</td>
<td>100</td>
<td></td>
<td>-100</td>
<td></td>
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<tr>
<td>PY</td>
<td></td>
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<tr>
<td>PN</td>
<td></td>
<td>20</td>
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<tr>
<td>PW</td>
<td></td>
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<td>200</td>
<td>-200</td>
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</tr>
<tr>
<td>PL</td>
<td>-80</td>
<td>-20</td>
<td>-100</td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>MK</td>
<td>-20</td>
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</tbody>
</table>

$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 = fixed 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'