$TITLE: M9-3.GMS: Monopolistic Competition with horizontal multinationals

$ontext

same data: calibrated to zero trade costs, so national firms only in bench

YI   YJ   XMI  XMJ  NMI  NMJ   WI   WJ CONI  CONJ  EHTI  ENTJ

PYI    100                             -100
PYJ    100                             -100
PXI    100                             -50  -50
PXJ                      ...  -10                                      10   10
MKJ                -10  -10                                      10   10

$offtext

$PARAMETERS

sigma: elasticity of substitution among varieties
trade costs on a gross basis (TC = 1 is costless trade)
fixed costs for a national firm
fixed costs for a multinational firm
scaling parameter for calibration
ENDOWIS  endowment of skilled labor in country i
ENDOWIL  endowment of unskilled labor in country i
ENDOWJS  endowment of skilled labor in country j
ENDOWJL  endowment of unskilled labor in country j
MODELSTAT indicator whether or not model solved
REALPUI  real price of unskilled labor in i
REALPUJ  real price of unskilled labor in j
REALPSIJ  real price of skilled labor in j
REALPSJ  real price of skilled labor in j;

SI = 5;
TC = 1.;
FC = 20;
FCM = 30;
ENDOWIS = 1;
ENDOWIL = 1;
ENDOWJS = 1;
ENDOWJL = 1;

* E0: scaling parameter s.t. the consumer price index PW = 1 initially

E0 = (1.25**(1-SI) + 1.25**(1-SI))**(1/(1-SI));

DISPLAY E0;

NONNEGATIVE VARIABLES
WFI  welfare of country i
WFJ  welfare of country j
XII  production of X in i for sale in i: national firm
XIJ  production of X in i for sale in j: national firm
XJJ  production of X in j for sale in j: national firm
XJI  production of X in j for sale in i: national firm
XMII production of X in i for sale in i: multinational firm in i
XMIJ production of X in j for sale in j: multinational firm in i
XMJJ production of X in j for sale in j: multinational firm in j
XMJI production of X in i for sale in i: multinational firm in j
YI   production of Y in country i
YJ   production of Y in country j
NI   number of national (n) firms in i (number of "varieties")
NJ   number of national (n) firms in j
MI   number of multinational (m) firms in i
MJ   number of multinational (m) firms in j
PXI  price of an X variety in country i
PXJ  price of an X variety in country j
PY   price of Y: domestic and world (no trade costs)
PWI  price of welfare (real consumer price index) in i
PWJ  price of welfare (real consumer price index) in j
PEI  price index for the X composite good in i
PEJ  price index for the X composite good in j
PSI  price of skilled labor in i
PUI  price of unskilled labor in i
PSJ  price of skilled labor in j
PUJ  price of unskilled labor in j
CONSI consumer income in i
CONSJ consumer income in j;
EQUATIONS

PRWI  pricing equation for WI
PRWJ  pricing equation for WJ
PRXI  MC gte MR for X produced in i (same for all firm types)
PRXJ  MC gte MR for X produced in j (same for all firm types)
PRYI  MC gte PY for Y produced in i
PRYJ  MC gte PY for Y produced in j
PRFI  MC gte PFI for fixed costs in i: national firm
PRFJ  MC gte PFJ for fixed costs in j: national firm
PRMI  MC gte PMI for fixed costs for an m firm headquartered in i
PRMJ  MC gte PMI for fixed costs for an m firm headquartered in j
DXII  supply-demand for a X variety produced in i sold in i: n firm i
DXJI  supply-demand for a X variety produced in j sold in i: n firm j
DXJJ  supply-demand for a X variety produced in j sold in j: n firm j
DXIJ  supply-demand for a X variety produced in i sold in j: n firm i
DMII  supply-demand for a X variety produced in i sold in i: m firm i
DMJI  supply-demand for a X variety produced in i sold in i: m firm j
DMJJ  supply-demand for a X variety produced in j sold in j: m firm j
DMIJ  supply-demand for a X variety produced in j sold in j: m firm i
DY   supply-demand for world production and consumption of Y
DWI  supply-demand for welfare in i
DWJ  supply-demand for welfare in j
PINDEXI price index for the X composite in i
PINDEXJ price index for the X composite in j
SKLABI supply-demand for skilled labor in i
UNLABI supply-demand for unskilled labor in i
SKLABJ supply-demand for skilled labor in j
UNLABJ supply-demand for unskilled labor in j
ICONSI  income-expenditure balance in i
ICONSJ  income-expenditure balance in j;

PRWI..  ((PEI/E0)**0.5)*(PY**0.5)  =G=  PWI;

PRWJ..  ((PEJ/E0)**0.5)*(PY**0.5)  =G=  PWJ;

PRXI..  (PUI**0.4)*(PSI**0.6)  =G=  PXI*(1-1/SI);

PRXJ..  (PUJ**0.4)*(PSJ**0.6)  =G=  PXJ*(1-1/SI);

PRYI..  (PUI**0.60)*(PSI**0.40)  =G=  PY;

PRYJ..  (PUJ**0.60)*(PSJ**0.40)  =G=  PY;

PRFI..  FC*(SI-1)  =G=  XII*40 + XIJ*40;

PRFJ..  FC*(SI-1)  =G=  XJJ*40 + XJI*40;

PRMI..  FCM*(0.75*(PUI**0.4)*(PSI**0.6) + 0.25*(PUJ**0.4)*(PSJ**0.6))
        =G=  (1/SI)*(PXI*XMII*40 + PXJ*XMIJ*40);

PRMJ..  FCM*(0.75*(PUJ**0.4)*(PSJ**0.6) + 0.25*(PUI**0.4)*(PSI**0.6))
        =G=  (1/SI)*(PXJ*XMJJ*40 + PXI*XMJII*40);

DXII..  XII*40  =E=  PXI**(-SI)*(PEI***(SI-1))*CONSI/2;

DXJI..  XJI*40/TC  =E=  (PXJ*TC)**(-SI)*(PEI***(SI-1))*CONSI/2;
DXJJ.. XJJ*40 =E= PXJ**(-SI)*(PEJ**(SI-1))*CONSJ/2;

DXIJ.. XIJ*40/TC =E= (PXI*TC)**(-SI)*(PEJ**(SI-1))*CONSJ/2;

DMII.. XMII*40 =E= PXI**(-SI)*(PEI**(SI-1))*CONSI/2;

DMJI.. XMJI*40 =E= PXI**(-SI)*(PEI**(SI-1))*CONSI/2;

DMJJ.. XMJJ*40 =E= PXJ**(-SI)*(PEJ**(SI-1))*CONSJ/2;

DMIJ.. XMIJ*40 =E= PXJ**(-SI)*(PEJ**(SI-1))*CONSJ/2;

DY.. YI*100 + YJ*100 =E= CONSI/(2*PY) + CONSJ/(2*PY);

DWI.. 200*WFI =E= CONSI/(PWI);

DWJ.. 200*WFJ =E= CONSJ/(PWJ);

PINDEXI.. PEI =E= (NI*PXI**(1-SI) + NJ*(PXJ*TC)**(1-SI) + (MI+MJ)*PXI**(1-SI))***(1/(1-SI));

PINDEXJ.. PEJ =E= (NI*(PXI*TC)**(1-SI) + NJ*PXJ**(1-SI) + (MI+MJ)*PXJ**(1-SI))***(1/(1-SI));

SKLABI.. 100*ENDOWIS =E= 0.40*YI*100*PY/PSI
          + 0.6*NI*((XII+XIJ)*40 + FC)*PXI*(1-1/SI)/PSI
+ 0.6*(MI*(XMII*40+0.75*FCM) + MJ*(XMJI*40+0.25*FCM)) *PXI*(1-1/SI)/PSI;

UNLABI.. 100*ENDOWIL =E= 0.60*YI*100*PY/PUI + 0.4*NI*((XII+XIJ)*40 + FC)*PXI*(1-1/SI)/PUI + 0.4*(MI*(XMII*40+0.75*FCM) + MJ*(XMJI*40+0.25*FCM)) *PXI*(1-1/SI)/PUI;

SKLABJ.. 100*ENDOWJS =E= 0.40*YJ*100*PY/PSJ + 0.6*NJ*((XJJ+XJI)*40 + FC)*PXJ*(1-1/SI)/PSJ + 0.6*(MJ*(XMJJ*40+0.75*FCM) + MI*(XMIJ*40+0.25*FCM)) *PXJ*(1-1/SI)/PSJ;

UNLABJ.. 100*ENDOWJL =E= 0.60*YJ*100*PY/PUJ + 0.4*NJ*((XJJ+XJI)*40 + FC)*PXJ*(1-1/SI)/PUJ + 0.4*(MJ*(XMJJ*40+0.75*FCM) + MI*(XMIJ*40+0.25*FCM)) *PXJ*(1-1/SI)/PUJ;

ICONSI.. CONSI =E= PSI*100*ENDOWIS + PUI*100*ENDOWIL;

ICONSJ.. CONSJ =E= PSJ*100*ENDOWJS + PUJ*100*ENDOWJL;

MODEL MNF /PRWI.WFI, PRWJ.WFJ, PRXI.PXI, PRXJ.PXJ, PRYI.YI, PRYJ.YJ, PRFI.NI, PRFJ.NJ, PRMI.MI, PRMJ.MJ, DXII.XII, DXJI.XJI, DXJJ.XJJ, DXIJ.XIJ, DMII.XMII, DMJI.XMJI, DMJJ.XMJJ, DMIJ.XMIJ, DY.PY, DWI.PWI, DWJ.PWJ,
PINDEXI.PEI, PINDEXJ.PEJ,
SKLABI.PSI, SKLABJ.PSJ, UNLABI.PUI, UNLABJ.PUJ,
ICONSI.CONSI, ICONSJ.CONSJ/;

**OPTION** MCP=PATH;

WFI.L = 1;
WFJ.L = 1;
PWI.L = 1;
PWJ.L = 1;
PEI.L = E0;
PEJ.L = E0;
CONSI.L = 200;
CONSJ.L = 200;
XII.L = 1;
XIJ.L = 1;
XJJ.L = 1;
XJI.L = 1;
XMII.L = 1;
XMIIJ.L = 1;
XMJJ.L = 1;
XMJI.L = 1;
YI.L = 1;
YJ.L = 1;
NI.L = 1;
NJ.L = 1;
MI.L = 0;
MJ.L = 0;
PXI.L = 1.25;
PXJ.L = 1.25;
PY.L = 1;
PSI.L = 1;
PUI.L = 1;
PSJ.L = 1;
PUJ.L = 1;
PY.FX = 1;
TC = 1.;

**SOLVE** MNF USING MCP;

MODELSTAT = MNF.MODELSTAT - 1.;

* counterfactual: trade costs of 100%
XMII.L = 1;
XMIJ.L = 1;
XMJJ.L = 1;
XMJI.L = 1;
XII.L = 0;
XIJ.L = 0;
XJJ.L = 0;
XJI.L = 0;
MI.L = 1;
MJ.L = 1;
NI.L = 0;
NJ.L = 0;
TC = 1.5;

*M63.ITERLIM = 0;
SOLVE  MNF USING MCP;

* counterfactual: country's identical except for size, * positive trade costs (home market advantage)

TC = 1.2;
ENDOWIL = 1.5;
ENDOWJL = 0.5;
ENDOWIS = 1.5;
ENDOWJS = 0.5;

SOLVE  MNF USING MCP;

TC = 1.5;
SOLVE  MNF USING MCP;

REALPUI = PUI.L/PWI.L;
REALPUJ = PUJ.L/PWJ.L;
REALPSI = PSI.L/PWI.L;
REALPSJ = PSJ.L/PWJ.L;

DISPLAY  REALPUI, REALPUJ, REALPSI, REALPSJ;