

\$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				100			-50	-50				
FCI					20						-20	
FCJ						20						-20
PSI	-40		-48		-12				100			
PSJ		-40		-48		-12				100		
PUI	-60		-32		-8				100			
PUJ		-60		-32		-8				100		
PWI							200		-200			
PWJ								200		-200		
MKI			-10	-10							10	10
MKJ			-10	-10							10	10

\$offtext

PARAMETERS

SI sigma: elasticity of substitution among varieties
 TC trade costs on a gross basis (TC = 1 is costless trade)
 FC fixed costs for a national firm
 FCM fixed costs for a multinational firm
 E0 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 i
REALPSI 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 i
 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.. $FCM*(0.75*(PUJ**0.4)*(PSJ**0.6) + 0.25*(PUI**0.4)*(PSI**0.6))$
 $=G= (1/SI)*(PXJ*XMJJ*40 + PXI*XMJI*40);$

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

$$+ 0.6 * (MI * (XMII * 40 + 0.75 * FCM) + MJ * (XMJI * 40 + 0.25 * FCM)) \\ * PXI * (1 - 1/SI) / PSI;$$

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

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

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

$$\text{ICONSI.. } \text{CONSI} = E = PSI * 100 * \text{ENDOWIS} + PUI * 100 * \text{ENDOWIL};$$

$$\text{ICONSJ.. } \text{CONSJ} = E = PSJ * 100 * \text{ENDOWJS} + PUJ * 100 * \text{ENDOWJL};$$

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,

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PINDEXI.PEI, PINDEXJ.PEJ,  
SKLABI.PSI, SKLABJ.PSJ, UNLABI.PUI, UNLABJ.PUJ,  
ICONSI.CONSI, ICONSJ.CONSJ/;
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OPTION MCP=PATH;
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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;  
XMIJ.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;
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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;