FDI, Trade, and Pricing Model

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This partial equilibrium (PE) model of the economic impact of several different types of FDI, including foreign acquisitions, with and without technology transfer, and greenfield investment. The model is described in detail in Riker, D. FDI, Trade, and Pricing in a Bertrand Differentiated Products Model. USITC Economics Working Paper 2019-04-A.

The user can modify data inputs, the elasticity value, and the tariff rate in the simulation by change the values in the ORANGE - shaded lines in the notebook below tab. The spreadsheet will update the estimated changes in economic outcomes that are reported in the GREEN - shaded cells once the user selects "Evaluate Notebook" under "Evaluation" in the Menu above.

This model is provided as a generic analytical tool, and the data and parameter values are fictional and illustrative. Actual data and parameter values should be supplied by the user based on the industry and market to which the model is applied. The model is the result of ongoing professional research of USITC staff and may be updated. The model is not meant to represent in any way the view of the U.S. International Trade Commission or any of its individual Commissioners. The model is posted to promote the active exchange of ideas between USITC staff and experts outside the USITC and to provide useful economic modeling tools to the public.

In[∘]:=
```
ClearAll[f];
```

Parameter Inputs

Elasticity of Substitution

In[∘]:=
```
sigma = 4;
```

Tariff Rate

In[∘]:=
```
t = 0.20;
```

Data Inputs - Initial Equilibrium Values

Domestic Duopoly (X and Y) and 1 Foreign Firm (F)

Consumer expenditures in the single market

```
In[]:= vx0 = 25;
```

```
In[]:= vy0 = 25;
```

```
In[]:= vf0 = 50;
```

Calculated or Normalized Initial Equilibrium Values

Prices

In[]:= $px0 = 1;$

In[]:= $py0 = 1;$

In[]:= $pf0 = 1;$

Quantities

In[]:= $qx0 = \frac{vx0}{px0};$

In[]:= $qy0 = \frac{vy0}{py0};$

In[]:= $qf0 = \frac{vf0}{pf0\,(1 + t)};$

Calibration of Parameters Based on the Initial Equilibrium

Initial Marginal Costs

In[]:= $mx0 = px0\left(1 - \frac{1}{sigma - \frac{(sigma-1)\,vx0}{vx0+vy0+vf0}}\right);$

In[]:= $my0 = py0\left(1 - \frac{1}{sigma - \frac{(sigma-1)\,vy0}{vx0+vy0+vf0}}\right);$

In[]:= $mf0 = pf0\left(1 - \frac{1}{sigma - \frac{(sigma-1)\,vf0}{vx0+vy0+vf0}}\right);$

In[]:= $bf = \frac{vf0\left(\frac{pf0\,(1+t)}{px0}\right)^{sigma-1}}{vx0};$

In[]:= $by = \frac{vy0\left(\frac{py0}{px0}\right)^{sigma-1}}{vx0};$

In[ ]:= $P0 = \left(px0^{1-sigma} + by\ py0^{1-sigma} + bf\ (pf0\ (1+t))^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[ ]:= $k = qx0\ P0^{-sigma+1}\ px0^{sigma};$

New Equilibrium Values with Merger of X and F, No Efficiencies

In[ ]:= $sharex = \left(\frac{px}{P}\right)^{1-sigma};$

In[ ]:= $sharey = \left(\frac{py}{P}\right)^{1-sigma} by;$

In[ ]:= $sharef = \left(\frac{pf\ (1+t)}{P}\right)^{1-sigma} bf;$

In[ ]:= $P = \left(px^{1-sigma} + by\ py^{1-sigma} + bf\ (pf\ (1+t))^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[ ]:= $EqnX1 = px == (px - mx0)\ (sigma - (sigma-1)\ sharex) - (pf - mf0)\ (sigma-1)\ sharex \left(\frac{pf\ (1+t)}{px}\right)^{-sigma} bf;$

In[ ]:= $EqnY1 = py == (py - my0)\ (sigma - (sigma-1)\ sharey);$

In[ ]:= $EqnF1 = pf == (pf - mf0)\ (sigma - (sigma-1)\ sharef) - \frac{(px - mx0)\ (sigma-1)\ sharef \left(\frac{px}{pf\ (1+t)}\right)^{-sigma}}{bf};$

```
In[ ]:= FindRoot[{EqnX1, EqnY1, EqnF1}, {px, px0}, {py, py0}, {pf, pf0}]
Out[ ]= {px → 1.28191, py → 1.04721, pf → 1.20465}
In[ ]:= px1 = px /. %;
In[ ]:= py1 = py /. %%;
In[ ]:= pf1 = pf /. %%%;
```

In[ ]:= $P1 = \left(px1^{1-sigma} + by\ py1^{1-sigma} + bf\ (pf1\ (1+t))^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[ ]:= $qx1 = k\ P1^{sigma-1}\ px1^{-sigma};$

In[ ]:= $qy1 = k\ P1^{sigma-1}\ py1^{-sigma}\ by;$

In[ ]:= $qf1 = k\ P1^{sigma-1}\ (pf1\ (1+t))^{-sigma}\ bf;$

Percent Changes in Consumer Prices, No Efficiencies

In[◦]:= $\frac{(px1 - px0)\ 100}{px0}$

Out[◦]= 28.1909

In[◦]:= $\frac{(py1 - py0)\ 100}{py0}$

Out[◦]= 4.72103

In[◦]:= $\frac{(pf1\ (1 + t) - pf0\ (1 + t))\ 100}{pf0\ (1 + t)}$

Out[◦]= 20.4645

In[◦]:= $\frac{(P1 - P0)\ 100}{P0}$

Out[◦]= 17.1243

Percent Changes in Quantities and Employment, No Efficiencies

Domestic Shipments

In[◦]:= $\frac{(qx1 - qx0)\ 100}{qx0}$

Out[◦]= -40.5006

In[◦]:= $\frac{(qy1 - qy0)\ 100}{qy0}$

Out[◦]= 33.5997

Imports

In[◦]:= $\frac{(qf1 - qf0)\ 100}{qf0}$

Out[◦]= -23.7036

Domestic Employment

In[∘]:=
$$\frac{((qx1+qy1)-(qx0+qy0))\ 100}{(qx0+qy0)}$$

Out[∘]= -3.45048

New Equilibrium Values with Merger of X and F, With Efficiencies

Adopting best practices through IP transfer

In[∘]:= mx3 = Min[mx0, mf0];

In[∘]:= mf3 = Min[mx0, mf0];

In[∘]:= my3 = my0;

In[∘]:= $P3 = \left(px3^{1-sigma} + by\ py3^{1-sigma} + bf\ (pf3\ (1+t))^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[∘]:= $sharex3 = \left(\frac{px3}{P3}\right)^{1-sigma};$

In[∘]:= $sharey3 = \left(\frac{py3}{P3}\right)^{1-sigma} by;$

In[∘]:= $sharef3 = \left(\frac{pf3\ (1+t)}{P3}\right)^{1-sigma} bf;$

In[∘]:= $EqnX3 = px3 == (px3 - mx3)\ (sigma - (sigma - 1)\ sharex3) - (pf3 - mf0)\ (sigma - 1)\ sharex3 \left(\frac{pf3\ (1+t)}{px3}\right)^{-sigma} bf;$

In[∘]:= $EqnY3 = py3 == (py3 - my3)\ (sigma - (sigma - 1)\ sharey3);$

In[∘]:= $EqnF3 = pf3 == (pf3 - mf3)\ (sigma - (sigma - 1)\ sharef3) - \frac{(px3 - mx0)\ (sigma - 1)\ sharef3 \left(\frac{px3}{pf3\ (1+t)}\right)^{-sigma}}{bf};$

In[∘]:= FindRoot[{EqnX3, EqnY3, EqnF3}, {px3, px0}, {py3, py0}, {pf3, pf0}]

Out[∘]= {px3 → 1.13128, py3 → 1.03405, pf3 → 1.18893}

In[∘]:= px4 = px3 /. %;

In[∘]:= py4 = py3 /. %%;

In[∘]:= pf4 = pf3 /. %%%;

In[∘]:= $P4 = \left(px4^{1-sigma} + by\ py4^{1-sigma} + bf\ (pf4\ (1+t))^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[∘]:= $qx4 = k\ P4^{sigma-1}\ px4^{-sigma};$

In[∘]:= $qy4 = k\, P4^{sigma-1}\, py4^{-sigma}\, by;$

In[∘]:= $qf4 = k\, P4^{sigma-1}\, (pf4\,(1+t))^{-sigma}\, bf;$

Percent Changes in Consumer Prices, With Efficiencies

In[∘]:= $\frac{(px4 - px0)\,100}{px0}$

Out[∘]= 13.1283

In[∘]:= $\frac{(py4 - py0)\,100}{py0}$

Out[∘]= 3.40513

In[∘]:= $\frac{(pf4\,(1+t) - pf0\,(1+t))\,100}{pf0\,(1+t)}$

Out[∘]= 18.8927

In[∘]:= $\frac{(P4 - P0)\,100}{P0}$

Out[∘]= 12.8243

Percent Changes in Quantities and Employment, With Efficiencies

Domestic Shipments

In[∘]:= $\frac{(qx4 - qx0)\,100}{qx0}$

Out[∘]= -12.3155

In[∘]:= $\frac{(qy4 - qy0)\,100}{qy0}$

Out[∘]= 25.6146

Imports

In[∘]:= $\frac{(qf4 - qf0)\ 100}{qf0}$

Out[∘]= -28.1234

Domestic Employment

In[∘]:= $\frac{((qx4 + qy4) - (qx0 + qy0))\ 100}{(qx0 + qy0)}$

Out[∘]= 6.64954

New Equilibrium Values without Merger, With Greenfield Investment

```
In[∘]:= hc = Min[1.10, 1 + t];
In[∘]:= mf5 = mf0 hc;
In[∘]:= my5 = my0;
In[∘]:= mx5 = mx0;
```

In[∘]:= $P5 = \left(px5^{1-sigma} + by\ py5^{1-sigma} + bf\ pf5^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[∘]:= $sharex5 = \left(\frac{px5}{P5}\right)^{1-sigma};$

In[∘]:= $sharey5 = \left(\frac{py5}{P5}\right)^{1-sigma} by;$

In[∘]:= $sharef5 = \left(\frac{pf5}{P5}\right)^{1-sigma} bf;$

```
In[∘]:= EqnX5 = px5 == (px5 - mx5) (sigma - (sigma - 1) sharex5);
In[∘]:= EqnY5 = py5 == (py5 - my5) (sigma - (sigma - 1) sharey5);
In[∘]:= EqnF5 = pf5 == (pf5 - mf5) (sigma - (sigma - 1) sharef5);
In[∘]:= FindRoot[{EqnX5, EqnY5, EqnF5}, {px5, px0}, {py5, py0}, {pf5, pf0}]
Out[∘]= {px5 → 0.992698, py5 → 0.992698, pf5 → 1.13461}
In[∘]:= px6 = px5 /. %;
In[∘]:= py6 = py5 /. %%;
In[∘]:= pf6 = pf5 /. %%%;
```

In[∘]:= $P6 = \left(px6^{1-sigma} + by\ py6^{1-sigma} + bf\ pf6^{1-sigma}\right)^{\frac{1}{1-sigma}};$

In[∘]:= $qx6 = k\, P6^{sigma-1}\, px6^{-sigma};$

In[∘]:= $qy6 = k\, P6^{sigma-1}\, py6^{-sigma}\, by;$

In[∘]:= $qf6 = k\, P6^{sigma-1}\, pf6^{-sigma}\, bf;$

Percent Changes in Consumer Prices, With Greenfield Investment

In[∘]:= $$\frac{(px6 - px0)\ 100}{px0}$$

Out[∘]= -0.730197

In[∘]:= $$\frac{(py6 - py0)\ 100}{py0}$$

Out[∘]= -0.730197

In[∘]:= $$\frac{(pf6 - pf0\ (1 + t))\ 100}{pf0\ (1 + t)}$$

Out[∘]= -5.44909

In[∘]:= $$\frac{(P6 - P0)\ 100}{P0}$$

Out[∘]= -3.20443

Percent Changes in Quantities and Employment, With Greenfield Investment

Domestic Shipments

In[∘]:= $$\frac{(qx6 - qx0)\ 100}{qx0}$$

Out[∘]= -6.61056

In[∘]:= $$\frac{(qy6 - qy0)\ 100}{qy0}$$

Out[∘]= -6.61056

Imports

In[ ]:=
$$\frac{(0 - (qf0))\ 100}{(qf0)}$$

Out[ ]= -100.

Domestic Employment

In[ ]:=
$$\frac{((qf6 + qx6 + qy6) - (qx0 + qy0))\ 100}{(qx0 + qy0)}$$

Out[ ]= 87.9527