Translog Demand PE Model of Tariff Changes

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This industry-specific partial equilibrium (PE) model of trade policy quantifies the economic impacts of a tariff change on prices and quantities. Instead of CES preferences, this model uses transcendental logarithmic (translog) preferences originally proposed by Christensen, Jorgenson, and Lau (1975) and made popular in recent times by Feenstra and others. There are three sources of supply to a single market: domestic shipments (d), subject imports (s) and non-subject imports (n). The market operates under the perfect competition assumption.

The user inputs translog demand parameters, price elasticities of supply, original and new tariff rates, and initial expenditure and price data on domestic shipments, subject imports, and non-subject imports. The user can modify data inputs in the simulation by changing the values in the ORANGE - shaded lines in the notebook below. 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. The own- and cross-price elasticity values populate in BLUE.

In[ ]:=
```
ClearAll[f];
```

Demand Parameters

Coefficient on interaction of log prices of domestic and subject import goods

In[ ]:=
```
gammads = -0.4;
```

Coefficient on interaction of log prices of domestic and non-subject import goods

In[ ]:=
```
gammadn = -0.3;
```

Coefficient on interaction of log prices of subject import and non-subject import goods

In[ ]:=
```
gammasn = 0;
```

Coefficient on interaction of log prices of subject import and domestic goods (restricted)

In[ ]:=
```
gammasd = gammads;
```

Coefficient on interaction of log prices of non-subject and domestic goods (restricted)

In[ ]:=
```
gammand = gammadn;
```

Coefficient on interaction of log prices of non-subject and subject import goods (restricted)

In[ ]:=
```
gammans = gammasn;
```

Coefficient on log price of domestic good (restricted)

In[ ]:=
```
gammadd = -(gammads + gammadn);
```

Coefficient on log price of subject import good (restricted)

In[ ]:=
```
gammass = -(gammasd + gammasn);
```

Coefficient on log price of non-subject import good (restricted)

In[ ]:=
```
gammann = -(gammand + gammans);
```

Price Elasticities of Supply

Policy Shocks

Data Inputs for Initial Equilibrium

Calibration of Parameters

Calculation of Uncompensated Elasticities of Demand

In[∘]:=

$$\text{etadd} = -1 + \left(\frac{\text{gammadd}}{(\text{vd0}/\text{M})} - (\text{gammads} + \text{gammadd} + \text{gammadn})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1+\text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[∘]= -2.

In[∘]:=

$$\text{etass} = -1 + \left(\frac{\text{gammass}}{(\text{vs0}/\text{M})} - (\text{gammass} + \text{gammasd} + \text{gammasn})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1+\text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[∘]= -3.

In[∘]:=

$$\text{etann} = -1 + \left(\frac{\text{gammann}}{(\text{vn0}/\text{M})} - (\text{gammans} + \text{gammand} + \text{gammann})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1+\text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[∘]= -4.

In[∘]:=

$$\text{etads} = \left(\frac{\text{gammads}}{(\text{vd0}/\text{M})} - (\text{gammads} + \text{gammadd} + \text{gammadn})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1+\text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[∘]= 0.571429

In[ ]:=

$$\text{etadn} = \left(\frac{\text{gammadn}}{(\text{vd0}/\text{M})} - (\text{gammads} + \text{gammadd} + \text{gammadn})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1 + \text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[ ]= 0.428571

In[ ]:=

$$\text{etasn} = \left(\frac{\text{gammasn}}{(\text{vs0}/\text{M})} - (\text{gammasn} + \text{gammasd} + \text{gammass})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1 + \text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[ ]= 0.

In[ ]:=

$$\text{etasd} = \left(\frac{\text{gammasd}}{(\text{vs0}/\text{M})} - (\text{gammasn} + \text{gammasd} + \text{gammass})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1 + \text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[ ]= 2.

In[ ]:=

$$\text{etand} = \left(\frac{\text{gammand}}{(\text{vn0}/\text{M})} - (\text{gammann} + \text{gammand} + \text{gammans})\right) \Big/ \left(-1 + (\text{gammads} + \text{gammans} + \text{gammass})\,\text{Log}\left[\frac{\text{ps0}\,(1 + \text{ts0})}{\text{M}}\right] + (\text{gammadn} + \text{gammann} + \text{gammasn})\,\text{Log}\left[\frac{\text{pn0}}{\text{M}}\right] + (\text{gammadd} + \text{gammand} + \text{gammasd})\,\text{Log}\left[\frac{\text{pd0}}{\text{M}}\right]\right)$$

Out[ ]= 3.

In[∘]:=
```
etans = (gammans/(vn0/M) - (gammann + gammand + gammans))/
  (-1 + (gammads + gammans + gammass) Log[ps0 (1 + ts0)/M] +
    (gammadn + gammann + gammasn) Log[pn0/M] + (gammadd + gammand + gammasd) Log[pd0/M])
```

Out[∘]= 0.

Changes in Equilibrium Prices and Quantities

In[∘]:= `qd = bd pd^ed;`

In[∘]:= `qs = bs ps^es;`

In[∘]:= `qn = bn pn^en;`

In[∘]:=
```
EQd1 = qd pd/M == ((alphaD + (gammads Log[ps (1 + ts1)/M] + gammadn Log[pn/M] + gammadd Log[pd/M]))/
    ((alphaD + alphaN + alphaS) + (gammads + gammans + gammass) Log[ps (1 + ts1)/M] +
      (gammadn + gammann + gammasn) Log[pn/M] + (gammadd + gammand + gammasd) Log[pd/M]));
```

In[∘]:=
```
EQs1 = qs ps (1 + ts1)/M ==
   ((alphaS + (gammass Log[ps (1 + ts1)/M] + gammasn Log[pn/M] + gammasd Log[pd/M]))/
    ((alphaD + alphaN + alphaS) + (gammads + gammans + gammass) Log[ps (1 + ts1)/M] +
      (gammadn + gammann + gammasn) Log[pn/M] + (gammadd + gammand + gammasd) Log[pd/M]));
```

In[∘]:=
```
EQn1 = qn pn/M == ((alphaN + (gammans Log[ps (1 + ts1)/M] + gammann Log[pn/M] + gammand Log[pd/M]))/
    ((alphaD + alphaN + alphaS) + (gammads + gammans + gammass) Log[ps (1 + ts1)/M] +
      (gammadn + gammann + gammasn) Log[pn/M] + (gammadd + gammand + gammasd) Log[pd/M]));
```

In[∘]:= `FindRoot[{EQd1, EQs1, EQn1}, {pd, pd0}, {ps, ps0}, {pn, pn0}]`

Out[∘]= {pd → 1.01078, ps → 0.979195, pn → 1.00228}

In[∘]:= `pd1 = pd /. %;`

In[ ]:=
```
ps1 = ps /. %%;
```

In[ ]:=
```
pn1 = pn /. %%%;
```

In[ ]:= $qd1 = bd\, pd1^{ed};$

In[ ]:= $qs1 = bs\, ps1^{es};$

In[ ]:= $qn1 = bn\, pn1^{en};$

% Change in price of domestic shipments

In[ ]:= $$\frac{(pd1 - pd0)\ 100}{pd0}$$

Out[ ]= 1.0783

% Change in producer price of subject imports

In[ ]:= $$\frac{(ps1 - ps0)\ 100}{ps0}$$

Out[ ]= -2.08049

% Change in consumer price of subject imports

In[ ]:= $$\frac{(ps1\ (1 + ts1) - pd0\ (1 + ts0))\ 100}{pd0\ (1 + ts0)}$$

Out[ ]= 7.71146

% Change in producer price of non-subject imports

In[ ]:= $$\frac{(pn1 - pn0)\ 100}{pn0}$$

Out[ ]= 0.22783

% Change in the quantity of domestic shipments

In[ ]:= $$\frac{(qd1 - qd0)\ 100}{qd0}$$

Out[ ]= 2.16823

% Change in the quantity of subject imports

In[ ]:= $$\frac{(qs1 - qs0)\ 100}{qs0}$$

Out[ ]= -18.9614

% Change in the quantity of non-subject imports

In[ ]:= $$\frac{(qn1 - qn0)\ 100}{qn0}$$

Out[ ]= 2.3018