IUU Fishing: Economic Effects of IUU Imports on U.S. Commercial Fishers

Species: Squid

Model Release

Read Me :
This model accompanies the USITC report, *Seafood Obtained via Illegal, Unreported, and Unregulated Fishing: U.S. Imports and Economic Impact on U.S. Commercial Fisheries*, Inv. 332-575. The report includes a quantitative analysis of the economic impact of IUU imports on U.S. commercial fishers and U.S. commercial fishing production, trade, and prices. Economic effects are modeled by species, with each species-level model customized to fit the unique features of the U.S. domestic industry. Consumers of seafood products choose between domestic marine-capture sources, imports, and in some models, domestic aquaculture products. Imports include both legal and IUU sources that enter the U.S. at the same price, so consumers cannot distinguish an IUU from non-IUU product. 2018 data is used to establish an initial equilibrium with imports of IUU products included in the baseline. The model then removes the IUU imports, as estimated in chapter 3, and solves for a new equilibrium absent those products.

Data inputs in the simulation are in the BLUE-shaded cells (with sources for the input data listed in the cell above). Outputs are in the GREEN-shaded cells. The white cells are intermediate calculations.

This PDF is a printout of the Mathematica file “IUU Fishing Model - squid - model release.nb”

In[914]:=
```
ClearAll[f];
```

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Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020). More information can be found in the technical appendix (appendix I).

Unprocessed products

In[915]:=
```
sigmau = 4.108653;
```

Processed products

In[916]:=
```
sigmap = 4.108653;
```

1.2 Industry Price Elasticity of Demand

Source: USITC Staff Estimate.

Unprocessed products

In[917]:=
```
etau = -1;
```

Processed products

In[918]:=
```
etap = -1;
```

1.3 Illegal Imports Replacement Rates

Source: USITC Staff Estimate. Further discussion on qualitative factors and rate determination can be found in appendix I of the USITC's report.

Unprocessed products

In[919]:=
```
replu = 0.30;
```

Processed products

In[920]:=
```
replp = 0.30;
```

1.4 Price Elasticity of Supply

Source: USITC Staff Estimate and Interviews with Industry Participants.

Unprocessed production

In[921]:=
```
eu = 5;
```

Processed production

In[922]:=
```
ep = 5;
```

2. Data Inputs

2.1 U.S. Landings Quantities and Prices

Source: National Oceanic and Atmospheric Administration. National Marine Fisheries Service (NOAA Fisheries). Fisheries of the United States 2018. Current Fishery Statistics No. 2018. U.S. Department of Commerce. Silver Spring MD: NOAA, February 2020. https://www.-fisheries.noaa.gov/resource/document/fisheries-united-states-2018-report.

In[923]:=
```
qdu0 = 73 313 000; (*kg*)
```

In[924]:=
```
pdu0 = 1.391759; (*$/kg*)
```

2.2 U.S. Processing Quantities and Prices

Sources:
National Oceanic and Atmospheric Administration. National Marine Fisheries Service (NOAA Fisheries). Fisheries of the United States 2018. Current Fishery Statistics No. 2018. U.S. Department of Commerce. Silver Spring MD: NOAA, February 2020. https://www.fish-eries.noaa.gov/resource/document/fisheries-united-states-2018-report.

National Oceanic and Atmospheric Administration. National Marine Fisheries Service (NOAA Fisheries). NOAA Processed Products database. Accessed September 1, 2020.https://www.fisheries.noaa.gov/foss/f?p=215:3:5412288074334::NO:::

In[925]:=
```
qdp0 = 31 163 478; (*kg*)
```

In[926]:=
```
pdp0 = 5.071207; (*$/kg*)
```

2.3 Import Quantities and Prices

Source: IUU Estimate Database as described in Chapter 3 of the report.

Total imports - unprocessed product

In[927]:=
```
qtu0 = 65 587 375; (*kg*)
```

In[928]:=
```
ptu0 = 5.12294; (*$/kg*)
```

Total imports - processed product

In[929]:=
```
qtp0 = 8 653 982; (*kg*)
```

In[930]:=
```
ptp0 = 6.55629; (*$/kg*)
```

Total illegal imports, unprocessed

In[931]:=
```
qiu0 = 19 059 585; (*kg*)
```

Total illegal imports, processed

In[932]:=
```
qip0 = 2 037 577; (*kg*)
```

Calculation of legal imports

In[933]:=
```
qlu0 = qtu0 - qiu0;
```

In[934]:=
```
qlp0 = qtp0 - qip0;
```

2.4 Export Quantities

Source:National Oceanic and Atmospheric Administration. National Marine Fisheries Service (NOAA Fisheries). NOAA US Trade in Fishery Products database. Accessed September 1, 2020. https://foss.nmfs.noaa.gov/apexfoss/f?p=215:2:14884747663545::NO

In[935]:=
```
qdue0 = 62 150 977; (*kg*)
```

In[936]:=
```
qdpe0 =  889 506; (*kg*)
```

2.5 Catch Limits

Sources:
California Department of Fish and Wildlife, "Market Squid Fishery Management Plan (MSFMP)," accessed November 19, 2020, https://wildlife.ca.gov/Conservation/Marine/MSFMP.

NOAA, "Fisheries of the Northeastern United States; Atlantic Mackerel, Squid, and Butterfish Fisheries," Federal Register, December 13, 2017, https://www.federalregister.gov/documents/2017/12/13/2017-26840/fisheries-of-the-northeastern-united-states-atlantic-mackerel-squid-and-butterfish-fisheries.

In[937]:=
```
qdcap = 163 847 000; (*kg*)
```

2.6 Import Market Share Statistics

In[938]:=
```
N[qtu0 / (qtu0 + qdu0 - qdue0)]
```
Out[938]=
```
0.854565
```

In[939]:=
```
N[qtp0 / (qtp0 + qdp0 - qdpe0)]
```
Out[939]=
```
0.222308
```

3. Calibration

Baseline values of domestic apparent consumption and imports

In[940]:=
```
vtu0 = qtu0 ptu0;
```

In[941]:=
```
vtp0 = qtp0 ptp0;
```

In[942]:=
```
vdu0 = (qdu0 - qdue0) pdu0;
```

In[943]:=
```
vdp0 = (qdp0 - qdpe0) pdp0;
```

3.1 Supply Parameters

In[944]:=
```
edu = N[eu qdu0 / (qdcap - qdu0)];
```

In[945]:=
```
adu = (qdcap - qdu0) pdu0^edu;
```

In[946]:=
```
adp = qdp0 pdp0^-ep;
```

3.2 Demand Parameters

In[947]:=
```
btu = vtu0 / vdu0 (ptu0 / pdu0)^(sigmau-1);
```

In[948]:=
```
Pu0 = (pdu0^(1-sigmau) + btu ptu0^(1-sigmau))^(1/(1-sigmau));
```

In[949]:=
```
btp = vtp0 / vdp0 (ptp0 / pdp0)^(sigmap-1);
```

In[950]:=
```
Pp0 = (pdp0^(1-sigmap) + btp ptp0^(1-sigmap))^(1/(1-sigmap));
```

In[951]:=
```
ku = qtu0 Pu0^(-etau-sigmau) ptu0^sigmau / btu;
```

In[952]:=
```
kp = qtp0 Pp0^(-etap-sigmap) ptp0^sigmap / btp;
```

4. New Equilibrium Calculation

In[953]:= $Pu = \left(pdu^{1-sigmau} + btu\ ptu^{1-sigmau}\right)^{\frac{1}{1-sigmau}};$

In[954]:= $Pp = \left(pdp^{1-sigmap} + btp\ ptp^{1-sigmap}\right)^{\frac{1}{1-sigmap}};$

Equilibrium equations

Total supply (landings) of squid = exports + consumer demand

In[955]:= $E1 = qdcap - adu\ pdu^{-edu} == qdue0 + ku\ Pu^{etau+sigmau}\ pdu^{-sigmau};$

Supply of imported unprocessed product = Demand for imported unprocessed product

In[956]:= $E2 = qlu0 + replu\ qiu0 == ku\ btu\ Pu^{etau+sigmau}\ ptu^{-sigmau};$

Supply of imported processed product = Demand for imported processed product

In[957]:= $E3 = qlp0 + replp\ qip0 == kp\ btp\ Pp^{etap+sigmap}\ ptp^{-sigmap};$

Supply of processed domestic product = Demand of processed domestic product

In[958]:= $E4 = adp\ pdp^{ep} == qdpe0 + kp\ Pp^{etap+sigmap}\ pdp^{-sigmap};$

In[959]:=
```
FindRoot[{E1, E2, E3, E4}, {pdu, pdu0}, {ptu, ptu0}, {ptp, ptp0}, {pdp, pdp0}]
```

Out[959]= {pdu → 1.42025, ptu → 6.23123, ptp → 6.95455, pdp → 5.10541}

In[960]:= $pdu1 = pdu\ /.\ \%;$

In[961]:= $ptu1 = ptu\ /.\ \%\%;$

In[962]:= $ptp1 = ptp\ /.\ \%\%\%;$

In[963]:= $pdp1 = pdp\ /.\ \%\%\%\%;$

In[964]:= $Pu1 = \left(pdu1^{1-sigmau} + btu\ ptu1^{1-sigmau}\right)^{\frac{1}{1-sigmau}};$

In[965]:= $Pp1 = \left(pdp1^{1-sigmap} + btp\ ptp1^{1-sigmap}\right)^{\frac{1}{1-sigmap}};$

In[966]:= $qdu1 = qdcap - adu\ pdu1^{-edu};$

In[967]:= $qtu1 = qlu0 + replu\ qiu0;$

In[968]:= $qtp1 = qlp0 + replp\ qip0;$

In[969]:= $qdp1 = qdpe0 + kp\ Pp1^{etap+sigmap}\ pdp1^{-sigmap};$

5. Results

Unprocessed product

Percent change in price of unprocessed domestic production

In[970]:=
$$\frac{(\text{pdu1} - \text{pdu0})\ 100}{\text{pdu0}}$$

Out[970]= 2.04683

Percent change in price of unprocessed imports

In[971]:=
$$\frac{(\text{ptu1} - \text{ptu0})\ 100}{\text{ptu0}}$$

Out[971]= 21.6339

Percent change in unprocessed price index

In[972]:=
$$\frac{(\text{Pu1} - \text{Pu0})\ 100}{\text{Pu0}}$$

Out[972]= 20.4045

Percent change in quantity of landings

In[973]:=
$$\frac{(\text{qdu1} - \text{qdu0})\ 100}{\text{qdu0}}$$

Out[973]= 9.7264

Quantity (kg) change in landings

In[974]:=
```
qdu1 - qdu0
```

Out[974]= 7.13072×10^6

Percent change in quantity of unprocessed imports

In[975]:=
$$\frac{(\text{qtu1} - \text{qtu0})\ 100}{\text{qtu0}}$$

Out[975]= −20.3419

Change ($) in operating income, unprocessed product

In[976]:=
```
(1 / sigmau) (pdu1 (qdu1 - qdue0) - pdu0 (qdu0 - qdue0))
```

Out[976]= 2.54228×10^6

Processed Product

Percent change in price of processed domestic production

In[977]:=
$$\frac{(\text{pdp1} - \text{pdp0})\ 100}{\text{pdp0}}$$

Out[977]= 0.674361

Percent change in price of processed imports

In[978]:=
$$\frac{(\text{ptp1} - \text{ptp0})\ 100}{\text{ptp0}}$$

Out[978]= 6.07445

Percent change in processed price index

In[979]:=
$$\frac{(\text{Pp1} - \text{Pp0})\ 100}{\text{Pp0}}$$

Out[979]= 2.02068

Percent change in quantity of processed domestic product

In[980]:=
$$\frac{(\text{qdp1} - \text{qdp0})\ 100}{\text{qdp0}}$$

Out[980]= 3.41759

Percent change in quantity of processed imports

In[981]:=
$$\frac{(\text{qtp1} - \text{qtp0})\ 100}{\text{qtp0}}$$

Out[981]= −16.4815

Change ($) in operating income, processed product

In[982]:=
$$(1 / \text{sigmap})\ (\text{pdp1}\ (\text{qdp1} - \text{qdpe0})\ -\ \text{pdp0}\ (\text{qdp0} - \text{qdpe0}))$$

Out[982]= 1.5754×10^6