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

Species: Snow crab

Model Release

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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 below). 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 - snow crab - model release.nb”

In[493]:=
```
ClearAll[f];
```

Table of Contents

1. 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[494]:=
```
sigmau = 8.991679;
```

Processed products

In[495]:=
```
sigmap = 8.991679;
```

1.2 Industry Price Elasticity of Demand

Source: USITC Staff Estimate.

Unprocessed products

In[496]:=
```
etau = -1;
```

Processed products

In[497]:=
```
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[498]:=
```
replu = 0.30;
```

Processed products

In[499]:=
```
replp = 0.30;
```

1.4 Price Elasticity of Supply

Source: USITC Staff Estimate and Interviews with Industry Participants.

Unprocessed production

In[500]:=
```
ed = 5;
```

1.5 Conversion Factors

Source: Conversion factors were obtained from NOAA Fisheries

In[501]:=
```
cr = 4.5;
```

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[502]:=
```
qdu0 = 10̸377̸000; (*kg*)
```

In[503]:=
```
pdu0 = 6.7043; (*$/kg*)
```

2.2 U.S. Processing Production 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[504]:=
```
qdp0 = 48̸423; (*kg*)
```

In[505]:=
```
pdp0 = 11.8335; (*$/kg*)
```

2.3 Import Quantities and Prices

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

Total imports, unprocessed product

In[506]:=
```
qtu0 = 41,725,550 ; (*kg*)
```

In[507]:=
```
ptu0 = 17.2412; (*$/kg*)
```

Total imports, processed product

In[508]:=
```
qtp0 = 3,068,901; (*kg*)
```

In[509]:=
```
ptp0 = 18.934; (*$/kg*)
```

Total illegal imports, unprocessed

In[510]:=
```
qiu0 = 2,442,591; (*kg*)
```

Total illegal imports, processed

In[511]:=
```
qip0 = 441,862; (*kg*)
```

Calculation of legal imports

In[512]:=
```
qlu0 = qtu0 - qiu0;
```

In[513]:=
```
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[514]:=
```
qdue0 = 2,479,533; (*kg*)
```

In[515]:=
```
qdpe0 =  0; (*kg*)
```

2.5 Catch Limits

Source:North Pacific Fishery Management Council, "Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions."

In[516]:=
```
qdcap = 40,500,000; (*kg*)
```

2.6 Import Market Share Statistics

In[517]:=
```
N[qtu0 / (qdu0 + qtu0 - qdue0)]
```

Out[517]=
```
0.840851
```

In[518]:= `N[qtp0 / (qdp0 + qtp0 - qdpe0)]`

Out[518]= `0.984466`

3. Calibration

Baseline values of domestic apparent consumption and imports

In[519]:= `vtu0 = qtu0 ptu0;`

In[520]:= `vtp0 = qtp0 ptp0;`

In[521]:= `vdu0 = (qdu0 - qdue0 - cr qdp0) pdu0;`

In[522]:= `vdp0 = (qdp0 - qdpe0) pdp0;`

3.1 Supply Parameters

In[523]:= $edu = N\left[ed \frac{qdu0}{(qdcap - qdu0)}\right];$

In[524]:= $adu = (qdcap - qdu0)\ pdu0^{edu};$

3.2 Demand Parameters

In[525]:= $btu = \frac{vtu0}{vdu0}\left(\frac{ptu0}{pdu0}\right)^{sigmau-1};$

In[526]:= $Pu0 = \left(pdu0^{1-sigmau} + btu\ ptu0^{1-sigmau}\right)^{\frac{1}{1-sigmau}};$

In[527]:= $btp = \frac{vtp0}{vdp0}\left(\frac{ptp0}{pdp0}\right)^{sigmap-1};$

In[528]:= $Pp0 = \left(pdp0^{1-sigmap} + btp\ ptp0^{1-sigmap}\right)^{\frac{1}{1-sigmap}};$

In[529]:= $ku = \frac{qtu0\ Pu0^{-etau-sigmau}\ ptu0^{sigmau}}{btu};$

In[530]:= $kp = \frac{qtp0\ Pp0^{-etap-sigmap}\ ptp0^{sigmap}}{btp};$

4. New Equilibrium Calculation

In[531]:= $Pu = \left(pdu^{1-sigmau} + btu\ ptu^{1-sigmau}\right)^{\frac{1}{1-sigmau}};$

In[532]:= $pdp = \frac{pdu\ pdp0}{pdu0};$

In[533]:= $Pp = \left(pdp^{1-sigmap} + btp\ ptp^{1-sigmap}\right)^{\frac{1}{1-sigmap}};$

Equilibrium equations

Total supply (landings) of wild caught = exports + consumer demand for whole fish + consumer demand for processed fish

In[534]:=
$$E1 = qdcap - adu\ pdu^{-edu} == qdue0 + cr\ qdpe0 + ku\ Pu^{etau+sigmau}\ pdu^{-sigmau} + cr\ kp\ Pp^{etap+sigmap}\ pdp^{-sigmap};$$

Supply of imported unprocessed product = Demand for imported unprocessed product

In[535]:=
$$E2 = qlu0 + replu\ qiu0 == ku\ btu\ Pu^{etau+sigmau}\ ptu^{-sigmau};$$

Supply of imported processed product = Demand for imported processed product

In[536]:=
$$E3 = qlp0 + replp\ qip0 == kp\ btp\ Pp^{etap+sigmap}\ ptp^{-sigmap};$$

In[537]:=
```
FindRoot[{E1, E2, E3}, {pdu, pdu0}, {ptu, ptu0},
 {ptp, ptp0}, AccuracyGoal → 7, PrecisionGoal → 7]
```

Out[537]=
```
{pdu → 6.82808, ptu → 17.8257, ptp → 20.8757}
```

In[538]:=
$$pdu1 = pdu /. \%;$$

In[539]:=
$$ptu1 = ptu /. \%\%;$$

In[540]:=
$$ptp1 = ptp /. \%\%\%;$$

In[541]:=
$$pdp1 = \frac{pdu1\ pdp0}{pdu0};$$

In[542]:=
$$Pu1 = \left(pdu1^{1-sigmau} + btu\ ptu1^{1-sigmau}\right)^{\frac{1}{1-sigmau}};$$

In[543]:=
$$Pp1 = \left(pdp1^{1-sigmap} + btp\ ptp1^{1-sigmap}\right)^{\frac{1}{1-sigmap}};$$

In[544]:=
$$qdu1 = qdcap - adu\ pdu1^{-edu};$$

In[545]:=
$$qtu1 = qlu0 + replu\ qiu0;$$

In[546]:=
$$qtp1 = qlp0 + replp\ qip0;$$

In[547]:=
$$qdp1 = qdpe0 + kp\ Pp1^{etap+sigmap}\ pdp1^{-sigmap};$$

5. Results

Unprocessed product

Percent change in price of unprocessed domestic production

In[548]:=
$$\frac{(pdu1 - pdu0)\ 100}{pdu0}$$

Out[548]=
```
1.84623
```

Percent change in price of unprocessed imports

In[549]:=
$$\frac{(\text{ptu1} - \text{ptu0})\ 100}{\text{ptu0}}$$

Out[549]= 3.39042

Percent change in unprocessed price index

In[550]:=
$$\frac{(\text{Pu1} - \text{Pu0})\ 100}{\text{Pu0}}$$

Out[550]= 3.28053

Percent change in quantity of landings

In[551]:=
$$\frac{(\text{qdu1} - \text{qdu0})\ 100}{\text{qdu0}}$$

Out[551]= 9.00437

Quantity (kg) change in landings

In[552]:=
```
qdu1 - qdu0
```

Out[552]= 934,384.

Percent change in quantity of unprocessed imports

In[553]:=
$$\frac{(\text{qtu1} - \text{qtu0})\ 100}{\text{qtu0}}$$

Out[553]= -4.09776

Change ($) in operating income, unprocessed product

In[554]:=
```
(1 / sigmau) (pdu1 (qdu1 - qdue0 - cr qdp1) - pdu0 (qdu0 - qdue0 - cr qdp0))
```

Out[554]= 677,075.

Processed Product

Percent change in price of processed domestic production

In[555]:=
$$\frac{(\text{pdp1} - \text{pdp0})\ 100}{\text{pdp0}}$$

Out[555]= 1.84623

Percent change in price of processed imports

In[556]:=
$$\frac{(\text{ptp1} - \text{ptp0})\ 100}{\text{ptp0}}$$

Out[556]= 10.2553

Percent change in processed price index

In[557]:=
$$\frac{(\text{Pp1} - \text{Pp0})\ 100}{\text{Pp0}}$$

Out[557]= 10.1366

Percent change in quantity of processed domestic product

In[558]:=
$$\frac{(\text{qdp1} - \text{qdp0})\ 100}{\text{qdp0}}$$

Out[558]= 83.5125

Percent change in quantity of processed imports

In[559]:=
$$\frac{(\text{qtp1} - \text{qtp0})\ 100}{\text{qtp0}}$$

Out[559]= −10.0786

Change ($) in operating income, processed product

In[560]:=
$$(1 / \text{sigmap})\ (\text{pdp1}\ (\text{qdp1} - \text{qdpe0}) - \text{pdp0}\ (\text{qdp0} - \text{qdpe0}))$$

Out[560]= 55 379.2