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

## Species: King Crab

*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 - king crab - model release.nb”

In[81]:=
```
ClearAll[f];
```

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## 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).*

In[82]:=
```
sigmak = 10.72781;
```

## 1.2 Industry Price Elasticity of Demand

*Source: USITC Staff Estimate.*

In[83]:=
```
eta = -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.*

In[84]:=
```
repl = 0.30;
```

## 1.4 Price Elasticity of Supply

*Source: USITC Staff Estimate and Interviews with Industry Participants.*

In[85]:=
```
ed = 2;
```

# 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[86]:=
```
qkd0 = 5,070,000;(*kg*)
```

In[87]:=
```
pkd0 = 13.2560; (*$/kg*)
```

### 2.2 Import Quantities and Prices

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

Total imports

In[88]:=
```
qkt0 = 11,100,444;(*kg*)
```

In[89]:=
```
pkt0 = 32.323; (*$/kg*)
```

Illegal imports

In[90]:=
```
qki0 = 1,779,480 ;(*kg*)
```

Calculation of legal imports

In[91]:=
```
qkl0 = qkt0 - qki0;
```

### 2.3 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[92]:=
```
qke0 = 1,332,202; (*kg*)
```

### 2.4 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," September 2018, https://www.npfmc.org/wp-content/PDFdocuments/resources/SAFE/CrabSAFE/2018/INTRO_SAFE_2018.pdf.*

In[93]:=
```
qkcap = 9,040,870; (*kg*)
```

### 2.5 Import Market Share Statistics

In[94]:=
```
N[qkt0 / (qkt0 + qkd0 - qke0)]
```

Out[94]=
```
0.748097
```

## 3. Calibration

Baseline values of domestic apparent consumption and imports

In[95]:= $vkd0 = (qkd0 - qke0)\, pkd0;$

In[96]:= $vkt0 = qkt0\, pkt0;$

### 3.1 Supply Parameters

In[97]:= $ekd = ed \frac{qkd0}{(qkcap - qkd0)};$

In[98]:= $akd = (qkcap - qkd0)\, pkd0^{ekd};$

### 3.2 Demand Parameters

In[99]:= $bkt = \frac{vkt0}{vkd0} \left(\frac{pkt0}{pkd0}\right)^{sigmak-1};$

In[100]:= $pkind0 = \left(pkd0^{1-sigmak} + bkt\, pkt0^{1-sigmak}\right)^{\frac{1}{1-sigmak}};$

In[101]:= $k = (qkd0 - qke0)\, pkind0^{-sigmak-eta}\, pkd0^{sigmak};$

## 4. New Equilibrium Calculation

In[102]:= $qkt = qkl0 + qki0\,(repl);$

In[103]:= $pkind = \left(pkd^{1-sigmak} + bkt\, pkt^{1-sigmak}\right)^{\frac{1}{1-sigmak}};$

**Equilibrium equations**

Supply (landings) of king crab = exports + consumer demand

In[104]:= $Eqnk1 = qkcap - akd\, pkd^{-ekd} == qke0 + k\, pkind^{sigmak+eta}\, pkd^{-sigmak};$

Supply of imported king crab = demand for imported product

In[105]:= $Eqnk2 = qkt == k\, bkt\, pkind^{sigmak+eta}\, pkt^{-sigmak};$

In[106]:= `FindRoot[{Eqnk1, Eqnk2}, {pkd, pkd0}, {pkt, pkt0}]`

Out[106]= $\{pkd \to 14.106,\ pkt \to 35.2521\}$

In[107]:= `pkd1 = pkd /. %;`

In[108]:= `pkt1 = pkt /. %%;`

In[109]:= $qkd1 = qkcap - akd\, pkd1^{-ekd};$

In[110]:= $qkt1 = qkl0 + qki0\,(repl);$

In[111]:= $pkind1 = \left(pkd1^{1-sigmak} + bkt\, pkt1^{1-sigmak}\right)^{\frac{1}{1-sigmak}};$

## 5. Results

Percent change in domestic price of king crab landings

In[112]:= $(\text{pkd1} - \text{pkd0}) \frac{100}{\text{pkd0}}$

Out[112]= 6.41188

Percent change in import price of king crab

In[113]:= $(\text{pkt1} - \text{pkt0}) \frac{100}{\text{pkt0}}$

Out[113]= 9.06206

Percent change in king crab price index

In[114]:= $(\text{pkind1} - \text{pkind0}) \frac{100}{\text{pkind0}}$

Out[114]= 8.70077

Percent change in domestic production of king crab

In[115]:= $(\text{qkd1} - \text{qkd0}) \frac{100}{\text{qkd0}}$

Out[115]= 11.4933

Percent change in total imports of king crab

In[116]:= $(\text{qkt1} - \text{qkt0}) \frac{100}{\text{qkt0}}$

Out[116]= -11.2215

Change ($) in Operating Income

In[117]:= N[1 / sigmak (pkd1 (qkd1 - qke0) - pkd0 (qkd0 - qke0))]

Out[117]= $1.06235 \times 10^{6}$

Change (kg) in landings

In[118]:= qkd1 - qkd0

Out[118]= 582,711.