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

Species: Atlantic salmon, chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon

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.

In the salmon model, there are domestic and imported varieties of atlantic, chinook, chum, coho, pink, and sockeye salmon species. The model includes cross-species substitution, so relative price changes in one species affects the other species. Landings of some of the domestic varieties are potentially constrained by low supply elasticities to capture their endangered species status. There are two markets modeled: unprocessed and processed products. Landings flow to three destinations: the unprocessed market, the processed market, or are exported outside the country. The price of the processed product is a constant markup over the price of the unprocessed product, so increases in domestic prices of landed fish affect the price of processing. Initial consumption of unprocessed products, before the policy change was implemented, was calculated as a residual using 2018 conversion factors.

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.

Note: p_xDU is the price of the unprocessed product sold to consumers. q_xDU is the quantity of landings, not the unprocessed quantity sold to U.S. consumers. The unprocessed quantity sold to U.S. consumers must exclude exports and processed product * conversion rate.

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

In[1]:=
```
ClearAll[f];
```

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1. Model Parameters

1.1 Within-Species 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 Atlantic salmon: elasticity of substitution across varieties of unprocessed atlantic salmon

In[2]:=
```
sigmaau = 5.1416;
```

Unprocessed chinook salmon: elasticity of substitution across varieties of unprocessed chinook salmon

In[3]:=
```
sigmacu = 4.0159 ;
```

Unprocessed chum salmon: elasticity of substitution across varieties of unprocessed chum salmon

In[4]:=
```
sigmahu = 4.0159;
```

Unprocessed coho salmon: elasticity of substitution across varieties of unprocessed coho salmon

In[5]:=
```
sigmaou = 4.0159;
```

Unprocessed pink salmon: elasticity of substitution across varieties of unprocessed pink salmon

In[6]:=
```
sigmapu = 4.0159;
```

Unprocessed sockeye salmon: elasticity of substitution across varieties of unprocessed sockeye salmon

In[7]:=
```
sigmasu = 4.0159;
```

Processed chinook salmon: elasticity of substitution across varieties of processed chinook salmon

In[8]:=
```
sigmacp = 4.0159;
```

Processed chum salmon: elasticity of substitution across varieties of processed chum salmon

In[9]:=
```
sigmahp = 4.0159;
```

Processed coho salmon: elasticity of substitution across varieties of processed coho salmon

In[10]:=
```
sigmaop = 4.0159;
```

Processed pink salmon: elasticity of substitution across varieties of processed pink salmon

In[11]:=
```
sigmapp = 4.0159;
```

Processed sockeye salmon: elasticity of substitution across varieties of processed sockeye salmon

In[12]:=
```
sigmasp = 4.0159 ;
```

1.2 Cross-Species Elasticity of Substitution

Source: USITC Staff Estimate and Interviews with Industry Participants.

Unprocessed: elasticity of substitution across unprocessed products

In[13]:=
```
betau = 3.0;
```

Processed: elasticity of substitution across processed products

In[14]:=
```
betap = 3.0;
```

1.3 Industry Price Elasticity of Demand

Source: USITC Staff Estimate.

Unprocessed

In[15]:=
```
etau = -1.0;
```

Processed

In[16]:=
```
etap = -1.0;
```

1.4 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.

Atlantic salmon: fraction of illegal imports replaced by legal imports of atlantic salmon

In[17]:=
```
repla = 0.3;
```

Chinook salmon: fraction of illegal imports replaced by legal imports of chinook salmon

In[18]:=
```
replc = 0.3;
```

Chum salmon: fraction of illegal imports replaced by legal imports of chum salmon

In[19]:=
```
replh = 0.3;
```

Coho salmon: fraction of illegal imports replaced by legal imports of coho salmon

In[20]:=
```
replo = 0.3;
```

Pink salmon: fraction of illegal imports replaced by legal imports of pink salmon

In[21]:=
```
replp = 0.3 ;
```

Sockeye salmon: fraction of illegal imports replaced by legal imports of sockeye salmon

In[22]:=
```
repls = 0.3;
```

1.5 Price Elasticity of Supply

Source: USITC Staff Estimate and Interviews with Industry Participants.

U.S. production of Atlantic salmon

In[23]:=
```
eau = 5.0;
```

U.S. landings of chinook salmon

In[24]:=
```
ecd = 2.0;
```

U.S. landings of chum salmon

In[25]:=
```
ehd = 2.0;
```

U.S. landings of coho salmon

In[26]:=
```
eod = 2.0;
```

U.S. landings of pink salmon

In[27]:=
```
epd = 5.0;
```

U.S. landings of sockeye salmon

In[28]:=
```
esd = 2.0;
```

1.6 Conversion Factors

Source: Conversion factors were obtained from NOAA Fisheries

In[29]:=
```
cr = 1.52;
```

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.

Chinook

In[30]:=
```
qcdu0 = 3,281,000.00;(*kg*)
```

In[31]:=
```
pcdu0 = 11.7482; (*$/kg*)
```

Chum

In[32]:=
```
qhdu0 = 62,944,000.00;(*kg*)
```

In[33]:=
```
phdu0 = 1.7379; (*$/kg*)
```

Coho

In[34]:=
```
qodu0 = 13,104,000.00;(*kg*)
```

In[35]:=
```
podu0 = 2.8403;(*$/kg*)
```

Sockeye

In[36]:=
```
qsdu0 = 120,339,000.00;(*kg*)
```

In[37]:=
```
psdu0 = 2.9210;(*$/kg*)
```

Pink

In[38]:=
```
qpdu0 = 61,590,000.00;(*kg*)
```

In[39]:=
```
ppdu0 = 0.9970;(*$/kg*)
```

Atlantic

In[40]:=
```
qadu0 = 18,003,000.00;(*kg*)
```

In[41]:=
```
padu0 = 4.4179; (*$/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.fisheries.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:::

Processed Chinook

In[42]:=
```
qcdp0 = 347,907.00; (*kg*)
```

In[43]:=
```
pcdp0 = 31.9409;(*$/kg*)
```

Processed Chum

In[44]:=
```
qhdp0 = 5,872,041.00;(*kg*)
```

In[45]:=
```
phdp0 = 7.7801;(*$/kg*)
```

Processed Coho

In[46]:=
```
qodp0 = 4,061,329.00; (*kg*)
```

In[47]:=
```
podp0 = 6.8543;(*$/kg*)
```

Processed Pink

In[48]:=
```
qpdp0 = 19,944,643.00; (*kg*)
```

In[49]:=
```
ppdp0 = 4.8824;(*$/kg*)
```

Processed Sockeye

In[50]:=
```
qsdp0 = 27,432,877.00;(*kg*)
```

In[51]:=
```
psdp0 = 13.9313;(*$/kg*)
```

2.3 Import Quantities and Prices

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

Chinook

Total unprocessed imports

In[52]:=
```
qctu0 = 3,647,588;(*kg*)
```

In[53]:=
```
pctu0 = 14.2695;(*$/kg*)
```

Total processed imports

In[54]:=
```
qctp0 = 590,030;(*kg*)
```

In[55]:=
```
pctp0 = 15.9467; (*$/kg*)
```

Illegal imports

In[56]:=
```
qciu0 = 298,564;(*kg*)
```

In[57]:=
```
qcip0 = 55,985;(*kg*)
```

Chum

Total unprocessed imports

In[58]:=
```
qhtu0 = 944,068;(*kg*)
```

In[59]:=
```
phtu0 = 4.27613;(*$/kg*)
```

Total processed imports

In[60]:=
```
qhtp0 = 11,082,850;(*kg*)
```

In[61]:=
```
phtp0 = 7.53876; (*$/kg*)
```

Illegal imports

In[62]:=
```
qhiu0 = 38,923;(*kg*)
```

In[63]:=
```
qhip0 = 213,194;(*kg*)
```

Coho

Total unprocessed imports

In[64]:=
```
qotu0 = 469,052;(*kg*)
```

In[65]:=
```
potu0 = 10.337;(*$/kg*)
```

Total processed imports

In[66]:=
```
qotp0 = 5,218,760;(*kg*)
```

In[67]:=
```
potp0 = 9.88819; (*$/kg*)
```

Illegal imports

In[68]:=
```
qoiu0 = 18,758;(*kg*)
```

In[69]:=
```
qoip0 = 385,118;(*kg*)
```

Pink

Total unprocessed imports

In[70]:=
```
qptu0 = 2,269,827;(*kg*)
```

In[71]:=
```
pptu0 = 5.69769;(*$/kg*)
```

Total processed imports

In[72]:=
```
qptp0 = 17,731,074;(*kg*)
```

In[73]:=
```
pptp0 = 6.62678;(*$/kg*)
```

Illegal imports

In[74]:=
```
qpiu0 = 330/333;(*kg*)
```

In[75]:=
```
qpip0 = 818/928;(*kg*)
```

Sockeye

Total unprocessed imports

In[76]:=
```
qstu0 = 4/236/885;(*kg*)
```

In[77]:=
```
pstu0 = 8.7212;(*$/kg*)
```

Total processed imports

In[78]:=
```
qstp0 = 19/781/556;(*kg*)
```

In[79]:=
```
pstp0 = 6.96608;(*$/kg*)
```

Illegal imports

In[80]:=
```
qsiu0 = 560/874;(*kg*)
```

In[81]:=
```
qsip0 = 3/655/213;(*kg*)
```

Atlantic

Total unprocessed imports

In[82]:=
```
qatu0 = 126/811/751;(*kg*)
```

In[83]:=
```
patu0 = 8.33607;(*$/kg*)
```

Total processed imports

In[84]:=
```
qatp0 = 210/415/300;(*kg*)
```

In[85]:=
```
patp0 = 12.026;(*$/kg*)
```

Illegal imports

In[86]:=
```
qaiu0 = 15/108/631;(*kg*)
```

In[87]:=
```
qaip0 = 25/053/337;(*kg*)
```

Calculation of legal imports

In[88]:= `qalu0 = qatu0 - qaiu0;`

In[89]:= `qalp0 = qatp0 - qaip0;`

In[90]:= `qclu0 = qctu0 - qciu0;`

In[91]:= `qclp0 = qctp0 - qcip0;`

In[92]:= `qhlu0 = qhtu0 - qhiu0;`

In[93]:= `qhlp0 = qhtp0 - qhip0;`

In[94]:= `qolu0 = qotu0 - qoiu0;`

In[95]:= `qolp0 = qotp0 - qoip0;`

In[96]:= `qplu0 = qptu0 - qpiu0;`

In[97]:= `qplp0 = qptp0 - qpip0;`

In[98]:= `qslu0 = qstu0 - qsiu0;`

In[99]:= `qslp0 = qstp0 - qsip0;`

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[100]:= `qadue0 = 8,033,812.00;(*kg*)`

In[101]:= `qcdue0 = 2,707,550.00;(*kg*)`

In[102]:= `qcdpe0 = 131,378.00; (*kg*)`

In[103]:= `qhdue0 = 36,963,258.00;(*kg*)`

In[104]:= `qhdpe0 = 2,471,392.00; (*kg*)`

In[105]:= `qodue0 = 5,980,213.00;(*kg*)`

In[106]:= `qodpe0 = 1,533,655.00; (*kg*)`

In[107]:= `qpdue0 = 30,000,412.00;(*kg*)`

In[108]:= `qpdpe0 = 16,530,654.00; (*kg*)`

In[109]:= `qsdue0 = 40,802,050.00;(*kg*)`

In[110]:=
```
qsdpe0 = 20,008,192.00; (*kg*)
```

2.5 Catch Limits

No aggregate ACL available, inserted arbitrarily high limit so it doesn't affect calculation.

In[111]:=
```
qadcap = 400,000,000.00; (*kg*)
```

In[112]:=
```
qcdcap = 400,000,000.00; (*kg*)
```

In[113]:=
```
qhdcap = 400,000,000.00; (*kg*)
```

In[114]:=
```
qodcap = 400,000,000.00; (*kg*)
```

In[115]:=
```
qpdcap = 400,000,000.00; (*kg*)
```

In[116]:=
```
qsdcap = 400,000,000.00; (*kg*)
```

2.6 Import Market Share Statistics

In[117]:=
```
N[qatu0 / (qatu0 + qadu0 - qadue0 )]
```
Out[117]= 0.927116

In[118]:=
```
N[qctu0 / (qctu0 + qcdu0 - qcdue0 - cr qcdp0)]
```
Out[118]= 0.987912

In[119]:=
```
N[qctp0 / (qctp0 + qcdp0 - qcdpe0)]
```
Out[119]= 0.73154

In[120]:=
```
N[qhtu0 / (qhtu0 + qhdu0 - qhdue0 - cr qhdp0)]
```
Out[120]= 0.0524502

In[121]:=
```
N[qhtp0 / (qhtp0 + qhdp0 - qhdpe0)]
```
Out[121]= 0.765205

In[122]:=
```
N[qotu0 / (qotu0 + qodu0 - qodue0 - cr qodp0)]
```
Out[122]= 0.330407

In[123]:=
```
N[qotp0 / (qotp0 + qodp0 - qodpe0)]
```
Out[123]= 0.673698

In[124]:=
```
N[qptu0 / (qptu0 + qpdu0 - qpdue0 - cr qpdp0)]
```
Out[124]= 0.64055

In[125]:= `N[qptp0 / (qptp0 + qpdp0 - qpdpe0)]`

Out[125]= `0.838544`

In[126]:= `N[qstu0 / (qstu0 + qsdu0 - qsdue0 - cr qsdp0)]`

Out[126]= `0.100696`

In[127]:= `N[qstp0 / (qstp0 + qsdp0 - qsdpe0)]`

Out[127]= `0.727096`

3. Calibration

In[128]:= `vatu0 = qatu0 patu0;`

In[129]:= `vatp0 = qatp0 patp0;`

In[130]:= `vctu0 = qctu0 pctu0;`

In[131]:= `vctp0 = qctp0 pctp0;`

In[132]:= `vhtu0 = qhtu0 phtu0;`

In[133]:= `vhtp0 = qhtp0 phtp0;`

In[134]:= `votu0 = qotu0 potu0;`

In[135]:= `votp0 = qotp0 potp0;`

In[136]:= `vptu0 = qptu0 pptu0;`

In[137]:= `vptp0 = qptp0 pptp0;`

In[138]:= `vstu0 = qstu0 pstu0;`

In[139]:= `vstp0 = qstp0 pstp0;`

In[140]:= `vadu0 = (qadu0 - qadue0) padu0;`

In[141]:= `vcdu0 = (qcdu0 - qcdue0 - cr qcdp0) pcdu0;`

In[142]:= `vcdp0 = (qcdp0 - qcdpe0) pcdp0;`

In[143]:= `vhdu0 = (qhdu0 - qhdue0 - cr qhdp0) phdu0;`

In[144]:= `vhdp0 = (qhdp0 - qhdpe0) phdp0;`

In[145]:= `vodu0 = (qodu0 - qodue0 - cr qodp0) podu0;`

In[146]:= `vodp0 = (qodp0 - qodpe0) podp0;`

In[147]:= `vpdu0 = (qpdu0 - qpdue0 - cr qpdp0) ppdu0;`

In[148]:= `vpdp0 = (qpdp0 - qpdpe0) ppdp0;`

In[149]:= `vsdu0 = (qsdu0 - qsdue0 - cr qsdp0) psdu0;`

In[150]:= `vsdp0 = (qsdp0 - qsdpe0) psdp0;`

3.1 Supply Parameters

$$\text{eauu} = N\left[\text{eau}\,\frac{\text{qadu0}}{(\text{qadcap} - \text{qadu0})}\right];$$

$$\text{aadu} = (\text{qadcap} - \text{qadu0})\,\text{padu0}^{\text{eauu}};$$

$$\text{ecdu} = N\left[\text{ecd}\,\frac{\text{qcdu0}}{(\text{qcdcap} - \text{qcdu0})}\right];$$

$$\text{acdu} = (\text{qcdcap} - \text{qcdu0})\,\text{pcdu0}^{\text{ecdu}};$$

$$\text{ehdu} = N\left[\text{ehd}\,\frac{\text{qhdu0}}{(\text{qhdcap} - \text{qhdu0})}\right];$$

$$\text{ahdu} = (\text{qhdcap} - \text{qhdu0})\,\text{phdu0}^{\text{ehdu}};$$

$$\text{eodu} = N\left[\text{eod}\,\frac{\text{qodu0}}{(\text{qodcap} - \text{qodu0})}\right];$$

$$\text{aodu} = (\text{qodcap} - \text{qodu0})\,\text{podu0}^{\text{eodu}};$$

$$\text{epdu} = N\left[\text{epd}\,\frac{\text{qpdu0}}{(\text{qpdcap} - \text{qpdu0})}\right];$$

$$\text{apdu} = (\text{qpdcap} - \text{qpdu0})\,\text{ppdu0}^{\text{epdu}};$$

$$\text{esdu} = N\left[\text{esd}\,\frac{\text{qsdu0}}{(\text{qsdcap} - \text{qsdu0})}\right];$$

$$\text{asdu} = (\text{qsdcap} - \text{qsdu0})\,\text{psdu0}^{\text{esdu}};$$

3.2 Demand Parameters

$$\text{batu} = \frac{\text{vatu0}}{\text{vadu0}}\left(\frac{\text{patu0}}{\text{padu0}}\right)^{\text{sigmaau}-1};$$

$$\text{Pau0} = \left(\text{padu0}^{1-\text{sigmaau}} + \text{batu}\,\text{patu0}^{1-\text{sigmaau}}\right)^{\frac{1}{1-\text{sigmaau}}};$$

$$\text{bctu} = \frac{\text{vctu0}}{\text{vcdu0}}\left(\frac{\text{pctu0}}{\text{pcdu0}}\right)^{\text{sigmacu}-1};$$

$$\text{Pcu0} = \left(\text{pcdu0}^{1-\text{sigmacu}} + \text{bctu}\,\text{pctu0}^{1-\text{sigmacu}}\right)^{\frac{1}{1-\text{sigmacu}}};$$

$$\text{bhtu} = \frac{\text{vhtu0}}{\text{vhdu0}}\left(\frac{\text{phtu0}}{\text{phdu0}}\right)^{\text{sigmahu}-1};$$

$$\text{Phu0} = \left(\text{phdu0}^{1-\text{sigmahu}} + \text{bhtu}\,\text{phtu0}^{1-\text{sigmahu}}\right)^{\frac{1}{1-\text{sigmahu}}};$$

$$\text{botu} = \frac{\text{votu0}}{\text{vodu0}}\left(\frac{\text{potu0}}{\text{podu0}}\right)^{\text{sigmaou}-1};$$

$$\text{Pou0} = \left(\text{podu0}^{1-\text{sigmaou}} + \text{botu}\,\text{potu0}^{1-\text{sigmaou}}\right)^{\frac{1}{1-\text{sigmaou}}};$$

In[171]:= $$bptu = \frac{vptu0}{vpdu0}\left(\frac{pptu0}{ppdu0}\right)^{sigmapu-1};$$

In[172]:= $$Ppu0 = \left(ppdu0^{1-sigmapu} + bptu\ pptu0^{1-sigmapu}\right)^{\frac{1}{1-sigmapu}};$$

In[173]:= $$bstu = \frac{vstu0}{vsdu0}\left(\frac{pstu0}{psdu0}\right)^{sigmasu-1};$$

In[174]:= $$Psu0 = \left(psdu0^{1-sigmasu} + bstu\ pstu0^{1-sigmasu}\right)^{\frac{1}{1-sigmasu}};$$

In[175]:= $$bcu = \frac{vcdu0 + vctu0}{vadu0 + vatu0}\left(\frac{Pcu0}{Pau0}\right)^{betau-1};$$

In[176]:= $$bhu = \frac{vhdu0 + vhtu0}{vadu0 + vatu0}\left(\frac{Phu0}{Pau0}\right)^{betau-1};$$

In[177]:= $$bou = \frac{vodu0 + votu0}{vadu0 + vatu0}\left(\frac{Pou0}{Pau0}\right)^{betau-1};$$

In[178]:= $$bpu = \frac{vpdu0 + vptu0}{vadu0 + vatu0}\left(\frac{Ppu0}{Pau0}\right)^{betau-1};$$

In[179]:= $$bsu = \frac{vsdu0 + vstu0}{vadu0 + vatu0}\left(\frac{Psu0}{Pau0}\right)^{betau-1};$$

In[180]:= $$Pu0 = \left(Pau0^{1-betau} + bcu\ Pcu0^{1-betau} + bhu\ Phu0^{1-betau} + bou\ Pou0^{1-betau} + bpu\ Ppu0^{1-betau} + bsu\ Psu0^{1-betau}\right)^{\frac{1}{1-betau}};$$

In[181]:= $$bctp = \frac{vctp0}{vcdp0}\left(\frac{pctp0}{pcdp0}\right)^{sigmacp-1};$$

In[182]:= $$Pcp0 = \left(pcdp0^{1-sigmacp} + bctp\ pctp0^{1-sigmacp}\right)^{\frac{1}{1-sigmacp}};$$

In[183]:= $$bhtp = \frac{vhtp0}{vhdp0}\left(\frac{phtp0}{phdp0}\right)^{sigmahp-1};$$

In[184]:= $$Php0 = \left(phdp0^{1-sigmahp} + bhtp\ phtp0^{1-sigmahp}\right)^{\frac{1}{1-sigmahp}};$$

In[185]:= $$botp = \frac{votp0}{vodp0}\left(\frac{potp0}{podp0}\right)^{sigmaop-1};$$

In[186]:= $$Pop0 = \left(podp0^{1-sigmaop} + botp\ potp0^{1-sigmaop}\right)^{\frac{1}{1-sigmaop}};$$

In[187]:= $$bptp = \frac{vptp0}{vpdp0}\left(\frac{pptp0}{ppdp0}\right)^{sigmapp-1};$$

In[188]:= $$Ppp0 = \left(ppdp0^{1-sigmapp} + bptp\ pptp0^{1-sigmapp}\right)^{\frac{1}{1-sigmapp}};$$

In[189]:= $$bstp = \frac{vstp0}{vsdp0}\left(\frac{pstp0}{psdp0}\right)^{sigmasp-1};$$

In[190]:= $$Psp0 = \left(psdp0^{1-sigmasp} + bstp\ pstp0^{1-sigmasp}\right)^{\frac{1}{1-sigmasp}};$$

In[191]:= $$bhp = \frac{vhdp0 + vhtp0}{vcdp0 + vctp0}\left(\frac{Php0}{Pcp0}\right)^{betap-1};$$

In[192]:= $$bop = \frac{vodp0 + votp0}{vcdp0 + vctp0}\left(\frac{Pop0}{Pcp0}\right)^{betap-1};$$

In[193]:= $$bpp = \frac{vpdp0 + vptp0}{vcdp0 + vctp0}\left(\frac{Ppp0}{Pcp0}\right)^{betap-1};$$

In[194]:= $$bsp = \frac{vsdp0 + vstp0}{vcdp0 + vctp0}\left(\frac{Psp0}{Pcp0}\right)^{betap-1};$$

In[195]:= $$bap = \frac{vatp0}{vcdp0 + vctp0}\left(\frac{patp0}{Pcp0}\right)^{betap-1};$$

In[196]:= $$Pp0 = \left(Pcp0^{1-betap} + bhp\ Php0^{1-betap} + bop\ Pop0^{1-betap} + bpp\ Ppp0^{1-betap} + bsp\ Psp0^{1-betap} + bap\ patp0^{1-betap}\right)^{\frac{1}{1-betap}};$$

In[197]:= $$ku = \frac{qatu0\ Pu0^{-etau-betau}\ Pau0^{betau-sigmaau}\ patu0^{sigmaau}}{batu};$$

In[198]:= $$kp = \frac{qatp0\ Pp0^{-etap-betap}\ patp0^{betap}}{bap};$$

4. New Equilibrium Calculation

In[199]:= $$Pau = \left(padu^{1-sigmaau} + batu\ patu^{1-sigmaau}\right)^{\frac{1}{1-sigmaau}};$$

In[200]:= $$Pcu = \left(pcdu^{1-sigmacu} + bctu\ pctu^{1-sigmacu}\right)^{\frac{1}{1-sigmacu}};$$

In[201]:= $$Phu = \left(phdu^{1-sigmahu} + bhtu\ phtu^{1-sigmahu}\right)^{\frac{1}{1-sigmahu}};$$

In[202]:= $$Pou = \left(podu^{1-sigmaou} + botu\ potu^{1-sigmaou}\right)^{\frac{1}{1-sigmaou}};$$

In[203]:= $$Ppu = \left(ppdu^{1-sigmapu} + bptu\ pptu^{1-sigmapu}\right)^{\frac{1}{1-sigmapu}};$$

In[204]:= $$Psu = \left(psdu^{1-sigmasu} + bstu\ pstu^{1-sigmasu}\right)^{\frac{1}{1-sigmasu}};$$

In[205]:= $$Pu = \left(Pau^{1-betau} + bcu\ Pcu^{1-betau} + bhu\ Phu^{1-betau} + bou\ Pou^{1-betau} + bpu\ Ppu^{1-betau} + bsu\ Psu^{1-betau}\right)^{\frac{1}{1-betau}};$$

In[206]:= $$pcdp = \frac{pcdu\ pcdp0}{pcdu0};$$

In[207]:= $$phdp = \frac{phdu\ phdp0}{phdu0};$$

In[208]:= $$podp = \frac{podu\ podp0}{podu0};$$

In[209]:= $$ppdp = \frac{ppdu\ ppdp0}{ppdu0};$$

In[210]:= $psdp = \frac{psdu\ psdp0}{psdu0};$

In[211]:= $Pcp = \left(pcdp^{1-sigmacp} + bctp\ pctp^{1-sigmacp}\right)^{\frac{1}{1-sigmacp}};$

In[212]:= $Php = \left(phdp^{1-sigmahp} + bhtp\ phtp^{1-sigmahp}\right)^{\frac{1}{1-sigmahp}};$

In[213]:= $Pop = \left(podp^{1-sigmaop} + botp\ potp^{1-sigmaop}\right)^{\frac{1}{1-sigmaop}};$

In[214]:= $Ppp = \left(ppdp^{1-sigmapp} + bptp\ pptp^{1-sigmapp}\right)^{\frac{1}{1-sigmapp}};$

In[215]:= $Psp = \left(psdp^{1-sigmasp} + bstp\ pstp^{1-sigmasp}\right)^{\frac{1}{1-sigmasp}};$

In[216]:= $Pp = \left(Pcp^{1-betap} + bhp\ Php^{1-betap} + bop\ Pop^{1-betap} + bpp\ Ppp^{1-betap} + bsp\ Psp^{1-betap} + bap\ patp^{1-betap}\right)^{\frac{1}{1-betap}};$

Equilibrium equations

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

In[217]:= $E1 = qadcap - aadu\ padu^{-eauu} == qadue0 + ku\ Pu^{etau+betau}\ Pau^{sigmaau-betau}\ padu^{-sigmaau};$

In[218]:= $E2 = qcdcap - acdu\ pcdu^{-ecdu} == qcdue0 + cr\ qcdpe0 + ku\ bcu\ Pu^{etau+betau}\ Pcu^{sigmacu-betau}\ pcdu^{-sigmacu} + cr\ kp\ Pp^{etap+betap}\ Pcp^{sigmacp-betap}\ pcdp^{-sigmacp};$

In[219]:= $E3 = qhdcap - ahdu\ phdu^{-ehdu} == qhdue0 + cr\ qhdpe0 + ku\ bhu\ Pu^{etau+betau}\ Phu^{sigmahu-betau}\ phdu^{-sigmahu} + cr\ bhp\ kp\ Pp^{etap+betap}\ Php^{sigmahp-betap}\ phdp^{-sigmahp};$

In[220]:= $E4 = qodcap - aodu\ podu^{-eodu} == qodue0 + cr\ qodpe0 + ku\ bou\ Pu^{etau+betau}\ Pou^{sigmaou-betau}\ podu^{-sigmaou} + cr\ bop\ kp\ Pp^{etap+betap}\ Pop^{sigmaop-betap}\ podp^{-sigmaop};$

In[221]:= $E5 = qpdcap - apdu\ ppdu^{-epdu} == qpdue0 + cr\ qpdpe0 + ku\ bpu\ Pu^{etau+betau}\ Ppu^{sigmapu-betau}\ ppdu^{-sigmapu} + cr\ bpp\ kp\ Pp^{etap+betap}\ Ppp^{sigmapp-betap}\ ppdp^{-sigmapp};$

In[222]:= $E6 = qsdcap - asdu\ psdu^{-esdu} == qsdue0 + cr\ qsdpe0 + ku\ bsu\ Pu^{etau+betau}\ Psu^{sigmasu-betau}\ psdu^{-sigmasu} + cr\ bsp\ kp\ Pp^{etap+betap}\ Psp^{sigmasp-betap}\ psdp^{-sigmasp};$

Supply of imported unprocessed product = Demand for imported unprocessed product

In[223]:= $E7 = qalu0 + repla\ qaiu0 == ku\ batu\ Pu^{etau+betau}\ Pau^{sigmaau-betau}\ patu^{-sigmaau};$

In[224]:= $E8 = qclu0 + replc\ qciu0 == ku\ bctu\ bcu\ Pu^{etau+betau}\ Pcu^{sigmacu-betau}\ pctu^{-sigmacu};$

In[225]:= $E9 = qhlu0 + replh\ qhiu0 == ku\ bhtu\ bhu\ Pu^{etau+betau}\ Phu^{sigmahu-betau}\ phtu^{-sigmahu};$

In[226]:= $E10 = qolu0 + replo\ qoiu0 == ku\ botu\ bou\ Pu^{etau+betau}\ Pou^{sigmaou-betau}\ potu^{-sigmaou};$

In[227]:= $E11 = qplu0 + replp\ qpiu0 == ku\ bptu\ bpu\ Pu^{etau+betau}\ Ppu^{sigmapu-betau}\ pptu^{-sigmapu};$

In[228]:= $E12 = qslu0 + repls\ qsiu0 == ku\ bstu\ bsu\ Pu^{etau+betau}\ Psu^{sigmasu-betau}\ pstu^{-sigmasu};$

Supply of imported processed product = Demand for imported processed product

In[229]:= $E13 = qalp0 + repla\ qaip0 == kp\ bap\ Pp^{etap+betap}\ patp^{-betap};$

In[230]:= $E14 = qclp0 + replc\ qcip0 == kp\ bctp\ Pp^{etap+betap}\ Pcp^{sigmacp-betap}\ pctp^{-sigmacp};$

In[231]:= $E15 = qhlp0 + replh\ qhip0 == kp\ bhtp\ bhp\ Pp^{etap+betap}\ Php^{sigmahp-betap}\ phtp^{-sigmahp};$

In[232]:=
$$E16 = qolp0 + replo\ qoip0 == kp\ botp\ bop\ Pp^{etap+betap}\ Pop^{sigmaop-betap}\ potp^{-sigmaop};$$

In[233]:=
$$E17 = qplp0 + replp\ qpip0 == kp\ bptp\ bpp\ Pp^{etap+betap}\ Ppp^{sigmapp-betap}\ pptp^{-sigmapp};$$

In[234]:=
$$E18 = qslp0 + repls\ qsip0 == kp\ bstp\ bsp\ Pp^{etap+betap}\ Psp^{sigmasp-betap}\ pstp^{-sigmasp};$$

In[235]:=
```
FindRoot[{E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18},
 {padu, padu0}, {patu, patu0}, {pcdu, pcdu0}, {pctu, pctu0}, {phdu, phdu0},
 {phtu, phtu0}, {podu, podu0}, {potu, potu0}, {patp, patp0}, {pctp, pctp0},
 {phtp, phtp0}, {potp, potp0}, {ppdu, ppdu0}, {pptu, pptu0}, {pptp, pptp0},
 {psdu, psdu0}, {pstu, pstu0}, {pstp, pstp0}, AccuracyGoal → 6, PrecisionGoal → 6]
```

Out[235]=
```
{padu → 4.50327, patu → 8.91384, pcdu → 11.8541, pctu → 15.1364,
 phdu → 1.76556, phtu → 4.45751, podu → 2.89877, potu → 10.8214,
 patp → 12.9862, pctp → 16.9778, phtp → 7.92113, potp → 10.5185, ppdu → 1.00104,
 pptu → 6.12923, pptp → 7.01129, psdu → 2.9752, pstu → 9.26916, pstp → 7.57592}
```

In[236]:=
```
padu1 = padu /. %;
```

In[237]:=
```
patu1 = patu /. %%;
```

In[238]:=
```
patp1 = patp /. %%%;
```

In[239]:=
```
pcdu1 = pcdu /. %%%%;
```

In[240]:=
```
pctu1 = pctu /. %%%%%;
```

In[241]:=
```
pctp1 = pctp /. %%%%%%;
```

In[242]:=
```
phdu1 = phdu /. %%%%%%%;
```

In[243]:=
```
phtu1 = phtu /. %%%%%%%%;
```

In[244]:=
```
phtp1 = phtp /. %%%%%%%%%;
```

In[245]:=
```
podu1 = podu /. %%%%%%%%%%;
```

In[246]:=
```
potu1 = potu /. %%%%%%%%%%%;
```

In[247]:=
```
potp1 = potp /. %%%%%%%%%%%%;
```

In[248]:=
```
ppdu1 = ppdu /. %%%%%%%%%%%%%;
```

In[249]:=
```
pptu1 = pptu /. %%%%%%%%%%%%%%;
```

In[250]:=
```
pptp1 = pptp /. %%%%%%%%%%%%%%%;
```

In[251]:=
```
psdu1 = psdu /. %%%%%%%%%%%%%%%%;
```

In[252]:=
```
pstu1 = pstu /. %%%%%%%%%%%%%%%%%;
```

In[253]:=
```
pstp1 = pstp /. %%%%%%%%%%%%%%%%%%;
```

In[254]:=
$$pcdp1 = \frac{pcdu1\ pcdp0}{pcdu0};$$

In[255]:=
$$phdp1 = \frac{phdu1\ phdp0}{phdu0};$$

In[256]:= $$podp1 = \frac{podu1\ podp0}{podu0};$$

In[257]:= $$ppdp1 = \frac{ppdu1\ ppdp0}{ppdu0};$$

In[258]:= $$psdp1 = \frac{psdu1\ psdp0}{psdu0};$$

In[259]:= $$Pau1 = \left(padu1^{1-sigmaau} + batu\ patu1^{1-sigmaau}\right)^{\frac{1}{1-sigmaau}};$$

In[260]:= $$Pcu1 = \left(pcdu1^{1-sigmacu} + bctu\ pctu1^{1-sigmacu}\right)^{\frac{1}{1-sigmacu}};$$

In[261]:= $$Phu1 = \left(phdu1^{1-sigmahu} + bhtu\ phtu1^{1-sigmahu}\right)^{\frac{1}{1-sigmahu}};$$

In[262]:= $$Pou1 = \left(podu1^{1-sigmaou} + botu\ potu1^{1-sigmaou}\right)^{\frac{1}{1-sigmaou}};$$

In[263]:= $$Ppu1 = \left(ppdu1^{1-sigmapu} + bptu\ pptu1^{1-sigmapu}\right)^{\frac{1}{1-sigmapu}};$$

In[264]:= $$Psu1 = \left(psdu1^{1-sigmasu} + bstu\ pstu1^{1-sigmasu}\right)^{\frac{1}{1-sigmasu}};$$

In[265]:= $$Pu1 = \left(Pau1^{1-betau} + bcu\ Pcu1^{1-betau} + bhu\ Phu1^{1-betau} + bou\ Pou1^{1-betau} + bpu\ Ppu1^{1-betau} + bsu\ Psu1^{1-betau}\right)^{\frac{1}{1-betau}};$$

In[266]:= $$Pcp1 = \left(pcdp1^{1-sigmacp} + bctp\ pctp1^{1-sigmacp}\right)^{\frac{1}{1-sigmacp}};$$

In[267]:= $$Php1 = \left(phdp1^{1-sigmahp} + bhtp\ phtp1^{1-sigmahp}\right)^{\frac{1}{1-sigmahp}};$$

In[268]:= $$Pop1 = \left(podp1^{1-sigmaop} + botp\ potp1^{1-sigmaop}\right)^{\frac{1}{1-sigmaop}};$$

In[269]:= $$Ppp1 = \left(ppdp1^{1-sigmapp} + bptp\ pptp1^{1-sigmapp}\right)^{\frac{1}{1-sigmapp}};$$

In[270]:= $$Psp1 = \left(psdp1^{1-sigmasp} + bstp\ pstp1^{1-sigmasp}\right)^{\frac{1}{1-sigmasp}};$$

In[271]:= $$Pp1 = \left(Pcp1^{1-betap} + bhp\ Php1^{1-betap} + bop\ Pop1^{1-betap} + bpp\ Ppp1^{1-betap} + bsp\ Psp1^{1-betap} + bap\ patp1^{1-betap}\right)^{\frac{1}{1-betap}};$$

In[272]:= $$qadu1 = qadcap - aadu\ padu1^{-eauu};$$

In[273]:= $$qatu1 = qalu0 + repla\ qaiu0;$$

In[274]:= $$qatp1 = qalp0 + repla\ qaip0;$$

In[275]:= $$qcdu1 = qcdcap - acdu\ pcdu1^{-ecdu};$$

In[276]:= $$qctu1 = qclu0 + replc\ qciu0;$$

In[277]:= $$qctp1 = qclp0 + replc\ qcip0;$$

In[278]:= $$qcdp1 = qcdpe0 + kp\ Pp1^{etap+betap}\ Pcp1^{sigmacp-betap}\ pcdp1^{-sigmacp};$$

In[279]:= $$qhdu1 = qhdcap - ahdu\ phdu1^{-ehdu};$$

In[280]:= $$qhtu1 = qhlu0 + replh\ qhiu0;$$

In[281]:= `qhtp1 = qhlp0 + replh qhip0;`

In[282]:= `qhdp1 = qhdpe0 + kp bhp Pp1^(etap+betap) Php1^(sigmahp-betap) phdp1^-sigmahp;`

In[283]:= `qodu1 = qodcap - aodu podu1^-eodu;`

In[284]:= `qotu1 = qolu0 + replo qoiu0;`

In[285]:= `qotp1 = qolp0 + replo qoip0;`

In[286]:= `qodp1 = qodpe0 + kp bop Pp1^(etap+betap) Pop1^(sigmaop-betap) podp1^-sigmaop;`

In[287]:= `qpdu1 = qpdcap - apdu ppdu1^-epdu;`

In[288]:= `qptu1 = qplu0 + replp qpiu0;`

In[289]:= `qptp1 = qplp0 + replp qpip0;`

In[290]:= `qpdp1 = qpdpe0 + kp bpp Pp1^(etap+betap) Ppp1^(sigmapp-betap) ppdp1^-sigmapp;`

In[291]:= `qsdu1 = qsdcap - asdu psdu1^-esdu;`

In[292]:= `qstu1 = qslu0 + repls qsiu0;`

In[293]:= `qstp1 = qslp0 + repls qsip0;`

In[294]:= `qsdp1 = qsdpe0 + kp bsp Pp1^(etap+betap) Psp1^(sigmasp-betap) psdp1^-sigmasp;`

5. Results

Atlantic Salmon

Percent change in price of unprocessed domestic production

In[295]:=
$$\frac{(\text{padu1} - \text{padu0})\ 100}{\text{padu0}}$$

Out[295]= `1.93229`

Percent change in quantity of landings

In[296]:=
$$\frac{(\text{qadu1} - \text{qadu0})\ 100}{\text{qadu0}}$$

Out[296]= `9.54774`

Change ($) in operating income, unprocessed product

In[297]:= `(1 / sigmaau) (padu1 (qadu1 - qadue0) - padu0 (qadu0 - qadue0))`

Out[297]= 1.671×10^6

Percent change in price of unprocessed imports

In[298]:=
$$\frac{(\text{patu1} - \text{patu0})\ 100}{\text{patu0}}$$

Out[298]=
```
6.93098
```

Percent change in quantity of unprocessed imports

In[299]:=
$$\frac{(\text{qatu1} - \text{qatu0})\ 100}{\text{qatu0}}$$

Out[299]=
```
-8.33995
```

Percent change in price of processed imports

In[300]:=
$$\frac{(\text{patp1} - \text{patp0})\ 100}{\text{patp0}}$$

Out[300]=
```
7.98448
```

Percent change in quantity of processed imports

In[301]:=
$$\frac{(\text{qatp1} - \text{qatp0})\ 100}{\text{qatp0}}$$

Out[301]=
```
-8.33463
```

Chinook Salmon

Percent change in price of unprocessed domestic production

In[302]:=
$$\frac{(\text{pcdu1} - \text{pcdu0})\ 100}{\text{pcdu0}}$$

Out[302]=
```
0.901156
```

Percent change in quantity of landings

In[303]:=
$$\frac{(\text{qcdu1} - \text{qcdu0})\ 100}{\text{qcdu0}}$$

Out[303]=
```
1.79411
```

Percent change in price of processed domestic production

In[304]:=
$$\frac{(\text{pcdp1} - \text{pcdp0})\ 100}{\text{pcdp0}}$$

Out[304]=
```
0.901156
```

Percent change in quantity of processed domestic product

In[305]:=
$$\frac{(\text{qcdp1} - \text{qcdp0})\ 100}{\text{qcdp0}}$$

Out[305]= 9.84545

Change ($) in operating income, unprocessed product

In[306]:= `(1 / sigmacu) (pcdu1 (qcdu1 - qcdue0 - cr qcdp1) - pcdu0 (qcdu0 - qcdue0 - cr qcdp0))`

Out[306]= 21,248.9

Change ($) in operating income, processed product

In[307]:= `(1 / sigmacp) (pcdp1 (qcdp1 - qcdpe0) - pcdp0 (qcdp0 - qcdpe0))`

Out[307]= 290,410.

Percent change in price of unprocessed imports

In[308]:=
$$\frac{(\text{pctu1} - \text{pctu0})\ 100}{\text{pctu0}}$$

Out[308]= 6.07504

Percent change in quantity of unprocessed imports

In[309]:=
$$\frac{(\text{qctu1} - \text{qctu0})\ 100}{\text{qctu0}}$$

Out[309]= −5.72967

Percent change in price of processed imports

In[310]:=
$$\frac{(\text{pctp1} - \text{pctp0})\ 100}{\text{pctp0}}$$

Out[310]= 6.46592

Percent change in quantity of processed imports

In[311]:=
$$\frac{(\text{qctp1} - \text{qctp0})\ 100}{\text{qctp0}}$$

Out[311]= −6.64195

Chum Salmon

Percent change in price of unprocessed domestic production

In[312]:=
$$\frac{(\text{phdu1} - \text{phdu0})\ 100}{\text{phdu0}}$$

Out[312]= 1.59132

Percent change in quantity of landings

In[313]:=
$$\frac{(\text{qhdu1} - \text{qhdu0})\ 100}{\text{qhdu0}}$$

Out[313]= 3.14829

Percent change in price of processed domestic production

In[314]:=
$$\frac{(\text{phdp1} - \text{phdp0})\ 100}{\text{phdp0}}$$

Out[314]= 1.59132

Percent change in quantity of processed domestic product

In[315]:=
$$\frac{(\text{qhdp1} - \text{qhdp0})\ 100}{\text{qhdp0}}$$

Out[315]= 7.4969

Change ($) in operating income, unprocessed product

In[316]:=
$$(1 / \text{sigmahu})\ (\text{phdu1}\ (\text{qhdu1} - \text{qhdue0} - \text{cr}\ \text{qhdp1})\ -\ \text{phdu0}\ (\text{qhdu0} - \text{qhdue0} - \text{cr}\ \text{qhdp0}))$$

Out[316]= 694,491.

Change ($) in operating income, processed product

In[317]:=
$$(1 / \text{sigmahp})\ (\text{phdp1}\ (\text{qhdp1} - \text{qhdpe0})\ -\ \text{phdp0}\ (\text{qhdp0} - \text{qhdpe0}))$$

Out[317]= 971,261.

Percent change in price of unprocessed imports

In[318]:=
$$\frac{(\text{phtu1} - \text{phtu0})\ 100}{\text{phtu0}}$$

Out[318]= 4.24167

Percent change in quantity of unprocessed imports

In[319]:=
$$\frac{(\text{qhtu1} - \text{qhtu0})\ 100}{\text{qhtu0}}$$

Out[319]= −2.88603

Percent change in price of processed imports

In[320]:=
$$\frac{(\text{phtp1} - \text{phtp0})\ 100}{\text{phtp0}}$$

Out[320]= 5.07208

Percent change in quantity of processed imports

In[321]:=
$$\frac{(\text{qhtp1} - \text{qhtp0})\ 100}{\text{qhtp0}}$$

Out[321]= −1.34655

Coho Salmon

Percent change in price of unprocessed domestic production

In[322]:=
$$\frac{(\text{podu1} - \text{podu0})\ 100}{\text{podu0}}$$

Out[322]= 2.05842

Percent change in quantity of landings

In[323]:=
$$\frac{(\text{qodu1} - \text{qodu0})\ 100}{\text{qodu0}}$$

Out[323]= 4.07223

Percent change in price of processed domestic production

In[324]:=
$$\frac{(\text{podp1} - \text{podp0})\ 100}{\text{podp0}}$$

Out[324]= 2.05842

Percent change in quantity of processed domestic product

In[325]:=
$$\frac{(\text{qodp1} - \text{qodp0})\ 100}{\text{qodp0}}$$

Out[325]= 7.46636

Change ($) in operating income, unprocessed product

In[326]:=
```
(1 / sigmaou) (podu1 (qodu1 - qodue0 - cr qodp1) - podu0 (qodu0 - qodue0 - cr qodp0))
```

Out[326]=
```
66323.2
```

Change ($) in operating income, processed product

In[327]:=
```
(1 / sigmaop) (podp1 (qodp1 - qodpe0) - podp0 (qodp0 - qodpe0))
```

Out[327]=
```
617014.
```

Percent change in price of unprocessed imports

In[328]:=
$$\frac{(\text{potu1} - \text{potu0})\ 100}{\text{potu0}}$$

Out[328]=
```
4.68644
```

Percent change in quantity of unprocessed imports

In[329]:=
$$\frac{(\text{qotu1} - \text{qotu0})\ 100}{\text{qotu0}}$$

Out[329]=
```
-2.79939
```

Percent change in price of processed imports

In[330]:=
$$\frac{(\text{potp1} - \text{potp0})\ 100}{\text{potp0}}$$

Out[330]=
```
6.37439
```

Percent change in quantity of processed imports

In[331]:=
$$\frac{(\text{qotp1} - \text{qotp0})\ 100}{\text{qotp0}}$$

Out[331]=
```
-5.16564
```

Pink Salmon

Percent change in price of unprocessed domestic production

In[332]:=
$$\frac{(\text{ppdu1} - \text{ppdu0})\ 100}{\text{ppdu0}}$$

Out[332]=
```
0.405075
```

Percent change in quantity of landings

In[333]:=
$$\frac{(\text{qpdu1} - \text{qpdu0})\ 100}{\text{qpdu0}}$$

Out[333]= 2.01757

Percent change in price of processed domestic production

In[334]:=
$$\frac{(\text{ppdp1} - \text{ppdp0})\ 100}{\text{ppdp0}}$$

Out[334]= 0.405075

Percent change in quantity of processed domestic product

In[335]:=
$$\frac{(\text{qpdp1} - \text{qpdp0})\ 100}{\text{qpdp0}}$$

Out[335]= 3.32277

Change ($) in operating income, unprocessed product

In[336]:=
$$(1 / \text{sigmapu})\ (\text{ppdu1}\ (\text{qpdu1} - \text{qpdue0} - \text{cr}\ \text{qpdp1})\ -\ \text{ppdu0}\ (\text{qpdu0} - \text{qpdue0} - \text{cr}\ \text{qpdp0}))$$

Out[336]= 59,932.5

Change ($) in operating income, processed product

In[337]:=
$$(1 / \text{sigmapp})\ (\text{ppdp1}\ (\text{qpdp1} - \text{qpdpe0})\ -\ \text{ppdp0}\ (\text{qpdp0} - \text{qpdpe0}))$$

Out[337]= 825,784.

Percent change in price of unprocessed imports

In[338]:=
$$\frac{(\text{pptu1} - \text{pptu0})\ 100}{\text{pptu0}}$$

Out[338]= 7.57388

Percent change in quantity of unprocessed imports

In[339]:=
$$\frac{(\text{qptu1} - \text{qptu0})\ 100}{\text{qptu0}}$$

Out[339]= −10.1873

Percent change in price of processed imports

In[340]:=
$$\frac{(\text{pptp1} - \text{pptp0})\ 100}{\text{pptp0}}$$

Out[340]= 5.80233

Percent change in quantity of processed imports

In[341]:=
$$\frac{(\text{qptp1} - \text{qptp0})\ 100}{\text{qptp0}}$$

Out[341]= −3.23302

Sockeye Salmon

Percent change in price of unprocessed domestic production

In[342]:=
$$\frac{(\text{psdu1} - \text{psdu0})\ 100}{\text{psdu0}}$$

Out[342]= 1.85552

Percent change in quantity of landings

In[343]:=
$$\frac{(\text{qsdu1} - \text{qsdu0})\ 100}{\text{qsdu0}}$$

Out[343]= 3.64809

Percent change in price of processed domestic production

In[344]:=
$$\frac{(\text{psdp1} - \text{psdp0})\ 100}{\text{psdp0}}$$

Out[344]= 1.85552

Percent change in quantity of processed domestic product

In[345]:=
$$\frac{(\text{qsdp1} - \text{qsdp0})\ 100}{\text{qsdp0}}$$

Out[345]= 3.59378

Change ($) in operating income, unprocessed product

In[346]:=
$$(1 / \text{sigmasu})\ (\text{psdu1}\ (\text{qsdu1} - \text{qsdue0} - \text{cr}\ \text{qsdp1})\ -\ \text{psdu0}\ (\text{qsdu0} - \text{qsdue0} - \text{cr}\ \text{qsdp0}))$$

Out[346]= 2.6529×10^{6}

Change ($) in operating income, processed product

In[347]:=
```
(1 / sigmasp) (psdp1 (qsdp1 - qsdpe0) - psdp0 (qsdp0 - qsdpe0))
```

Out[347]=
$$3.96142 \times 10^6$$

Percent change in price of unprocessed imports

In[348]:=
$$\frac{(\text{pstu1} - \text{pstu0})\ 100}{\text{pstu0}}$$

Out[348]=
$$6.28314$$

Percent change in quantity of unprocessed imports

In[349]:=
$$\frac{(\text{qstu1} - \text{qstu0})\ 100}{\text{qstu0}}$$

Out[349]=
$$-9.26652$$

Percent change in price of processed imports

In[350]:=
$$\frac{(\text{pstp1} - \text{pstp0})\ 100}{\text{pstp0}}$$

Out[350]=
$$8.75436$$

Percent change in quantity of processed imports

In[351]:=
$$\frac{(\text{qstp1} - \text{qstp0})\ 100}{\text{qstp0}}$$

Out[351]=
$$-12.9345$$

Price Indexes

Percent change in unprocessed price index

In[352]:=
$$\frac{(\text{Pu1} - \text{Pu0})\ 100}{\text{Pu0}}$$

Out[352]=
$$6.10258$$

Percent change in processed price index

In[353]:=
$$\frac{(\text{Pp1} - \text{Pp0})\ 100}{\text{Pp0}}$$

Out[353]=
$$7.43472$$