Modeling the Impact of Winter Squash Imports on U.S. Producers

Seasonal Effects Model Release

Read Me :
This model accompanies the USITC report, *Squash: Effect of Imports on U.S. Seasonal Markets, with a Focus on the U.S. Southeast*, Inv. 332-584. The report includes a quantitative analysis of the economic impact of fresh winter squash imports on U.S. domestic prices, production, revenue, operating income, and employment. Economic effects are modeled to reflect seasonal implications, where harvesting periods are split into June-October and November-May. The model inputs (BLUE-shaded cells) include elasticities that describe responsiveness to price changes, and domestic production and imports data for each growing season from 2015 to 2020. Data sources are listed in the cell above the data input. The model then lowers imports to a counterfactual level where the historical above-average growth rates are removed. Outputs are in the GREEN-shaded cells. The white cells are intermediate calculations.

This PDF is a printout of the Mathematica file "Seasonal winter squash model - model release.nb".

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Nov 2019 - Oct 2020

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

1. Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020).

Riker, David. "A Trade Cost Approach to Estimating the Elasticity of Substitution." Economics Working Paper Series 2020-07-D, U.S. International Trade Commission, July 2020. https://www.usitc.gov/publications/332/working_papers/ecwp_2017-07-d.pdf.

In[ ]:= **sigma = 3.0880;**

1.2 Industry Price Elasticity of Demand

Source: USITC staff estimate.

In[ ]:= **eta = -1;**

1.3 Domestic Supply Elasticities

Source: USITC staff estimate and interviews with industry participants.

June-October domestic supply elasticity

In[ ]:= **en = 4;**

November-May domestic supply elasticity

In[ ]:= **ef = 4;**

2. Data Inputs

2.1 U.S. Production Values and Quantities

Source: USITC estimates. Annual state level data obtained from U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). State level data was split into June-October and November-May production using information about state-level harvesting months.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October domestic production quantity (mt) and value ($)

In[ ]:=   **qdn0 = 152 576;**

In[ ]:=   **vdn0 = 109 785 822;**

In[ ]:= **pdn0 = vdn0 / qdn0;**

November-May domestic production quantity (mt) and value ($)

In[ ]:=   **qdf0 = 10 080;**

In[ ]:=   **vdf0 = 7 704 332;**

In[ ]:= **pdf0 = vdf0 / qdf0;**

2.2 Import Values and Quantities

Source: USITC estimates. Monthly import data was obtained from USITC DataWeb/Census for HTS product code 0709.93.20. Import data was split into summer and winter varieties using production estimates by major trading partner. The import counterfactuals were calculated by removing the above-average increases in imports from 2009 to 2019, reducing the high-growth years growth rates in imports to follow average growth rates.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October import quantity (mt) and value ($)

In[ ]:=   **qfn0 = 22 163;**

In[ ]:=   **vfn0 = 19 159 145;**

In[ ]:= **pfn0 = vfn0 / qfn0;**

November-May import quantity (mt) and value ($)

In[ ]:=   **qff0 = 80 545;**

In[ ]:=   **vff0 = 78 714 153;**

In[ ]:= **pff0 = vff0 / qff0;**

June-October counterfactual import quantity (mt)

In[ ]:=   **qcn0 = 16 925;**

November-May counterfactual import quantity (mt)

In[ ]:=   `qcf0 = 63 112;`

2.3 Domestic Export Quantity

Source: USITC estimates. Monthly exports data were obtained from USITC DataWeb/Census for HTS product code 0709.93.20.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October exports quantity (mt)

In[ ]:=   `qdne0 = 1520;`

In[ ]:= `vdn0 = (qdn0 – qdne0) * pdn0;`

November-May exports quantity (mt)

In[ ]:=   `qdfe0 = 1825;`

In[ ]:= `vdf0 = (qdf0 – qdfe0) * pdf0;`

2.4 Domestic Employment

Source: USITC estimates. The number of full-time equivalent (FTE) workers was estimated using information about per-acre labor hours and acreage data from USDA NASS.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October number of FTEs

In[ ]:=   `qempn0 = 1844;`

November-May number of FTEs

In[ ]:=   `qempf0 = 122;`

---

3. Calibration

3.1 Supply Parameters

In[ ]:= `adn = qdn0 pdn0^{-en};`

In[ ]:= `adf = qdf0 pdf0^{-ef};`

3.2 Demand Parameters

$In[\bullet]:=$ $\mathbf{bfn} = \dfrac{\mathbf{vfn0}}{\mathbf{vdn0}} \left(\dfrac{\mathbf{pfn0}}{\mathbf{pdn0}} \right)^{\mathbf{sigma-1}};$

$In[\bullet]:=$ $\mathbf{pin0} = \left(\mathbf{pdn0}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pfn0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{kn} = \left(\mathbf{qdn0} - \mathbf{qdne0} \right) \mathbf{pin0}^{-\mathbf{sigma}-\mathbf{eta}}\,\mathbf{pdn0}^{\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{bff} = \dfrac{\mathbf{vff0}}{\mathbf{vdf0}} \left(\dfrac{\mathbf{pff0}}{\mathbf{pdf0}} \right)^{\mathbf{sigma-1}};$

$In[\bullet]:=$ $\mathbf{pif0} = \left(\mathbf{pdf0}^{1-\mathbf{sigma}} + \mathbf{bff}\,\mathbf{pff0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{kf} = \left(\mathbf{qdf0} - \mathbf{qdfe0} \right) \mathbf{pif0}^{-\mathbf{sigma}-\mathbf{eta}}\,\mathbf{pdf0}^{\mathbf{sigma}};$

4. New Equilibrium Calculation

June-October Equilibrium Calculation

$In[\bullet]:=$ $\mathbf{pin} = \left(\mathbf{pd1}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pf1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{Eqn11} = \mathbf{adn}\,\mathbf{pd1}^{\mathbf{en}} == \mathbf{qdne0} + \mathbf{kn}\,\mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pd1}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{Eqn12} = \mathbf{qcn0} == \mathbf{kn}\,\mathbf{bfn}\,\mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pf1}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn11}, \mathbf{Eqn12}\}, \{\mathbf{pd1}, \mathbf{pdn0}\}, \{\mathbf{pf1}, \mathbf{pfn0}\}]$

$Out[\bullet]=$ $\{\mathrm{pd1} \to 723.437,\ \mathrm{pf1} \to 955.151\}$

$In[\bullet]:=$ $\mathbf{pdn1} = \mathbf{pd1}\ /.\ \%;$

$In[\bullet]:=$ $\mathbf{pfn1} = \mathbf{pf1}\ /.\ \%\%;$

$In[\bullet]:=$ $\mathbf{qdn1} = \mathbf{adn}\,\mathbf{pdn1}^{\mathbf{en}};$

$In[\bullet]:=$ $\mathbf{qfn1} = \mathbf{qcn0};$

$In[\bullet]:=$ $\mathbf{pin1} = \left(\mathbf{pdn1}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pfn1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

November-May Equilibrium Calculation

$In[\bullet]:=$ $\mathbf{pif} = \left(\mathbf{pd2}^{1-\mathbf{sigma}} + \mathbf{bff}\,\mathbf{pf2}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{Eqn21} = \mathbf{adf}\,\mathbf{pd2}^{\mathbf{ef}} == \mathbf{qdfe0} + \mathbf{kf}\,\mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pd2}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{Eqn22} = \mathbf{qcf0} == \mathbf{kf}\,\mathbf{bff}\,\mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pf2}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn21}, \mathbf{Eqn22}\}, \{\mathbf{pd2}, \mathbf{pdf0}\}, \{\mathbf{pf2}, \mathbf{pff0}\}]$

$Out[\bullet]=$ $\{\mathrm{pd2} \to 806.103,\ \mathrm{pf2} \to 1211.2\}$

$In[\bullet]:=$ $\mathbf{pdf1} = \mathbf{pd2}\ /.\ \%;$

$In[\bullet]:=$ $\mathbf{pff1} = \mathbf{pf2}\ /.\ \%\%;$

$In[\bullet]:=$ `qdf1 = adf pdf1^ef;`

$In[\bullet]:=$ `qff1 = qcf0;`

$In[\bullet]:=$ `pif1 = ( pdf1^{1-sigma} + bff pff1^{1-sigma} )^{\frac{1}{1-sigma}};`

---

5. Results

Percent change in prices of domestic product, {June-October, November-May}

$In[\bullet]:=$ `PriceChange = { `$\dfrac{100\ (pdn1 - pdn0)}{pdn0}$`, `$\dfrac{100\ (pdf1 - pdf0)}{pdf0}$` }`

$Out[\bullet]=$ {0.540485, 5.4669}

Percent change in quantities of domestic product, {June-October, November-May}

$In[\bullet]:=$ `QuantityChange = { `$\dfrac{100\ (qdn1 - qdn0)}{qdn0}$`, `$\dfrac{100\ (qdf1 - qdf0)}{qdf0}$` }`

$Out[\bullet]=$ {2.17953, 23.7271}

Percent change in price of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportPChange = { `$\dfrac{100\ (pfn1 - pfn0)}{pfn0}$`, `$\dfrac{100\ (pff1 - pff0)}{pff0}$` }`

$Out[\bullet]=$ {10.4904, 23.9372}

Percent change in quantities of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportQChange = {N[ `$\dfrac{100\ (qfn1 - qfn0)}{qfn0}$` ], N[ `$\dfrac{100\ (qff1 - qff0)}{qff0}$` ]}`

$Out[\bullet]=$ {− 23.634, − 21.6438}

Change in revenue of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `Revenues = {IntegerPart[pdn1 qdn1 − pdn0 qdn0], IntegerPart[pdf1 qdf1 − pdf0 qdf0]}`

$Out[\bullet]=$ {2 999 125, 2 349 136}

Change in operating income of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `OP = IntegerPart[{ (`$\dfrac{1}{sigma}$`) (pdn1 qdn1 − pdn0 qdn0), (`$\dfrac{1}{sigma}$`) (pdf1 qdf1 − pdf0 qdf0) }]`

$Out[\bullet]=$ {971 219, 760 730}

Change in employment (# of FTEs), {June-October, November-May}

In[●]:= `Employment = {qempn0` $\frac{(qdn1 - qdn0)}{qdn0}$`, qempf0` $\frac{(qdf1 - qdf0)}{qdf0}$`}`

Out[●]= `{40.1906, 28.947}`

Nov 2018 - Oct 2019

In[●]:= `ClearAll[f];`

1. Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020).

Riker, David. "A Trade Cost Approach to Estimating the Elasticity of Substitution." Economics Working Paper Series 2020-07-D, U.S. International Trade Commission, July 2020. https://www.usitc.gov/publications/332/working_papers/ecwp_2017-07-d.pdf.

In[●]:= `sigma = 3.0880;`

1.2 Industry Price Elasticity of Demand

Source: USITC staff estimate.

In[●]:= `eta = -1;`

1.3 Domestic Supply Elasticities

Source: USITC staff estimate and interviews with industry participants..

June-October domestic supply elasticity

In[●]:= `en = 4;`

November-May domestic supply elasticity

In[●]:= `ef = 4;`

2. Data Inputs

2.1 U.S. Production Values and Quantities

Source: USITC estimates. Annual state level data obtained from U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). State level data was split into June-October and November-May production using information about state-

level harvesting months.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Squash Greenhouse production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October domestic production quantity (mt) and value ($)

In[ ]:= `qdn0 = 103 986;`

In[ ]:= `vdn0 = 87 857 408;`

In[ ]:= `pdn0 = vdn0 / qdn0;`

November-May domestic production quantity (mt) and value ($)

In[ ]:= `qdf0 = 14 179;`

In[ ]:= `vdf0 = 8 489 133;`

In[ ]:= `pdf0 = vdf0 / qdf0;`

2.2 Import Values and Quantities

Source: USITC estimates. Monthly import data was obtained from USITC DataWeb/Census for HTS product code 0709.93.20. Import data was split into summer and winter varieties using production estimates by major trading partner. The import counterfactuals were calculated by removing the above-average increases in imports from 2009 to 2019, reducing the high-growth years growth rates in imports to follow average growth rates.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October import quantity (mt) and value ($)

In[ ]:= `qfn0 = 21 694;`

In[ ]:= `vfn0 = 18 061 572;`

In[ ]:= `pfn0 = vfn0 / qfn0;`

November-May import quantity (mt) and value ($)

In[ ]:= `qff0 = 83 300;`

In[ ]:= `vff0 = 106 550 888;`

In[ ]:= `pff0 = vff0 / qff0;`

June-October counterfactual import quantity (mt)

In[ ]:=
```
qcn0 = 16 568;
```

November-May counterfactual import quantity (mt)

In[ ]:=
```
qcf0 = 65 271;
```

2.3 Domestic Export Quantity

Source: USITC estimates. Monthly exports data were obtained from USITC DataWeb/Census for HTS product code 0709.93.20.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October exports quantity (mt)

In[ ]:=
```
qdne0 = 1587;
```

In[ ]:=
```
vdn0 = (qdn0 - qdne0) * pdn0;
```

November-May exports quantity (mt)

In[ ]:=
```
qdfe0 = 2785;
```

In[ ]:=
```
vdf0 = (qdf0 - qdfe0) * pdf0;
```

2.4 Domestic Employment

Source: USITC estimates. The number of full-time equivalent (FTE) workers was estimated using information about per-acre labor hours and acreage data from USDA NASS.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October number of FTEs

In[ ]:=
```
qempn0 = 1695;
```

November-May number of FTEs

In[ ]:=
```
qempf0 = 231;
```

---

3. Calibration

3.1 Supply Parameters

In[ ]:=
```
adn = qdn0 pdn0^(-en);
```

In[ ]:=
```
adf = qdf0 pdf0^(-ef);
```

3.2 Demand Parameters

$In[\bullet]:=$ $\text{bfn} = \dfrac{\text{vfn0}}{\text{vdn0}} \left(\dfrac{\text{pfn0}}{\text{pdn0}} \right)^{\text{sigma}-1};$

$In[\bullet]:=$ $\text{pin0} = \left(\text{pdn0}^{1-\text{sigma}} + \text{bfn pfn0}^{1-\text{sigma}} \right)^{\frac{1}{1-\text{sigma}}};$

$In[\bullet]:=$ $\text{kn} = \left(\text{qdn0} - \text{qdne0} \right) \text{pin0}^{-\text{sigma}-\text{eta}} \text{pdn0}^{\text{sigma}};$

$In[\bullet]:=$ $\text{bff} = \dfrac{\text{vff0}}{\text{vdf0}} \left(\dfrac{\text{pff0}}{\text{pdf0}} \right)^{\text{sigma}-1};$

$In[\bullet]:=$ $\text{pif0} = \left(\text{pdf0}^{1-\text{sigma}} + \text{bff pff0}^{1-\text{sigma}} \right)^{\frac{1}{1-\text{sigma}}};$

$In[\bullet]:=$ $\text{kf} = \left(\text{qdf0} - \text{qdfe0} \right) \text{pif0}^{-\text{sigma}-\text{eta}} \text{pdf0}^{\text{sigma}};$

---

4. New Equilibrium Calculation

June-October Equilibrium Calculation

$In[\bullet]:=$ $\text{pin} = \left(\text{pd1}^{1-\text{sigma}} + \text{bfn pf1}^{1-\text{sigma}} \right)^{\frac{1}{1-\text{sigma}}};$

$In[\bullet]:=$ $\text{Eqn11} = \text{adn pd1}^{\text{en}} == \text{qdne0} + \text{kn pin}^{\text{sigma}+\text{eta}} \text{pd1}^{-\text{sigma}};$

$In[\bullet]:=$ $\text{Eqn12} = \text{qcn0} == \text{kn bfn pin}^{\text{sigma}+\text{eta}} \text{pf1}^{-\text{sigma}};$

$In[\bullet]:=$ $\text{FindRoot}[\{\text{Eqn11}, \text{Eqn12}\}, \{\text{pd1}, \text{pdn0}\}, \{\text{pf1}, \text{pfn0}\}]$

$Out[\bullet]=$ $\{\text{pd1} \rightarrow 850.21, \text{pf1} \rightarrow 921.788\}$

$In[\bullet]:=$ $\text{pdn1} = \text{pd1} /. \%;$

$In[\bullet]:=$ $\text{pfn1} = \text{pf1} /. \%\%;$

$In[\bullet]:=$ $\text{qdn1} = \text{adn pdn1}^{\text{en}};$

$In[\bullet]:=$ $\text{qfn1} = \text{qcn0};$

$In[\bullet]:=$ $\text{pin1} = \left(\text{pdn1}^{1-\text{sigma}} + \text{bfn pfn1}^{1-\text{sigma}} \right)^{\frac{1}{1-\text{sigma}}};$

November-May Equilibrium Calculation

$In[\bullet]:=$ $\text{pif} = \left(\text{pd2}^{1-\text{sigma}} + \text{bff pf2}^{1-\text{sigma}} \right)^{\frac{1}{1-\text{sigma}}};$

$In[\bullet]:=$ $\text{Eqn21} = \text{adf pd2}^{\text{ef}} == \text{qdfe0} + \text{kf pif}^{\text{sigma}+\text{eta}} \text{pd2}^{-\text{sigma}};$

$In[\bullet]:=$ $\text{Eqn22} = \text{qcf0} == \text{kf bff pif}^{\text{sigma}+\text{eta}} \text{pf2}^{-\text{sigma}};$

$In[\bullet]:=$ $\text{FindRoot}[\{\text{Eqn21}, \text{Eqn22}\}, \{\text{pd2}, \text{pdf0}\}, \{\text{pf2}, \text{pff0}\}]$

$Out[\bullet]=$ $\{\text{pd2} \rightarrow 632.309, \text{pf2} \rightarrow 1593.05\}$

$In[\bullet]:=$ $\text{pdf1} = \text{pd2} /. \%;$

$In[\bullet]:=$ $\text{pff1} = \text{pf2} /. \%\%;$

In[ ]:= `qdf1 = adf pdf1^ef;`

In[ ]:= `qff1 = qcf0;`

In[ ]:= `pif1 = ( pdf1^{1-sigma} + bff pff1^{1-sigma})^{\frac{1}{1-sigma}};`

---

5. Results

Percent change in prices of domestic product, {June-October, November-May}

In[ ]:= `PriceChange = { $\frac{100\ (pdn1 - pdn0)}{pdn0}$, $\frac{100\ (pdf1 - pdf0)}{pdf0}$ }`

Out[ ]= `{0.62894, 5.61168}`

Percent change in quantities of domestic product, {June-October, November-May}

In[ ]:= `QuantityChange = { $\frac{100\ (qdn1 - qdn0)}{qdn0}$, $\frac{100\ (qdf1 - qdf0)}{qdf0}$ }`

Out[ ]= `{2.53959, 24.4079}`

Percent change in price of imported product, {June-October, November-May}

In[ ]:= `ImportPChange = { $\frac{100\ (pfn1 - pfn0)}{pfn0}$, $\frac{100\ (pff1 - pff0)}{pff0}$ }`

Out[ ]= `{10.7172, 24.5422}`

Percent change in quantities of imported product, {June-October, November-May}

In[ ]:= `ImportQChange = {N[ $\frac{100\ (qfn1 - qfn0)}{qfn0}$ ], N[ $\frac{100\ (qff1 - qff0)}{qff0}$ ]}`

Out[ ]= `{-23.6287, -21.6435}`

Change in revenue of domestic producers ($), {June-October, November-May}

In[ ]:= `Revenues = {IntegerPart[pdn1 qdn1 - pdn0 qdn0], IntegerPart[pdf1 qdf1 - pdf0 qdf0]}`

Out[ ]= `{2 797 824, 2 664 673}`

Change in operating income of domestic producers ($), {June-October, November-May}

In[ ]:= `OP = IntegerPart[{ ($\frac{1}{sigma}$) (pdn1 qdn1 - pdn0 qdn0), ($\frac{1}{sigma}$) (pdf1 qdf1 - pdf0 qdf0)}]`

Out[ ]= `{906 031, 862 912}`

Change in employment (# of FTEs), {June-October, November-May}

In[ ]:= `Employment = {qempn0` $\dfrac{(\text{qdn1 – qdn0})}{\text{qdn0}}$ `, qempf0` $\dfrac{(\text{qdf1 – qdf0})}{\text{qdf0}}$ `}`

Out[ ]= `{43.0461, 56.3822}`

Nov 2017 - Oct 2018

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

1. Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020).

Riker, David. "A Trade Cost Approach to Estimating the Elasticity of Substitution." Economics Working Paper Series 2020-07-D, U.S. International Trade Commission, July 2020. https://www.usitc.gov/publications/332/working_papers/ecwp_2017-07-d.pdf.

In[ ]:= `sigma = 3.0880;`

1.2 Industry Price Elasticity of Demand

Source: USITC staff estimate.

In[ ]:= `eta = -1;`

1.3 Domestic Supply Elasticities

Source: USITC staff estimate and interviews with industry participants..

June-October domestic supply elasticity

In[ ]:= `en = 4;`

November-May domestic supply elasticity

In[ ]:= `ef = 4;`

2. Data Inputs

2.1 U.S. Production Values and Quantities

Source: USITC estimates. Annual state level data obtained from U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). State level data was split into June-October and November-May production using information about state-

level harvesting months.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October domestic production quantity (mt) and value ($)

In[ ]:= **qdn0 = 163 722;**

In[ ]:= **vdn0 = 95 138 564;**

In[ ]:= **pdn0 = vdn0 / qdn0;**

November-May domestic production quantity (mt) and value ($)

In[ ]:= **qdf0 = 10 536;**

In[ ]:= **vdf0 = 6 516 396;**

In[ ]:= **pdf0 = vdf0 / qdf0;**

2.2 Import Values and Quantities

Source: USITC estimates. Monthly import data was obtained from USITC DataWeb/Census for HTS product code 0709.93.20. Import data was split into summer and winter varieties using production estimates by major trading partner. The import counterfactuals were calculated by removing the above-average increases in imports from 2009 to 2019, reducing the high-growth years growth rates in imports to follow average growth rates.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October import quantity (mt) and value ($)

In[ ]:= **qfn0 = 19 943;**

In[ ]:= **vfn0 = 15 089 917;**

In[ ]:= **pfn0 = vfn0 / qfn0;**

November-May import quantity (mt) and value ($)

In[ ]:= **qff0 = 77 162;**

In[ ]:= **vff0 = 59 356 531;**

In[ ]:= **pff0 = vff0 / qff0;**

June-October counterfactual import quantity (mt)

In[ ]:=   `qcn0 = 15 966;`

November-May counterfactual import quantity (mt)

In[ ]:=   `qcf0 = 63 059;`

2.3 Domestic Export Quantity

Source: USITC estimates. Monthly exports data were obtained from USITC DataWeb/Census for HTS product code 0709.93.20.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October exports quantity (mt)

In[ ]:=   `qdne0 = 1511;`

In[ ]:= `vdn0 = (qdn0 − qdne0) * pdn0;`

November-May exports quantity (mt)

In[ ]:=   `qdfe0 = 3927;`

In[ ]:= `vdf0 = (qdf0 − qdfe0) * pdf0;`

2.4 Domestic Employment

Source: USITC estimates. The number of full-time equivalent (FTE) workers was estimated using information about per-acre labor hours and acreage data from USDA NASS.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October number of FTEs

In[ ]:=   `qempn0 = 1864;`

November-May number of FTEs

In[ ]:=   `qempf0 = 120;`

3. Calibration

3.1 Supply Parameters

In[ ]:= `adn = qdn0 pdn0^{-en};`

In[ ]:= `adf = qdf0 pdf0^{-ef};`

3.2 Demand Parameters

$In[\circ]:=$ $\mathbf{bfn} = \dfrac{\mathbf{vfn0}}{\mathbf{vdn0}} \left(\dfrac{\mathbf{pfn0}}{\mathbf{pdn0}} \right)^{\mathbf{sigma-1}};$

$In[\circ]:=$ $\mathbf{pin0} = \left(\mathbf{pdn0}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pfn0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\circ]:=$ $\mathbf{kn} = \left(\mathbf{qdn0} - \mathbf{qdne0} \right) \mathbf{pin0}^{-\mathbf{sigma}-\mathbf{eta}}\,\mathbf{pdn0}^{\mathbf{sigma}};$

$In[\circ]:=$ $\mathbf{bff} = \dfrac{\mathbf{vff0}}{\mathbf{vdf0}} \left(\dfrac{\mathbf{pff0}}{\mathbf{pdf0}} \right)^{\mathbf{sigma-1}};$

$In[\circ]:=$ $\mathbf{pif0} = \left(\mathbf{pdf0}^{1-\mathbf{sigma}} + \mathbf{bff}\,\mathbf{pff0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\circ]:=$ $\mathbf{kf} = \left(\mathbf{qdf0} - \mathbf{qdfe0} \right) \mathbf{pif0}^{-\mathbf{sigma}-\mathbf{eta}}\,\mathbf{pdf0}^{\mathbf{sigma}};$

4. New Equilibrium Calculation

June-October Equilibrium Calculation

$In[\circ]:=$ $\mathbf{pin} = \left(\mathbf{pd1}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pf1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\circ]:=$ $\mathbf{Eqn11} = \mathbf{adn}\,\mathbf{pd1}^{\mathbf{en}} == \mathbf{qdne0} + \mathbf{kn}\,\mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pd1}^{-\mathbf{sigma}};$

$In[\circ]:=$ $\mathbf{Eqn12} = \mathbf{qcn0} == \mathbf{kn}\,\mathbf{bfn}\,\mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pf1}^{-\mathbf{sigma}};$

$In[\circ]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn11}, \mathbf{Eqn12}\}, \{\mathbf{pd1}, \mathbf{pdn0}\}, \{\mathbf{pf1}, \mathbf{pfn0}\}]$

$Out[\circ]=$ $\{\mathbf{pd1} \to 583.505, \mathbf{pf1} \to 820.952\}$

$In[\circ]:=$ $\mathbf{pdn1} = \mathbf{pd1}\ /.\ \%;$

$In[\circ]:=$ $\mathbf{pfn1} = \mathbf{pf1}\ /.\ \%\%;$

$In[\circ]:=$ $\mathbf{qdn1} = \mathbf{adn}\,\mathbf{pdn1}^{\mathbf{en}};$

$In[\circ]:=$ $\mathbf{qfn1} = \mathbf{qcn0};$

$In[\circ]:=$ $\mathbf{pin1} = \left(\mathbf{pdn1}^{1-\mathbf{sigma}} + \mathbf{bfn}\,\mathbf{pfn1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

November-May Equilibrium Calculation

$In[\circ]:=$ $\mathbf{pif} = \left(\mathbf{pd2}^{1-\mathbf{sigma}} + \mathbf{bff}\,\mathbf{pf2}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\circ]:=$ $\mathbf{Eqn21} = \mathbf{adf}\,\mathbf{pd2}^{\mathbf{ef}} == \mathbf{qdfe0} + \mathbf{kf}\,\mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pd2}^{-\mathbf{sigma}};$

$In[\circ]:=$ $\mathbf{Eqn22} = \mathbf{qcf0} == \mathbf{kf}\,\mathbf{bff}\,\mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\,\mathbf{pf2}^{-\mathbf{sigma}};$

$In[\circ]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn21}, \mathbf{Eqn22}\}, \{\mathbf{pd2}, \mathbf{pdf0}\}, \{\mathbf{pf2}, \mathbf{pff0}\}]$

$Out[\circ]=$ $\{\mathbf{pd2} \to 642.73, \mathbf{pf2} \to 920.893\}$

$In[\circ]:=$ $\mathbf{pdf1} = \mathbf{pd2}\ /.\ \%;$

$In[\circ]:=$ $\mathbf{pff1} = \mathbf{pf2}\ /.\ \%\%;$

$In[\bullet]:=$ `qdf1 = adf pdf1`$^{\text{ef}}$`;`

$In[\bullet]:=$ `qff1 = qcf0;`

$In[\bullet]:=$ `pif1 = ` $\left(\text{pdf1}^{1-\text{sigma}} + \text{bff pff1}^{1-\text{sigma}}\right)^{\frac{1}{1-\text{sigma}}}$ `;`

---

5. Results

Percent change in prices of domestic product, {June-October, November-May}

$In[\bullet]:=$ `PriceChange = ` $\left\{ \dfrac{100\,(\text{pdn1} - \text{pdn0})}{\text{pdn0}}, \dfrac{100\,(\text{pdf1} - \text{pdf0})}{\text{pdf0}} \right\}$

$Out[\bullet]=$ $\{0.414101, 3.91938\}$

Percent change in quantities of domestic product, {June-October, November-May}

$In[\bullet]:=$ `QuantityChange = ` $\left\{ \dfrac{100\,(\text{qdn1} - \text{qdn0})}{\text{qdn0}}, \dfrac{100\,(\text{qdf1} - \text{qdf0})}{\text{qdf0}} \right\}$

$Out[\bullet]=$ $\{1.66672, 16.6235\}$

Percent change in price of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportPChange = ` $\left\{ \dfrac{100\,(\text{pfn1} - \text{pfn0})}{\text{pfn0}}, \dfrac{100\,(\text{pff1} - \text{pff0})}{\text{pff0}} \right\}$

$Out[\bullet]=$ $\{8.49794, 19.7138\}$

Percent change in quantities of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportQChange = ` $\left\{ N\left[\dfrac{100\,(\text{qfn1} - \text{qfn0})}{\text{qfn0}} \right], N\left[\dfrac{100\,(\text{qff1} - \text{qff0})}{\text{qff0}} \right] \right\}$

$Out[\bullet]=$ $\{-19.9418, -18.2771\}$

Change in revenue of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `Revenues = {IntegerPart[pdn1 qdn1 – pdn0 qdn0], IntegerPart[pdf1 qdf1 – pdf0 qdf0]}`

$Out[\bullet]=$ $\{1\,986\,230, 1\,381\,114\}$

Change in operating income of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `OP = IntegerPart`$\left[\left\{ \left(\dfrac{1}{\text{sigma}} \right) (\text{pdn1 qdn1} - \text{pdn0 qdn0}), \left(\dfrac{1}{\text{sigma}} \right) (\text{pdf1 qdf1} - \text{pdf0 qdf0}) \right\} \right]$

$Out[\bullet]=$ $\{643\,209, 447\,252\}$

Change in employment (# of FTEs), {June-October, November-May}

In[ ]:= `Employment = ` $\left\{ \text{qempn0} \dfrac{(\text{qdn1} - \text{qdn0})}{\text{qdn0}}, \text{qempf0} \dfrac{(\text{qdf1} - \text{qdf0})}{\text{qdf0}} \right\}$

Out[ ]= {31.0677, 19.9482}

Nov 2016 - Oct 2017

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

1. Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020).

Riker, David. "A Trade Cost Approach to Estimating the Elasticity of Substitution." Economics Working Paper Series 2020-07-D, U.S. International Trade Commission, July 2020. https://www.usitc.gov/publications/332/working_papers/ecwp_2017-07-d.pdf.

In[ ]:= `sigma = 3.0880;`

1.2 Industry Price Elasticity of Demand

Source: USITC staff estimate.

In[ ]:= `eta = -1;`

1.3 Domestic Supply Elasticities

Source: USITC staff estimate and interviews with industry participants..

June-October domestic supply elasticity

In[ ]:= `en = 4;`

November-May domestic supply elasticity

In[ ]:= `ef = 4;`

2. Data Inputs

2.1 U.S. Production Values and Quantities

Source: USITC estimates. Annual state level data obtained from U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). State level data was split into June-October and November-May production using information about state-

level harvesting months.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October domestic production quantity (mt) and value ($)

In[ ]:= `qdn0 = 152 639;`

In[ ]:= `vdn0 = 93 926 085;`

In[ ]:= `pdn0 = vdn0 / qdn0;`

November-May domestic production quantity (mt) and value ($)

In[ ]:= `qdf0 = 9297;`

In[ ]:= `vdf0 = 7 508 085;`

In[ ]:= `pdf0 = vdf0 / qdf0;`

2.2 Import Values and Quantities

Source: USITC estimates. Monthly import data was obtained from USITC DataWeb/Census for HTS product code 0709.93.20. Import data was split into summer and winter varieties using production estimates by major trading partner. The import counterfactuals were calculated by removing the above-average increases in imports from 2009 to 2019, reducing the high-growth years growth rates in imports to follow average growth rates.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October import quantity (mt) and value ($)

In[ ]:= `qfn0 = 21 144;`

In[ ]:= `vfn0 = 17 230 534;`

In[ ]:= `pfn0 = vfn0 / qfn0;`

November-May import quantity (mt) and value ($)

In[ ]:= `qff0 = 76 236;`

In[ ]:= `vff0 = 55 548 343;`

In[ ]:= `pff0 = vff0 / qff0;`

June-October counterfactual import quantity (mt)

In[ ]:=
```
qcn0 = 16 927;
```

November-May counterfactual import quantity (mt)

In[ ]:=
```
qcf0 = 62 302;
```

2.3 Domestic Export Quantity

Source: USITC estimates. Monthly exports data were obtained from USITC DataWeb/Census for HTS product code 0709.93.20.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October exports quantity (mt)

In[ ]:=
```
qdne0 = 1779;
```

In[ ]:=
```
vdn0 = (qdn0 - qdne0) * pdn0;
```

November-May exports quantity (mt)

In[ ]:=
```
qdfe0 = 4425;
```

In[ ]:=
```
vdf0 = (qdf0 - qdfe0) * pdf0;
```

2.4 Domestic Employment

Source: USITC estimates. The number of full-time equivalent (FTE) workers was estimated using information about per-acre labor hours and acreage data from USDA NASS.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October number of FTEs

In[ ]:=
```
qempn0 = 1915;
```

November-May number of FTEs

In[ ]:=
```
qempf0 = 117;
```

---

3. Calibration

3.1 Supply Parameters

In[ ]:=
```
adn = qdn0 pdn0^(-en);
```

In[ ]:=
```
adf = qdf0 pdf0^(-ef);
```

3.2 Demand Parameters

$In[\bullet]:=$ $\mathtt{bfn} = \dfrac{\mathtt{vfn0}}{\mathtt{vdn0}} \left(\dfrac{\mathtt{pfn0}}{\mathtt{pdn0}}\right)^{\mathtt{sigma-1}};$

$In[\bullet]:=$ $\mathtt{pin0} = \left(\mathtt{pdn0}^{1-\mathtt{sigma}} + \mathtt{bfn}\,\mathtt{pfn0}^{1-\mathtt{sigma}}\right)^{\frac{1}{1-\mathtt{sigma}}};$

$In[\bullet]:=$ $\mathtt{kn} = \left(\mathtt{qdn0} - \mathtt{qdne0}\right)\mathtt{pin0}^{-\mathtt{sigma}-\mathtt{eta}}\,\mathtt{pdn0}^{\mathtt{sigma}};$

$In[\bullet]:=$ $\mathtt{bff} = \dfrac{\mathtt{vff0}}{\mathtt{vdf0}} \left(\dfrac{\mathtt{pff0}}{\mathtt{pdf0}}\right)^{\mathtt{sigma-1}};$

$In[\bullet]:=$ $\mathtt{pif0} = \left(\mathtt{pdf0}^{1-\mathtt{sigma}} + \mathtt{bff}\,\mathtt{pff0}^{1-\mathtt{sigma}}\right)^{\frac{1}{1-\mathtt{sigma}}};$

$In[\bullet]:=$ $\mathtt{kf} = \left(\mathtt{qdf0} - \mathtt{qdfe0}\right)\mathtt{pif0}^{-\mathtt{sigma}-\mathtt{eta}}\,\mathtt{pdf0}^{\mathtt{sigma}};$

4. New Equilibrium Calculation

June-October Equilibrium Calculation

$In[\bullet]:=$ $\mathtt{pin} = \left(\mathtt{pd1}^{1-\mathtt{sigma}} + \mathtt{bfn}\,\mathtt{pf1}^{1-\mathtt{sigma}}\right)^{\frac{1}{1-\mathtt{sigma}}};$

$In[\bullet]:=$ $\mathtt{Eqn11} = \mathtt{adn}\,\mathtt{pd1}^{\mathtt{en}} \mathrel{==} \mathtt{qdne0} + \mathtt{kn}\,\mathtt{pin}^{\mathtt{sigma}+\mathtt{eta}}\,\mathtt{pd1}^{-\mathtt{sigma}};$

$In[\bullet]:=$ $\mathtt{Eqn12} = \mathtt{qcn0} \mathrel{==} \mathtt{kn}\,\mathtt{bfn}\,\mathtt{pin}^{\mathtt{sigma}+\mathtt{eta}}\,\mathtt{pf1}^{-\mathtt{sigma}};$

$In[\bullet]:=$ $\mathtt{FindRoot}[\{\mathtt{Eqn11}, \mathtt{Eqn12}\}, \{\mathtt{pd1}, \mathtt{pdn0}\}, \{\mathtt{pf1}, \mathtt{pfn0}\}]$

$Out[\bullet]=$ $\{\mathtt{pd1} \rightarrow 618.266, \mathtt{pf1} \rightarrow 885.409\}$

$In[\bullet]:=$ $\mathtt{pdn1} = \mathtt{pd1}\ /.\ \%;$

$In[\bullet]:=$ $\mathtt{pfn1} = \mathtt{pf1}\ /.\ \%\%;$

$In[\bullet]:=$ $\mathtt{qdn1} = \mathtt{adn}\,\mathtt{pdn1}^{\mathtt{en}};$

$In[\bullet]:=$ $\mathtt{qfn1} = \mathtt{qcn0};$

$In[\bullet]:=$ $\mathtt{pin1} = \left(\mathtt{pdn1}^{1-\mathtt{sigma}} + \mathtt{bfn}\,\mathtt{pfn1}^{1-\mathtt{sigma}}\right)^{\frac{1}{1-\mathtt{sigma}}};$

November-May Equilibrium Calculation

$In[\bullet]:=$ $\mathtt{pif} = \left(\mathtt{pd2}^{1-\mathtt{sigma}} + \mathtt{bff}\,\mathtt{pf2}^{1-\mathtt{sigma}}\right)^{\frac{1}{1-\mathtt{sigma}}};$

$In[\bullet]:=$ $\mathtt{Eqn21} = \mathtt{adf}\,\mathtt{pd2}^{\mathtt{ef}} \mathrel{==} \mathtt{qdfe0} + \mathtt{kf}\,\mathtt{pif}^{\mathtt{sigma}+\mathtt{eta}}\,\mathtt{pd2}^{-\mathtt{sigma}};$

$In[\bullet]:=$ $\mathtt{Eqn22} = \mathtt{qcf0} \mathrel{==} \mathtt{kf}\,\mathtt{bff}\,\mathtt{pif}^{\mathtt{sigma}+\mathtt{eta}}\,\mathtt{pf2}^{-\mathtt{sigma}};$

$In[\bullet]:=$ $\mathtt{FindRoot}[\{\mathtt{Eqn21}, \mathtt{Eqn22}\}, \{\mathtt{pd2}, \mathtt{pdf0}\}, \{\mathtt{pf2}, \mathtt{pff0}\}]$

$Out[\bullet]=$ $\{\mathtt{pd2} \rightarrow 835.502, \mathtt{pf2} \rightarrow 871.258\}$

$In[\bullet]:=$ $\mathtt{pdf1} = \mathtt{pd2}\ /.\ \%;$

$In[\bullet]:=$ $\mathtt{pff1} = \mathtt{pf2}\ /.\ \%\%;$

$In[\ \circ\ ]:=$ `qdf1 = adf pdf1`$^{\text{ef}}$`;`

$In[\ \circ\ ]:=$ `qff1 = qcf0;`

$In[\ \circ\ ]:=$ `pif1 = ` $\left(\text{pdf1}^{1-\text{sigma}} + \text{bff pff1}^{1-\text{sigma}}\right)^{\frac{1}{1-\text{sigma}}}$ `;`

---

5. Results

Percent change in prices of domestic product, {June-October, November-May}

$In[\ \circ\ ]:=$ `PriceChange = ` $\left\{ \dfrac{100\ (\text{pdn1} - \text{pdn0})}{\text{pdn0}},\ \dfrac{100\ (\text{pdf1} - \text{pdf0})}{\text{pdf0}} \right\}$

$Out[\ \circ\ ]=$ {0.474243, 3.45733}

Percent change in quantities of domestic product, {June-October, November-May}

$In[\ \circ\ ]:=$ `QuantityChange = ` $\left\{ \dfrac{100\ (\text{qdn1} - \text{qdn0})}{\text{qdn0}},\ \dfrac{100\ (\text{qdf1} - \text{qdf0})}{\text{qdf0}} \right\}$

$Out[\ \circ\ ]=$ {1.91051, 14.5632}

Percent change in price of imported product, {June-October, November-May}

$In[\ \circ\ ]:=$ `ImportPChange = ` $\left\{ \dfrac{100\ (\text{pfn1} - \text{pfn0})}{\text{pfn0}},\ \dfrac{100\ (\text{pff1} - \text{pff0})}{\text{pff0}} \right\}$

$Out[\ \circ\ ]=$ {8.6506, 19.5737}

Percent change in quantities of imported product, {June-October, November-May}

$In[\ \circ\ ]:=$ `ImportQChange = ` $\left\{ \text{N}\left[\dfrac{100\ (\text{qfn1} - \text{qfn0})}{\text{qfn0}} \right],\ \text{N}\left[\dfrac{100\ (\text{qff1} - \text{qff0})}{\text{qff0}} \right] \right\}$

$Out[\ \circ\ ]=$ {-19.9442, -18.2775}

Change in revenue of domestic producers ($), {June-October, November-May}

$In[\ \circ\ ]:=$ `Revenues = {IntegerPart[pdn1 qdn1 - pdn0 qdn0], IntegerPart[pdf1 qdf1 - pdf0 qdf0]}`

$Out[\ \circ\ ]=$ {2 248 415, 1 390 800}

Change in operating income of domestic producers ($), {June-October, November-May}

$In[\ \circ\ ]:=$ `OP = IntegerPart`$\left[\left\{ \left(\dfrac{1}{\text{sigma}} \right) (\text{pdn1 qdn1} - \text{pdn0 qdn0}),\ \left(\dfrac{1}{\text{sigma}} \right) (\text{pdf1 qdf1} - \text{pdf0 qdf0}) \right\} \right]$

$Out[\ \circ\ ]=$ {728 113, 450 388}

Change in employment (# of FTEs), {June-October, November-May}

In[ ]:= `Employment = {qempn0` $\frac{(qdn1 - qdn0)}{qdn0}$ `, qempf0` $\frac{(qdf1 - qdf0)}{qdf0}$ `}`

Out[ ]= {36.5863, 17.0389}

Nov 2015 - Oct 2016

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

1. Model Parameters

1.1 Elasticity of Substitution

Source: USITC's econometric estimation using the trade cost method in Riker (2020).

Riker, David. "A Trade Cost Approach to Estimating the Elasticity of Substitution." Economics Working Paper Series 2020-07-D, U.S. International Trade Commission, July 2020. https://www.usitc.gov/publications/332/working_papers/ecwp_2017-07-d.pdf.

In[ ]:= `sigma = 3.0880;`

1.2 Industry Price Elasticity of Demand

Source: USITC staff estimate.

In[ ]:= `eta = -1;`

1.3 Domestic Supply Elasticities

Source: USITC staff estimate and interviews with industry participants..

June-October domestic supply elasticity

In[ ]:= `en = 4;`

November-May domestic supply elasticity

In[ ]:= `ef = 4;`

2. Data Inputs

2.1 U.S. Production Values and Quantities

Source: USITC estimates. Annual state level data obtained from U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). State level data was split into June-October and November-May production using information about state-

level harvesting months.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October domestic production quantity (mt) and value ($)

In[ ]:= `qdn0 = 160 460;`

In[ ]:= `vdn0 = 77 723 490;`

In[ ]:= `pdn0 = vdn0 / qdn0;`

November-May domestic production quantity (mt) and value ($)

In[ ]:= `qdf0 = 11 009;`

In[ ]:= `vdf0 = 7 403 230;`

In[ ]:= `pdf0 = vdf0 / qdf0;`

2.2 Import Values and Quantities

Source: USITC estimates. Monthly import data was obtained from USITC DataWeb/Census for HTS product code 0709.93.20. Import data was split into summer and winter varieties using production estimates by major trading partner. The import counterfactuals were calculated by removing the above-average increases in imports from 2009 to 2019, reducing the high-growth years growth rates in imports to follow average growth rates.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October import quantity (mt) and value ($)

In[ ]:= `qfn0 = 17 746;`

In[ ]:= `vfn0 = 12 258 796;`

In[ ]:= `pfn0 = vfn0 / qfn0;`

November-May import quantity (mt) and value ($)

In[ ]:= `qff0 = 75 310;`

In[ ]:= `vff0 = 66 875 948;`

In[ ]:= `pff0 = vff0 / qff0;`

June-October counterfactual import quantity (mt)

In[ ]:= `qcn0 = 14 832;`

November-May counterfactual import quantity (mt)

In[ ]:= `qcf0 = 61 545;`

2.3 Domestic Export Quantity

Source: USITC estimates. Monthly exports data were obtained from USITC DataWeb/Census for HTS product code 0709.93.20.

U.S. International Trade Commission Interactive Tariff and Trade DataWeb (USITC DataWeb)/U.S. Census Bureau (Census). Accessed various dates. http://dataweb.usitc.gov.

June-October exports quantity (mt)

In[ ]:= `qdne0 = 1316;`

In[ ]:= `vdn0 = (qdn0 - qdne0) * pdn0;`

November-May exports quantity (mt)

In[ ]:= `qdfe0 = 3524;`

In[ ]:= `vdf0 = (qdf0 - qdfe0) * pdf0;`

2.4 Domestic Employment

Source: USITC estimates. The number of full-time equivalent (FTE) workers was estimated using information about per-acre labor hours and acreage data from USDA NASS.

U.S. Department of Agriculture (USDA). National Agricultural Statistics Service (NASS). "Squash Production, Area harvested, and Yield," Quick Stats database. Accessed various dates. https://quickstats.nass.usda.gov/.

June-October number of FTEs

In[ ]:= `qempn0 = 1910;`

November-May number of FTEs

In[ ]:= `qempf0 = 131;`

3. Calibration

3.1 Supply Parameters

In[ ]:= $adn = qdn0 \, pdn0^{-en};$

In[ ]:= $adf = qdf0 \, pdf0^{-ef};$

3.2 Demand Parameters

$In[\bullet]:=$ $\mathbf{bfn} = \dfrac{\mathbf{vfn0}}{\mathbf{vdn0}} \left(\dfrac{\mathbf{pfn0}}{\mathbf{pdn0}} \right)^{\mathbf{sigma-1}};$

$In[\bullet]:=$ $\mathbf{pin0} = \left(\mathbf{pdn0}^{1-\mathbf{sigma}} + \mathbf{bfn}\, \mathbf{pfn0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{kn} = \left(\mathbf{qdn0} - \mathbf{qdne0} \right) \mathbf{pin0}^{-\mathbf{sigma}-\mathbf{eta}}\, \mathbf{pdn0}^{\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{bff} = \dfrac{\mathbf{vff0}}{\mathbf{vdf0}} \left(\dfrac{\mathbf{pff0}}{\mathbf{pdf0}} \right)^{\mathbf{sigma-1}};$

$In[\bullet]:=$ $\mathbf{pif0} = \left(\mathbf{pdf0}^{1-\mathbf{sigma}} + \mathbf{bff}\, \mathbf{pff0}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{kf} = \left(\mathbf{qdf0} - \mathbf{qdfe0} \right) \mathbf{pif0}^{-\mathbf{sigma}-\mathbf{eta}}\, \mathbf{pdf0}^{\mathbf{sigma}};$

4. New Equilibrium Calculation

June-October Equilibrium Calculation

$In[\bullet]:=$ $\mathbf{pin} = \left(\mathbf{pd1}^{1-\mathbf{sigma}} + \mathbf{bfn}\, \mathbf{pf1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{Eqn11} = \mathbf{adn}\, \mathbf{pd1}^{\mathbf{en}} == \mathbf{qdne0} + \mathbf{kn}\, \mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\, \mathbf{pd1}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{Eqn12} = \mathbf{qcn0} == \mathbf{kn}\, \mathbf{bfn}\, \mathbf{pin}^{\mathbf{sigma}+\mathbf{eta}}\, \mathbf{pf1}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn11}, \mathbf{Eqn12}\}, \{\mathbf{pd1}, \mathbf{pdn0}\}, \{\mathbf{pf1}, \mathbf{pfn0}\}]$

$Out[\bullet]=$ $\{\mathrm{pd1} \to 486.011,\ \mathrm{pf1} \to 737.805\}$

$In[\bullet]:=$ $\mathbf{pdn1} = \mathbf{pd1}\ /.\ \%;$

$In[\bullet]:=$ $\mathbf{pfn1} = \mathbf{pf1}\ /.\ \%\%;$

$In[\bullet]:=$ $\mathbf{qdn1} = \mathbf{adn}\, \mathbf{pdn1}^{\mathbf{en}};$

$In[\bullet]:=$ $\mathbf{qfn1} = \mathbf{qcn0};$

$In[\bullet]:=$ $\mathbf{pin1} = \left(\mathbf{pdn1}^{1-\mathbf{sigma}} + \mathbf{bfn}\, \mathbf{pfn1}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

November-May Equilibrium Calculation

$In[\bullet]:=$ $\mathbf{pif} = \left(\mathbf{pd2}^{1-\mathbf{sigma}} + \mathbf{bff}\, \mathbf{pf2}^{1-\mathbf{sigma}} \right)^{\frac{1}{1-\mathbf{sigma}}};$

$In[\bullet]:=$ $\mathbf{Eqn21} = \mathbf{adf}\, \mathbf{pd2}^{\mathbf{ef}} == \mathbf{qdfe0} + \mathbf{kf}\, \mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\, \mathbf{pd2}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{Eqn22} = \mathbf{qcf0} == \mathbf{kf}\, \mathbf{bff}\, \mathbf{pif}^{\mathbf{sigma}+\mathbf{eta}}\, \mathbf{pf2}^{-\mathbf{sigma}};$

$In[\bullet]:=$ $\mathbf{FindRoot}[\{\mathbf{Eqn21}, \mathbf{Eqn22}\}, \{\mathbf{pd2}, \mathbf{pdf0}\}, \{\mathbf{pf2}, \mathbf{pff0}\}]$

$Out[\bullet]=$ $\{\mathrm{pd2} \to 699.821,\ \mathrm{pf2} \to 1061.65\}$

$In[\bullet]:=$ $\mathbf{pdf1} = \mathbf{pd2}\ /.\ \%;$

$In[\bullet]:=$ $\mathbf{pff1} = \mathbf{pf2}\ /.\ \%\%;$

$In[\bullet]:=$ `qdf1 = adf pdf1`^{ef}`;`

$In[\bullet]:=$ `qff1 = qcf0;`

$In[\bullet]:=$ `pif1 = ` $\left(pdf1^{1-sigma} + bff\ pff1^{1-sigma} \right)^{\frac{1}{1-sigma}}$ `;`

---

5. Results

Percent change in prices of domestic product, {June-October, November-May}

$In[\bullet]:=$ `PriceChange = {` $\dfrac{100\ (pdn1 - pdn0)}{pdn0}$ `, ` $\dfrac{100\ (pdf1 - pdf0)}{pdf0}$ `}`

$Out[\bullet]=$ `{0.336826, 4.06716}`

Percent change in quantities of domestic product, {June-October, November-May}

$In[\bullet]:=$ `QuantityChange = {` $\dfrac{100\ (qdn1 - qdn0)}{qdn0}$ `, ` $\dfrac{100\ (qdf1 - qdf0)}{qdf0}$ `}`

$Out[\bullet]=$ `{1.35413, 17.2883}`

Percent change in price of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportPChange = {` $\dfrac{100\ (pfn1 - pfn0)}{pfn0}$ `, ` $\dfrac{100\ (pff1 - pff0)}{pff0}$ `}`

$Out[\bullet]=$ `{6.80571, 19.554}`

Percent change in quantities of imported product, {June-October, November-May}

$In[\bullet]:=$ `ImportQChange = {N[` $\dfrac{100\ (qfn1 - qfn0)}{qfn0}$ `], N[` $\dfrac{100\ (qff1 - qff0)}{qff0}$ `]}`

$Out[\bullet]=$ `{-16.4206, -18.2778}`

Change in revenue of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `Revenues = {IntegerPart[pdn1 qdn1 - pdn0 qdn0], IntegerPart[pdf1 qdf1 - pdf0 qdf0]}`

$Out[\bullet]=$ `{1,317,813, 1,633,051}`

Change in operating income of domestic producers ($), {June-October, November-May}

$In[\bullet]:=$ `OP = IntegerPart[{` $\left(\dfrac{1}{sigma}\right)$ `(pdn1 qdn1 - pdn0 qdn0), ` $\left(\dfrac{1}{sigma}\right)$ `(pdf1 qdf1 - pdf0 qdf0)}]`

$Out[\bullet]=$ `{426,753, 528,837}`

Change in employment (# of FTEs), {June-October, November-May}

In[•]:= **Employment** = $\left\{\text{qempn0} \frac{(\text{qdn1} - \text{qdn0})}{\text{qdn0}}, \text{qempf0} \frac{(\text{qdf1} - \text{qdf0})}{\text{qdf0}}\right\}$

Out[•]= {25.8638, 22.6477}