Agricultural Trade and Consumer Demand in China: The Impact of the Phase One Trade Agreement

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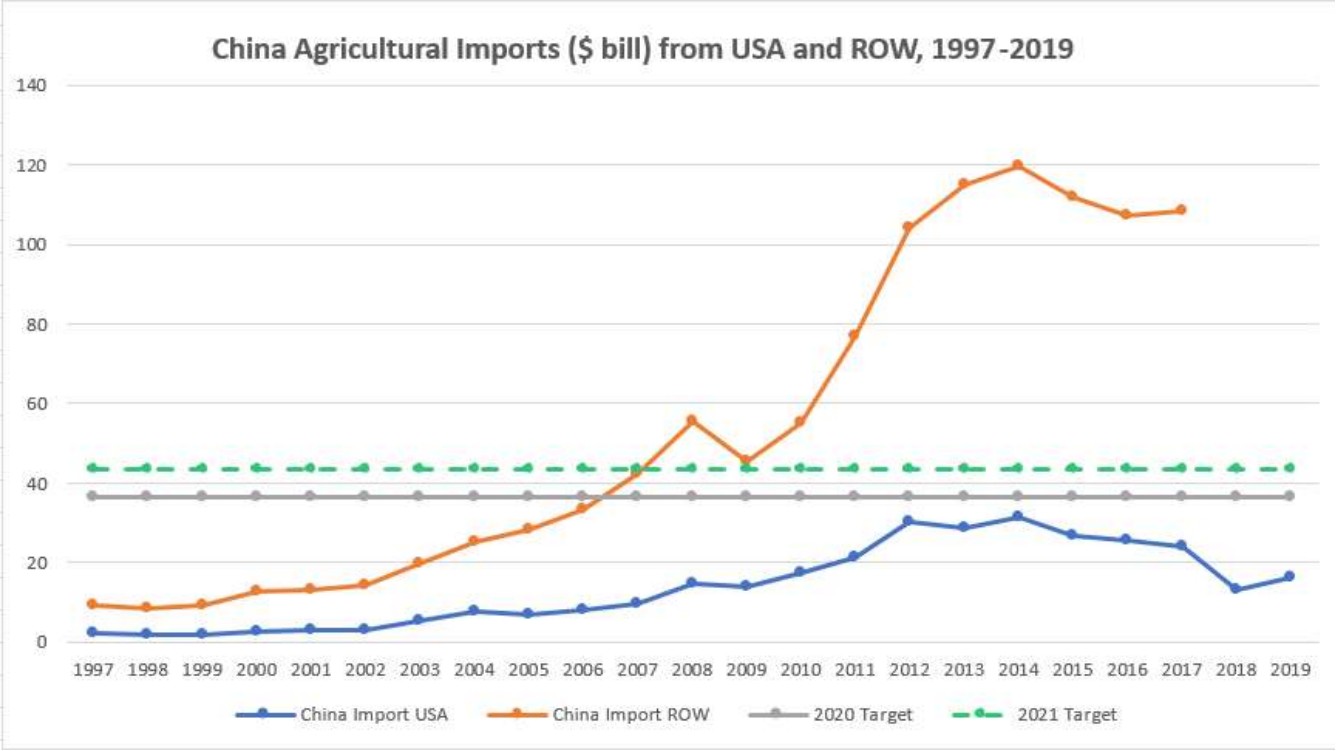
Introduction

- USA and China reached a Phase One agreement in December 2019 to end the trade war.
- China would purchase $12.5 billion more agricultural imports from USA in 2020 and $19.5 billion more in 2021 than it had in 2017.
- Can it ever be achieved with the coronavirus pandemic in 2020?



Findings

- We estimate a non-homothetic demand system (Fajgelbaum and Khandelwal 2016) for agricultural imports into China and obtain Product- Exporter Specific elasticity with respect to price and income.
- Forecast China's future import demand for U.S. agricultural products based on these key estimated parameters
- The *most efficient* way for China to import more from USA is to mimic the effect of an import subsidy on U.S. imports.

Effective subsidies	**2020**	**2021**
Average 2007-17 growth from 2017	12%	23%
0.5*Ave 2007-17 growth from 2017	18%	41%
Zero growth from 2017	42%	59%

Findings (cont.)

- An effective subsidy on the U.S. would divert trade away from other countries.

1) A conventional substitution effect ***within*** products, which depends on the number of competing countries selling each product in each province
2) An income effect that can offset the substitution effect in part or in whole
3) A further substitution effect that can occur ***across*** products.

   As some expenditure shares in the AIDS system reach zero, there is a readjustment of all other shares.

- Countries strongly affected:
  - Australia and Canada;
  - Brazil, Indonesia, Malaysia, Thailand, and Vietnam;
  - Argentina, France, Germany, Netherlands and New Zealand.

Outline of the Talk

1. Introduction (done)
2. AIDS and the Gravity Equation (brief)
3. Estimation
4. Targets for Chinese Imports from the United States
5. Forecast Results
6. Conclusions

Almost Ideal Demand System (AIDS) Structure and Gravity Equation

- $S_{ij}^{n} = \frac{X_{ij}^{n}}{Y_i} = \alpha_{ij}^{n} + \sum_{n'} \sum_{j'} \gamma_{jj'}^{nn'} \ln p_{ij'}^{n'} + \beta_j^{n} \mathrm{y}_i$
  - β_j^{n} : non-homotheticity in demand for the product *n* purchased by importing country *i* from country *j* (later adjust *i* to be China provinces)
  - $y_i = \left[\ln\left(\frac{\bar{x}_i}{a_i}\right) + IN_i \right]$, real income

- Simplifying Assumptions
  - $\gamma_{jj'}^{nn'} = (1 - \frac{1}{N})\gamma^{n}$ for $n = n'$ and $j = j'$
  - $\gamma_{jj'}^{nn'} = \gamma^{n} / N$ for $n = n'$ and $j \neq j'$
  - $\gamma_{jj'}^{nn'} = 0$ if for $n \neq n'$

Two-tier D system: Upper level Substitution between Goods

- $\boldsymbol{S_i^n = \sum_j S_{ij}^n = \bar{\alpha}_i^n + \bar{\beta}^n y_i}$ (1)
  - $\bar{\alpha}_i^n = \sum_j \alpha_{ij}^n \; ; \; \bar{\beta}^n = \sum_j \beta_j^n$
  - S_i^n is the share of commodity n in the imports of province i from all sources.

- Income Elasticities:

- $$\frac{\boldsymbol{dlnX_i^n}}{\boldsymbol{dlnY_i}} = \frac{\boldsymbol{dln(S_i^n Y_i\ )}}{\boldsymbol{dlnY_i}} = \mathbf{1} + \frac{\boldsymbol{dlnS_i^n}}{\boldsymbol{dlnY_i}} = \mathbf{1} + \frac{\boldsymbol{dS_i^n}}{\boldsymbol{dlnY_i}} \frac{\mathbf{1}}{\boldsymbol{S_{ij}^n}} = \mathbf{1} + \frac{\bar{\boldsymbol{\beta}}^{\boldsymbol{n}}}{\boldsymbol{S_i^n}}$$ (2)

  - $\bar{\beta}^n > 0 \rightarrow \frac{dlnX_i^n}{dlnY_i} > 1 \rightarrow$ Product is viewed as luxuries or superior
  - $\bar{\beta}^n < 0 \rightarrow \frac{dlnX_i^n}{dlnY_i} < 1 \rightarrow$ Product is viewed as necessities

AIDS-Gravity Estimation Equation

- $\frac{X_{ij}^n}{Y_i} = \frac{Y_j^n}{Y_W} + \alpha_j(S_i^n - S_W^n) - (\gamma^n \rho^n) D_{ij} + (\boldsymbol{\beta_j^n} - \alpha_j \bar{\beta}^n)\Omega_i + \varepsilon_{ij}^n$

- X_{ij}^n : value of exports from exporter j to importer i in sector n
- Y_i: the total income of importer i
- Y_j^n : total sales of exporter j in sector n,
- Y_W: world total output of all agricultural products
- S_i^n : share of sector n in the total expenditure of country i
- S_W^n : share of sector n in world expenditures
- D_{ij}:bilateral distance
- Ω_i: real income adjusted for the Theil index

Product- Exporter Specific Income Elasticity

- The income elasticity:

$$\frac{dlnX_{ij}^{n}}{dlnY_i} = \frac{dln(S_{ij}^{n}Y_i\ )}{dlnY_i} = 1 + \frac{dlnS_{ij}^{n}}{dlnY_i} = 1 + \frac{dS_{ij}^{n}}{dlnY_i}\frac{1}{S_{ij}^{n}} = 1 + \beta_j^n / S_{ij}^{n}$$

- $\beta_j^n > 0 \longrightarrow \frac{dlnX_i^n}{dlnY_i} > 1 \longrightarrow$ Product is viewed as luxuries or superior
- $\beta_j^n < 0 \longrightarrow \frac{dlnX_i^n}{dlnY_i} < 1 \longrightarrow$ Product is viewed as necessities

Data

- Bilateral imports by Chinese provinces (*i*) from each of its trading partners (*j*), on 58 agricultural products (*n*)
- The Chinese and Hong Kong trade statistics by the Harmonized System (HS) classification and by source country and destination province over 1997-2017
- Convert to the BICO agricultural product classification developed by the U.S. Department of Agriculture
- *distance* measures trade costs
- Provincial level GDP, population, retail price indexes, and income data are obtained from China Statistical Yearbooks 1997-2017
- Provincial level income inequality GINI indexes from Tian (2012)

Table 1: Estimates of $\bar{\beta}^n$ Coefficient

BICO	Agricultural Products	Estimate
B	Soybeans	0.030***
O	Forest Products	-0.009***
B	Cotton	-0.012***
I	Hides & Skins	-0.007**
I	Distillers Grains	0.003
B	Coarse Grains (ex. corn)	-0.009**
O	Fish Products	0.001
B	Corn	0.001
C	Pork & Pork Products	0.009**
O	Biodiesel & Blends > B30	0.008***
C	Dairy Products	0.009***
B	Wheat	-0.011***
C	Prepared Foods	0.014***
I	Hay	0.003
I	Other Intermediate	-0.015***
C	Fresh Fruit	0.003
B	Tobacco	0.003

BICO	Agricultural Products	Estimate
I	Soybean Oil	-0.014***
C	Processed Vegetables	0
C	Poultry Meat & Prods	0.003
I	Rubber & Allied Gums	-0.025***
C	Palm Oil	-0.021***
C	Essential Oils	0.002
O	Processed Fruit	0.003
I	Planting Seeds	0.003
C	Tree Nuts	0.002
C	Feeds & Fodders	0
B	Wine & Beer	0.005
I	Ethanol	0.003
B	Vegetable Oils	-0.006**
B	Meat Products	0.002
C	Chocolate & Cocoa	0.002
C	Peanuts	0.001
C	Live Animals	0.011***

*** p<0.01, ** p<0.05, * p<0.10

Table 2: Product-Exporter Specific β_j^n Estimates

cat	Product	USA	Brazil	AUS	TLD	CAN	MAL	IND	NZL	ARG	RUS
B	Soybeans	-0.047**	-0.07**	0.05***	0.14***	0.01	0.02*	0.01	0.12	-0.01**	-0.1***
O	Forest Products	0.01***	-0.01**	-0.002	0.01***	0.01***	0.02***	0.03***	0.01***	-0.01**	-0.10**
B	Cotton	-0.01**	0.01***	-0.01**	-0.01	0.004	0.01***	0.002	0.01	0.003	0.10**
I	Hides & Skins	0.01***	0.02***	-0.03**	0.01	0.003	0.02***	0.01	0.01*	0.01***	0.05**
I	DDG	0.005	0.001	-0.03	-0.001	0.001					
B	Corn	-0.02**	-0.02	0.001	0.01	0.003	0.001	-0.011		0	-0.01
C	Pork	-0.003	0.01	0.002	0.001	0.002	0.001	-0.004	0.002	0.001	-0.03*
C	Dairy Products	0	-0.01	0.004**	-0.004	0	0.002	0.003	0.003	-0.002	-0.01*
B	Wheat	-0.01**		-0.01*	0.17	-0.04**	0.01			-0.05	0.004
C	Prepared Foods	0.01***	-0.001	-0.001	0.001	0.001	0.003	0	0.001	-0.001	-0.01**
C	Fresh Fruit	0.01*	0	-0.001	0.002	-0.001	0.001	0	0.004	-0.002	-0.023
B	Tobacco	0.01***	-0.01**		-0.006	-0.001	0.06***	0.006		-0.010*	0.68**
C	Poultry Meat	0.01***	0.004	0.01	0.001	0.004	0.003	0.003	0.001	0.001	0.01
C	Beef	-0.001	0.003	0.004**	0.003	-0.001	0.001	0.002	0	0.003	0.01

*** p<0.01, ** p<0.05, * p<0.10

Target for Chinese Imports from the United States

- China faces a target on the minimum imports of agricultural goods from USA

$$\sum_{n=1}^{N}\sum_{i} p_{i1}^{n} q_{i1}^{n} \geq Y_1. \qquad (1)$$

- China maximizes the utility along with a budget constraint over all agricultural goods

$$\sum_{n=1}^{N}\sum_{j}\sum_{i} p_{ij}^{n} q_{ij}^{n} \leq Y \qquad (2)$$

- Lagrangian maximizing utility subject to two constraints
  - $$L = U(\mathbf{q}^{\mathbf{1}},\ldots,\mathbf{q}^{\mathbf{N}}) + \lambda(Y - \sum_{n=1}^{N}\sum_{j}\sum_{i} p_{ij}^{n} q_{ij}^{n}) + \mu(\sum_{n=1}^{N}\sum_{i} p_{i1}^{n} q_{i1}^{n} - Y_1). \qquad (3)$$
  - Marginal utility of income: $\lambda > 0.$
  - Lagrange multiplier: $\partial L / \partial Y_1 = -\mu < 0, \Longrightarrow \mu > 0,$
  - Further Assume: $\mu < \lambda.$

Solution

- The first-order conditions for problem are:

$$\frac{\partial U}{\partial q_{ij}^n} = \lambda p_{ij}^n, \qquad \text{for } j \neq 1 \tag{1}$$

$$\frac{\partial U}{\partial q_{i1}^n} = (\lambda - \mu) p_{i1}^n = \lambda\left(1 - \frac{\mu}{\lambda}\right) p_{i1}^n \equiv \lambda \delta p_{i1}^n, \text{ for } j = 1 \tag{2}$$

$$\text{where } \delta \equiv [1 - (\mu / \lambda)] < 1$$

- The optimal policy is an *ad valorem subsidy* on U.S. prices,
  - The effective subsidy is the *same* across all agricultural imports.

- Increase in U.S. imports = Reduction in total imports from ROW
  - But not on a product-by-product basis

Substitution and Income Effects

- Change in the provincial share of China's imports from each country

$$\Delta S_{i1t}^{n} = -(1 - \frac{1}{N_i^n})\gamma^n \, ln\, \delta + \beta_1^n \Delta y_i \quad \text{for } j = 1 \qquad (1)$$

$$\Delta S_{ijt}^{n} = \frac{1}{N_i^n}\gamma^n \, ln\, \delta + \beta_j^n \Delta y_i \quad \text{for } j \neq 1 \qquad (2)$$

- The first terms is a conventional substitution effect
  - $ln\delta < 0$ => China's imports from USA always increases
    => China imports from other countries decreases
  - U.S. imports increases = decrease from ROW when add up over N-1 countries
  - large N => More competitors lead to strong substitution effect towards USA.

- The second terms is an income effect
  - positive for both U.S. and ROW (for non-inferior good)

- Cross-product substitution (explain at the end)

Table 3: Forecast China's Import Demand from USA

	2020	2021	Impact on U.S. imports		
	billion US$		Year	bill US$	Percent
Phase One Target	**36.6**	**43.6**			
Average 2007-17 growth from 2017	33.62	37.52			
Average 2007-17 growth, **subsidy = 12%**	**36.50**	40.15	2020	+2.88	8.6%
Average 2007-17 growth, **subsidy = 23%**	39.96	**43.63**	2021	+6.33	16.9%
0.5*Ave 2007-17 growth from 2017	28.41	30.07			
0.5*Ave 2007-17 growth, **subsidy = 18%**	**36.63**	38.28	2020	+8.22	28.9%
0.5*Ave 2007-17 growth, **subsidy = 41%**	41.67	**43.42**	2021	+13.35	44.4%
Zero growth from 2017	24.1	24.1			
Zero growth from 2017, **subsidy = 42%**	**36.62**	36.62	2020	+12.52	51.9%
Zero growth from 2017, **subsidy = 59%**	43.56	**43.56**	2021	+19.46	80.7%

Table 4: Impact on U.S. Major Agricultural Exports, Assuming Zero Growth from 2017

Agricultural Product	No Subsidy 2020 & 2021 Million US$	Subsidy=42% Difference from 2020 Million US$	Subsidy=42% Difference from 2020 Percent	Subsidy=59% Difference from 2021 Million US$	Subsidy=59% Difference from 2021 Percent
Soybeans	13,858.8	289.2	2.1%	529.7	3.8%
Forest Products	2,080.7	359.0	17.3%	558.7	26.9%
Cotton	975.3	278.3	28.5%	429.3	44.0%
Coarse Grains (ex. corn)	918.2	117.7	12.8%	228.0	24.8%
Hides & Skins	898.7	309.6	34.5%	478.7	53.3%
Fish Products	607.3	305.7	50.3%	473.8	78.0%
Pork & Pork Products	535.5	308.6	57.6%	476.7	89.0%
Dairy Products	529.9	322.4	60.8%	499.1	94.2%

Note: Only products with 2017 export sales to China exceeding $500 million are shown. Results for the complete list of products that the United States exported to China in 2017 is in Appendix Table A11.

Table 5: China's Import Demand from the Rest of the World, Zero Growth from 2017

	Country	No Subsidy 2020 & 2021 Billion US$	Subsidy=42% Difference from 2020 Billion US$	Percent	Subsidy=59% Difference from 2021 Billion US$	Percent
	ROW	105.86	-12.52	-11.8%	-19.46	-18.4%
1	Brazil	24.08	-0.59	-2.5%	-0.96	-4.0%
2	Australia	9.18	-0.99	-10.8%	-1.67	-18.1%
3	Thailand	7.65	-0.51	-6.6%	-0.90	-11.8%
4	Canada	6.38	-0.87	-13.6%	-1.34	-20.9%
5	Indonesia	5.81	-0.49	-8.5%	-0.82	-14.1%
6	New Zealand	5.34	-0.43	-8.1%	-0.75	-14.0%
7	Malaysia	4.34	-0.48	-11.2%	-0.79	-18.3%
8	Vietnam	3.73	-0.57	-15.2%	-0.92	-24.5%
9	Argentina	3.55	-0.31	-8.6%	-0.41	-11.5%
10	France	2.99	-0.42	-14.0%	-0.69	-23.1%

Note: Only countries with 2017 export sales to China exceeding $500 million are shown.

Table 6: Forecast of China's Import Demand for Forest Products, Zero growth from 2017

Country	No Subsidy 2020 and 2021 Million US$	Subsidy=42% Difference from 2020 Million US$	Percent	Subsidy=59% Difference from 2021 Million US$	Percent
United States	2,080.7	359.0	17.3%	558.7	26.9%
ROW	9,199.5	-1,033.6	-11.2%	-1,798.6	-19.6%
Thailand	1,385.5	-22.7	-1.6%	-61.5	-4.4%
Vietnam	998.4	-78.9	-7.9%	-145.2	-14.5%
Australia	749.9	-37.0	-4.9%	-82.9	-11.1%
Papua New Guinea	577.7	-19.3	-3.3%	-45.5	-7.9%
Malaysia	521.9	-20.6	-3.9%	-56.0	-10.7%
Solomon Is	479.8	-15.8	-3.3%	-28.3	-5.9%
Russia	400.5	-48.7	-12.2%	-49.9	-12.5%
Nigeria	387.3	-25.4	-6.6%	-43.9	-11.3%
Indonesia	369.9	-16.1	-4.3%	-37.6	-10.2%
Mozambique	317.6	-49.1	-15.4%	-91.4	-28.8%

Table 7: Forecast China's Import Demand for Soybeans, Zero growth from 2017

Country	No Subsidy 2020 Million US$	Subsidy=42% Difference from 2020 Million US$	Percent	Subsidy=59% Difference from 2021 Million US$	Percent
United States	13,858.8	289.2	2.1%	529.7	3.8%
ROW	25,569.5	-151.5	-0.6%	-37.0	-0.1%
Brazil	20,873.2	-99.4	-0.5%	-104.4	-0.5%
Argentina	2,644.0	-110	-4.2%	-121.5	-4.6%
Uruguay	990.7	-47.6	-4.8%	-1.5	-0.2%
Canada	886.3	2.7	0.3%	46.1	5.2%
Russia	158.4	20.6	13.0%	30.7	19.4%
Ukraine	9.2	8.2	88.4%	6.5	70.5%
Ethiopia	4.5	44.7	>100%	63.6	>100%
Kazakhstan	2.8	0.4	13.0%	0.6	21.2%
Germany	0.2	8.4	>100%	12.1	>100%
Mozambique	0.1	8.4	>100%	12.1	>100%

Note: Only countries with 2017 export sales to China exceeding $50,000 are shown.

Table 8: Forecast of China's Import Demand for Rapeseed, Zero growth from 2017

Country	No Subsidy 2020 Million US$	Subsidy=42% Difference from 2020 Million US$	Percent	Subsidy=59% Difference from 2021 Million US$	Percent
ROW	2,100.2	-246.6	-11.7%	-336.9	-16.0%
Canada	2,035.1	-239.6	-11.8%	-320.1	-15.7%
Mongolia	26.7	-0.2	-0.6%	-0.4	-1.4%
Australia	25.8	-6.6	-25.7%	-16	-62.2%
Russia	12.6	-0.2	-1.5%	-0.4	-3.2%

Note: All countries with 2017 export sales of rapeseed to China are shown.

Conclusion

- The *most efficient* way for China to reach Phase One Agreement target is to mimic the effect of an import subsidy on U.S. imports.
- Magnitude of subsidies depend on the assumptions of how much China's imports would have grown since 2017
- Increased imports from the United States will result in trade diversion away from the ROW.
- Effective subsidy will generate substitution effect within products, income effect, and substitution effect across products.
- We see a rich pattern of trade diversion across source countries.