The Quality of Distance: Quality Sorting, Alchian-Allen Effect, and Geography

Kazu Takechi

Hosei University

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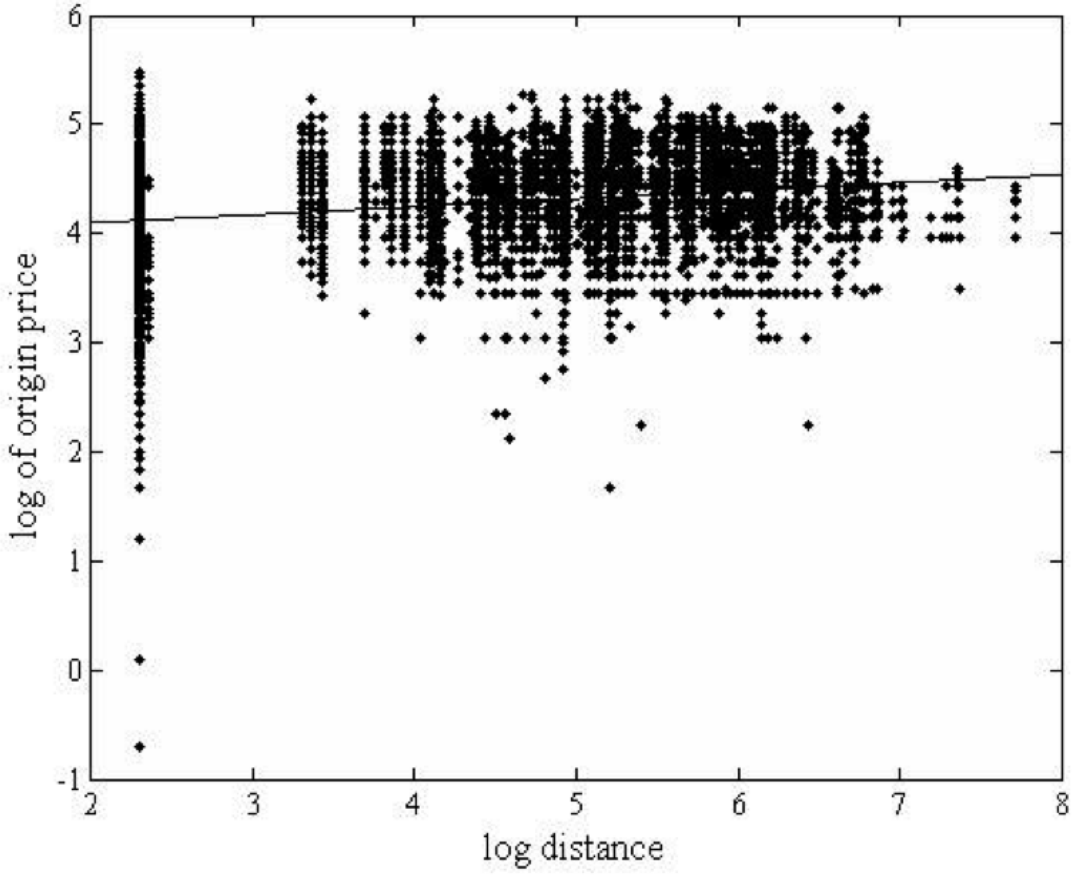
Are high quality goods shipped to distant market?

- The relationship between quality (measured by FOB prices) and distance to market is positive (Bastos and Silva (2010 JIE) Baldwin and Harrigan (2011 AEJ), Manova and Zhang (2012 QJE).
- **What kind of mechanism drives this positive link?**
  - **Standard model (productivity heterogeneity + iceberg trade costs)**: high productivity firms have low costs thus set low prices
- Let's see our data...

Quality-Distane Relationships in our sample: cabbage price



Quality Sorting and the Alchian-Allen effect

1. **High quality firms can deliver to a costly market (remote market)**
   - If quality improves more rapidly than the rate of cost increase, high priced goods are delivered to distant markets
2. **The relative price of high quality goods is lower in remote market because of specific costs**
   - If specific costs (not ad valorem) exist, higher demand exists for high quality goods

- Reduced form regressions (FOB prices = a + b distance) cannot quantify the magnitude of these effects

Reduced form regressions

	Cabbage	Cabbage
Distance	0.074	0.007
	(0.002)	(0.003)
Num. of Obs.	15841	15841
R squre	0.065	0.494
Regional Specific Effect	No	Yes

Problems and Our Solution

- No interpretation for distance coefficient
  - Difficult to interpret estimation results
- What we do: estimate a structural model and match with empirical regularities

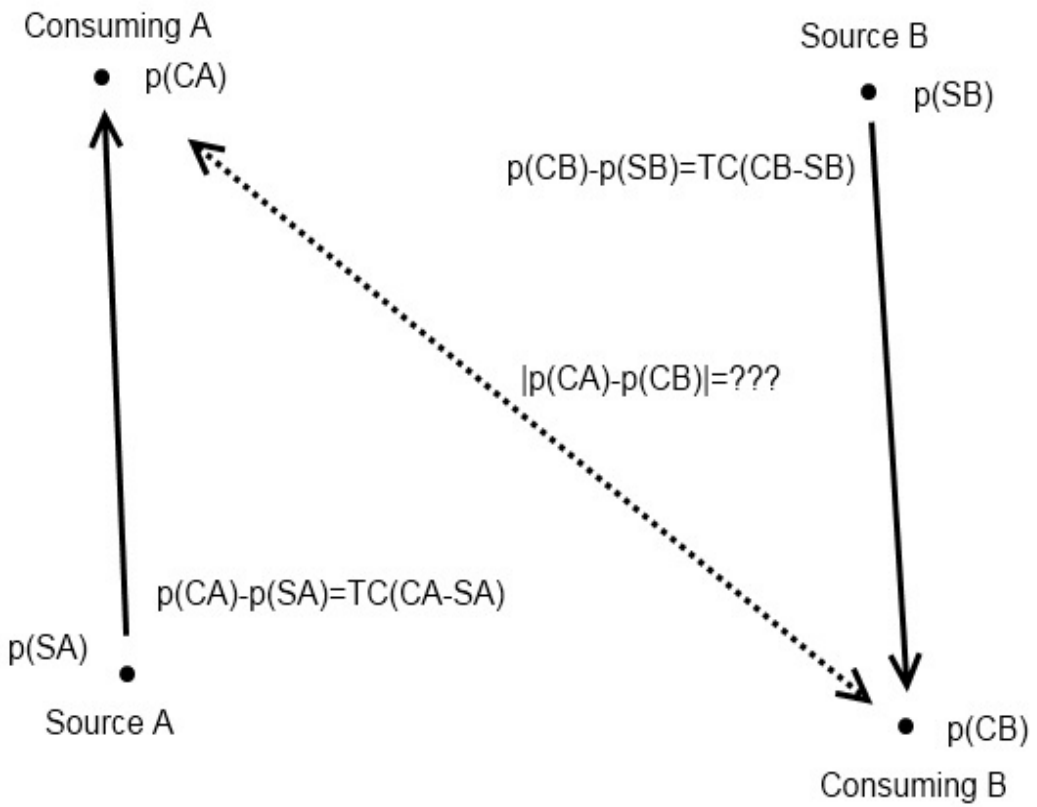
Three issues

1. Use destination-origin price differential data: Anderson and van Wincoop (2003 JEL), Atkin and Donaldson (2015), Kano et al (2013 JIE) Donaldson (2016 AER)
2. Control for delivery choice (sample selection): Helpman et al (2008 QJE), Kano et al (2013)
3. Take into account quality and specific costs

1: Data on source

- Focus on distance effect: **regional price differentials within country** (no effect of trade barriers and exchange rates (Parsely and Wei 1996 QJE))
- Unique daily data set of **wholesale prices** of agricultural products in Japan.
- Why unique? We can identify two crucial data aspects
  1. **Source regions:** in which regions are products made?
  2. **Product delivery patterns:** to which regions are products delivered from the sources?
- Why important?

Production and Delivery



Source regions

- Need to know source regions of products in order to measure transportation costs correctly (Anderson and van Wincoop 2004 JEL).
- However, retail price data are not accompanied by information of the sources of products.
- Using wholesale prices and information on source regions, we can eliminate other costs associated with distance
- Kano et al (2013 JIE), Atkin and Donaldson (2015), and Donaldson (2016) use information about source regions

Data description

- "Daily Wholesale Market Information on Fresh Fruits and Vegetables (*Seikabutsu Hinmokubetsu Shikyo Joho*)."
- Selected vegetables in 2007: cabbage, Chinese cabbage, and lettuce.
- High product categorization by sources, brands, sizes, and grades: "Identical" product shares the same brand, same size, same grade, same source, and same date.
- 55 wholesale markets across 47 prefectures in Japan: each prefecture has at least one wholesale market.
- Distances between prefectural head offices in prefectural capital cities.

Data description

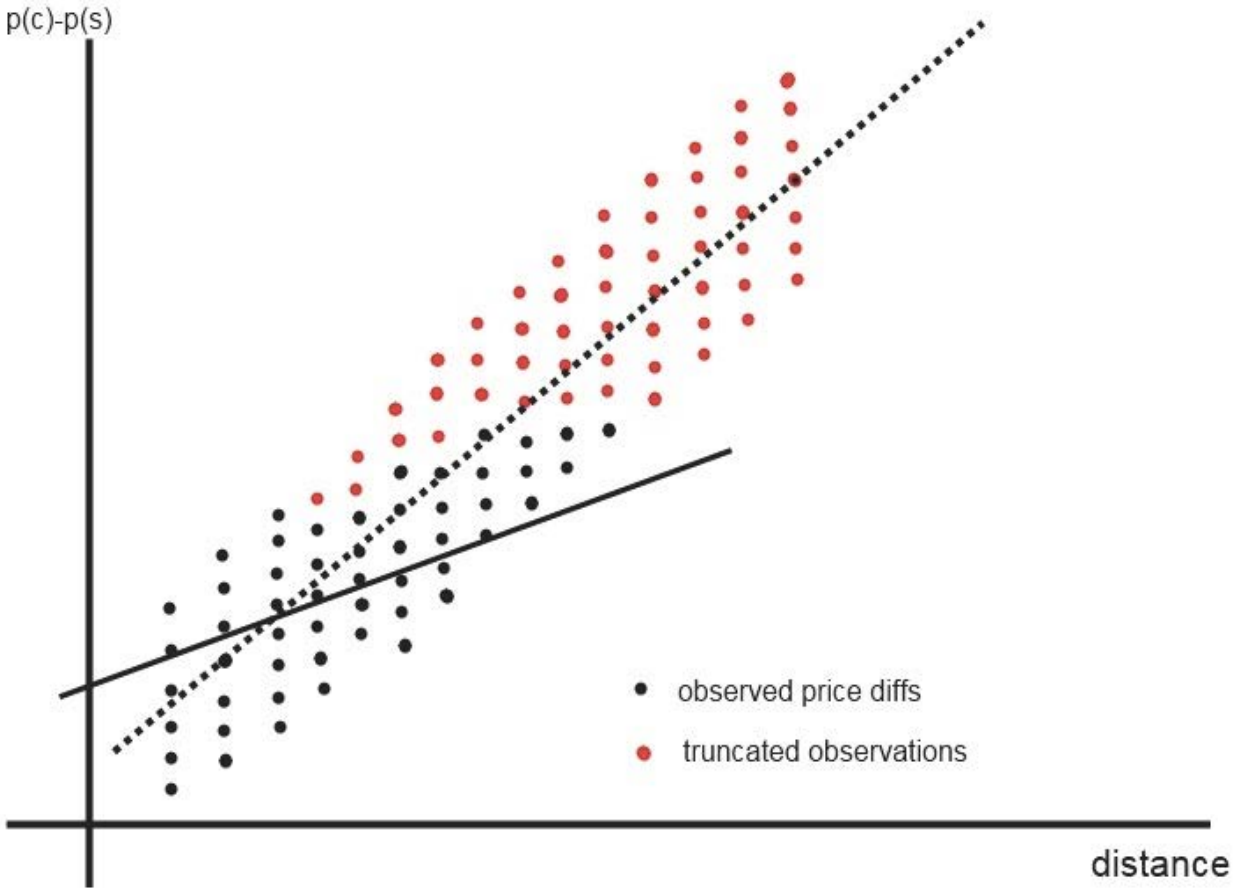
	Cabbage	Lettuce
Average Price	77.833	183.909
Product entry		
No. of Varieties	3	7
No. of size categories	63	71
No. of grade categories	34	46
No. producing prefectures	47	43
No. of distinct product entries	1207	903
No. of $T_{ij}(l) = 0$ or 1	369,343	239,703
No. of $T_{ij}(l) = 1$	15,841	11,565

Data issue 2

- Two roles of trade costs:
  1. **intensive margin**: increase price differential
  2. **extensive margin**: decrease chance of product delivery
- Trade costs make product delivery concentrated around local areas neighboring source regions: Data truncation of price differentials.
- **Estimates of distance elasticity using price data alone could be biased downwards due to sample selection.**

Sample selection

Data truncation due to delivery choice might result in a sample selection bias.



3: Producer heterogeneity model with quality

- Model: monopolistic competition + producer heterogeneity (Helpman et al 2008 QJE) + quality (Baldwin and Harrigan (2011)) + specific cost term in trade cost function
- the key parameters $\Rightarrow$ the elasticity of quality with respect to costs and the elasticity of trade costs with respect to distance

Consumers: CES Preference

- Baldwin and Harrigan (2011)'s framework

$$U_n = \left(\int_{\omega \in J_j} (c_{nj} q_{nj})^{(\sigma-1)/\sigma} d\omega \right)^{(\sigma/(\sigma-1))\mu} Z^{1-\mu}$$

- Then the demand function is: $c_{nj}(\omega) = \frac{p_{nj}^{-\sigma}}{q_{nj}^{1-\sigma}} \frac{Y\mu}{P^{1-\sigma}}$.

Producers

- Each producer: monopolistic competition
- Producer's profit maximization problem:

$$\max \pi_{nj} = px - a_{nj}\tau_{nj}x_i - t_{nj}x_n - f_{nj}$$

- The optimal price in market n from source j:

$$p_{nj} = \frac{\sigma}{\sigma - 1}(\tau_{nj}a + t_{nj})$$

- Source price: $p_{jj} = \frac{\sigma}{\sigma-1}a$.
- Profit function:

$$\pi_{nj} = \frac{(\frac{\sigma}{\sigma-1})^{1-\sigma}(\tau_{nj}a + t_{nj})^{1-\sigma}}{q_{nj}^{1-\sigma}} \frac{Y\mu}{\sigma P_n^{1-\sigma}} - f$$

Quality-cost relationship

- Quality and costs

$$q = a^{1+\theta}, \theta > -1$$

- If $\theta > 0$, operating profits are increasing in a.
- If $0 > \theta > -1$, high cost producers produce high quality goods
- but the improvement rate is low, so that quality sorting does not occur under the iceberg specification

Price Differentials

- Price differentials
$$\frac{p_{nj}}{p_{jj}} = \tau_{nj} + \frac{1}{a} t_{nj}$$
- ad-valorem term is in the equation directly, specific component is interacted with cost term.
- unit cost a can be implied from the source price: $p_{jj} = \frac{\sigma}{\sigma - 1} a$.
- This is used for identification of ad-valorem and specific terms separatelly.

Trade Cost Function

- ad valorem type and specific cost
- Parametric specification of trade costs τ_{ij} and t_{ij} with distance D_{ij}

$$\tau_{ij} = D_{ij}^{\gamma_1} \exp(const + \epsilon_{ij}), \quad \epsilon_{ij} \sim N(0, \sigma_\epsilon^2)$$
$$t_{ij} = D_{ij}^{\gamma_2} \exp(const + \epsilon_{ij}), \quad \epsilon_{ij} \sim N(0, \sigma_\epsilon^2)$$

- γ_i is the distance elasticity parameter
- other components are assumed to be common

Empirical Framework: ML estimation of sample selection

- Price differential

$$\ln(p_{nj}/p_{jj}) = const + \ln(D_{nj}^{\gamma_1} + \frac{1}{a} D_{nj}^{\gamma_2}) + \epsilon_{nj}$$
$$= const + \ln(D_{nj}^{\gamma_1} + \frac{\sigma - 1}{p_{jj}\sigma} D_{nj}^{\gamma_2}) + \epsilon_{nj}$$

- Delivery decision

$$\ln Z = \ln(\frac{\sigma}{\sigma - 1})^{1-\sigma} + (1-\sigma)\ln((p_{jj}(\sigma-1)/\sigma)D_{nj}^{\gamma_1} + D_{nj}^{\gamma_2})$$
$$+ (1-\sigma)(const + \epsilon_{nj}) + \ln(Y\mu) + (\sigma-1)((1+\theta)(\ln p_{jj}$$
$$+ \ln(\sigma-1)/\sigma) - \ln\sigma - (1-\sigma)\ln P_{nj} - f$$

Estimation results

Point estimates and s.e.	Cabbage	Cabbage	Cabbage
γ_1	0.227	0.228	0.162
	(0.016)	(0.002)	(0.002)
γ_2			0.61
			(0.003)
θ		-0.041	-0.158
		(0.003)	(0.004)
σ	4.957	4.966	5.219
	(0.021)	(0.023)	(0.022)
ρ	-0.84	-0.847	-0.847
	(0.0023)	(0.003)	(0.002)
Num of obs.	369343	369343	369343
Log-likelihood	-21404.133	-21344.762	-20234.094

Estimation Results

- Large distance effect compared with the LOP literature (OLS or in the previous literature: $0.001 \sim 0.3$)
- Consistent with the trade literature (Donaldson (2014), Kano et al. (2013))
- Specific cost is significant, more distance elastic
- The condition on quality sorting parameter is relaxed: even if $\theta < 0$, the positive relationship between quality and distance

Welfare Evaluations: Trade cost reduction in a three region model

Welfare Gains (% increase)	Core	Periphery
Friction to No Ad-valorem costs	0.132%	0.07%
Friction to No Specific costs	25.133%	22.131%
Friction to No Friction	30.413%	31%

Conclusions

- High cost producers make high quality goods
  - High cost producers produce high quality goods, but the rate of quality improvement is low (maybe because of agricultural products)
- Quality-cost parameter is over-biased without specific costs
- Specific costs exist (as we know, but we have almost ignored)
  - Specific costs are more distance elastic than ad valorem ones
- Results are robust to different measure of distance and specification
- Removal of specific costs has a large impact on welfare