Evaluating a Simple Hybrid Method for Estimating Sub-National Trade Flows

Ross J. Hallren
U.S. International Trade Commission

23rd Annual Conference on Global Economic Analysis

June, 2020
Tokyo, Japan

Motivation

- Analysis is national but effects are sub-national.
- Sub-national analysis requires inter-regional trade data.
- Most estimation methods calibrate on industry totals and sub-national flows.
- What is needed is a method that relies only on trade and consumption data.

Literature

- Several gravity approaches exist to estimate inter-regional trade.
- Polenske (1970) applied to Leontief-Strout gravity formulate to the 1963 Japan data.
- Horridge, *et al.* (2005) use a gravity approach with production and demand constraints.
- Both require sub-national flows or micro-data for calibration that is not widely available.

Gravity Based Hybrid Method

- Riker (2019) proposed a hybrid Gravity method that utilizes readily available data.
- Uses a linearized, reduced form gravity equation to estimate trade cost parameters (σ, α, β).

$$lnv_{jet} = h_{jt} + (1-\sigma)lnf_{jet} - \sigma \sum_{c} \theta_{ct}(\alpha AD_{ec} + \beta NAD_{ec}) + \varepsilon_{jet}$$

Gravity Based Hybrid Method

- Riker (2019) then estimates sub-national flows.

$$lnv_{jet} = ln\theta_c + \sum_{j'}\sum_{e'}(\sigma - 1)vSHR_{j'e'}\ln(d_{j'e'c}) + \sigma ln(d_{jec})$$

- v_{je} is the LDP value if shipments from j to e.
- $d_{j'e'c}$ is the transportation cost factor that is a function of our trade cost parameters

Data Requirements

- Import data by country of origin and region of entry in CV and LDP to calculate our international trade cost factor.

$$f_{jet} = \frac{vLDP_{jet}}{vCV_{jet}}$$

- Personal expenditure data by region

Gap

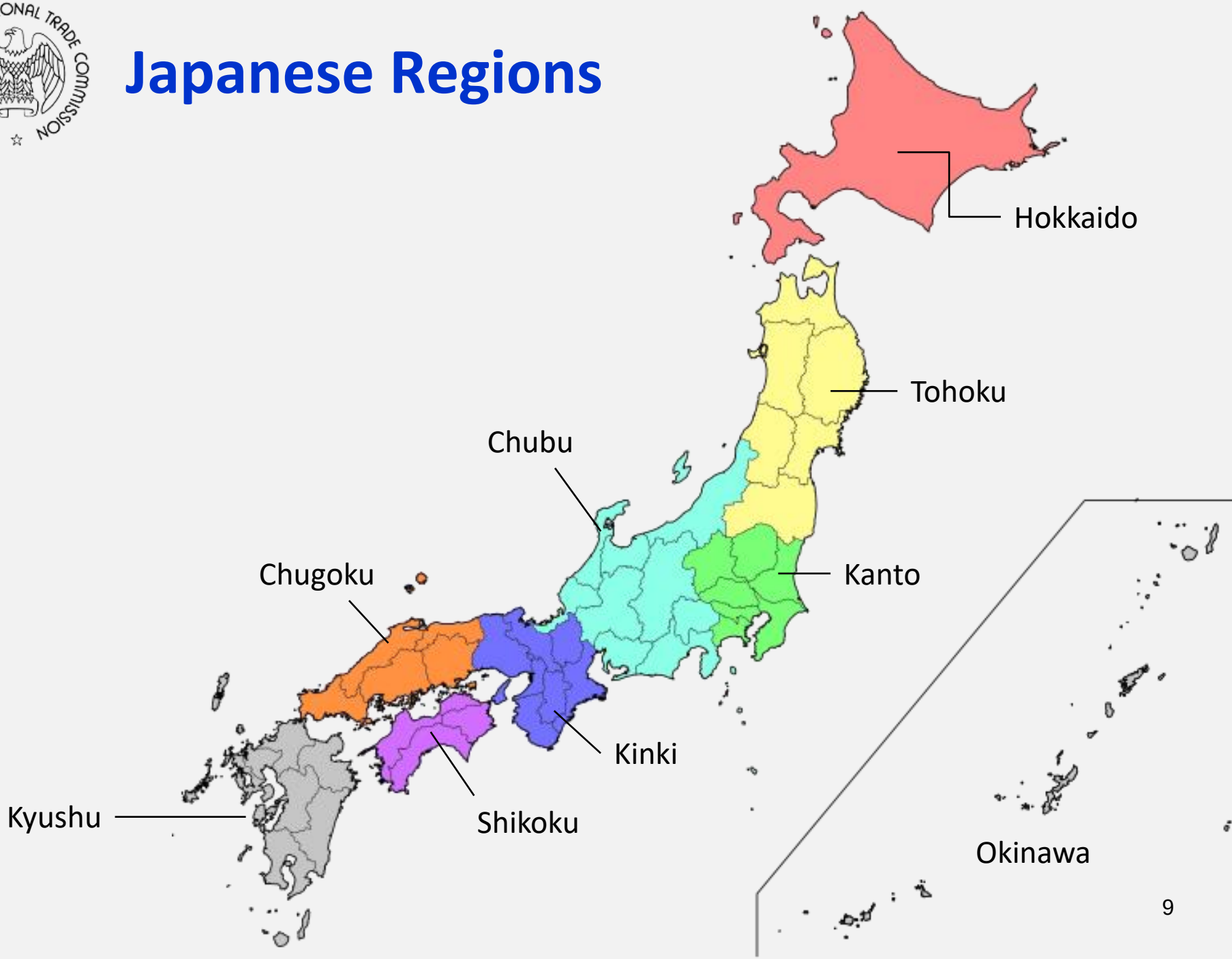
- Riker (2019) proposes a theoretically consistent set of equations that predict sub-national trade.
- Riker (2019) utilizes only readily available data.
- BUT, the US lacks data to test its accuracy.

Japanese IRIOT

- Inter-Regional Input-Output Table
- Created every five years 1960 – 2005.

- Sub-national trade data comes from an Economic Census and micro-file import price data.
- Creates opportunity to test Riker (2019)
- Use household electronics as baseline data to check the performance of Riker (2019)

Japanese Regions



Japanese IRIOT

	Intermediate Demand			In-Region Final Demand			Exports			Imports			Production (Output)
	RegA	RegB	RegC	RegA	RegB	RegC	RegA	RegB	RegC	RegA	RegB	RegC	
RegA													
RegB													
RegC													
Value Added													
Production (Output)													

- Balanced inter-regional input-output table
- Each production region is divided into 53 sectors.
- Inter-regional flows can map to either intermediate or final demand.
- Quantity flows come from the Japan Economic Census.

Japanese Data Issues

- Japan only reports import trade CIF.
- Data on trade margins is highly restricted.

- Use US data to estimate trade cost parameters as in Riker (2019).

- Apply these parameters to Japanese expenditure and IM data to estimate flows.

Table 6. Econometric Estimates of the Model Parameters

Dependent Variable: Log of the Value of Imports	Less Restricted Point Estimates (Std. Errors)
Econometric Coefficients	
Log of International Trade Cost Factor	-3.97
	(0.54)
Expenditure Shares in Adjacent Regions	-5.61
	(0.62)
Expenditures Shares in Non-Adjacent Regions	-5.84
	(0.63)
(Country-Year Fixed Effects and Constant Included)	
Implied Values of the Model Parameters	
Elasticity of Substitution (σ)	4.97
Domestic Transport Cost to Adjustment Regions (α)	1.13
Domestic Transport Cost to Non-Adjacent Regions (β)	1.17
R-Squared Statistic	0.90
Number of Observations	3057

Sub-National Flow Estimates

Table 7a. Estimated Allocation of Domestic Output by Consuming Region

	Chubu	Chugoku	Hokkaido	Kanto	Kinki	Kyushu	Okinawa	Shikoku	Tohoku
Chubu	0.98	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Chugoku	0.01	0.95	0.00	0.02	0.01	0.01	0.00	0.00	0.00
Hokkaido	0.01	0.00	0.93	0.02	0.01	0.01	0.00	0.00	0.01
Kanto	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
Kinki	0.00	0.00	0.00	0.01	0.98	0.00	0.00	0.00	0.00
Kyushu	0.01	0.00	0.00	0.01	0.01	0.97	0.00	0.00	0.00
Okinawa	0.05	0.02	0.01	0.10	0.05	0.03	0.70	0.01	0.02
Shikoku	0.02	0.01	0.00	0.03	0.02	0.01	0.00	0.90	0.01
Tohoku	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.95

Table 7b. Percent Difference in Estimated and Benchmark Omegas

	Chubu	Chugoku	Hokkaido	Kanto	Kinki	Kyushu	Okinawa	Shikoku	Tohoku
Chubu	706%	-98%	-98%	-98%	-98%	-98%	-98%	-97%	-96%
Chugoku	-90%	403%	-92%	-94%	-94%	-93%	-98%	-94%	-89%
Hokkaido	-92%	-93%	370%	-93%	-87%	-90%	-96%	-95%	-91%
Kanto	-98%	-98%	-98%	97%	-98%	-99%	-99%	-99%	-98%
Kinki	-97%	-98%	-98%	-98%	362%	-98%	-98%	-97%	-96%
Kyushu	-93%	-94%	54%	-97%	-97%	423%	-98%	-92%	-93%
Okinawa									
Shikoku	-58%	-74%	-70%	-88%	-88%	-39%	-90%	137%	-88%
Tohoku	-85%	-92%	-90%	-96%	-93%	-94%	-91%	-94%	695%

Tuning Cost Parameters

- Gravity is overly strong and predicts output is consumed almost wholly intra-regionally

Table 4. Average Distances between Regions

	Japan	USA
Adj	228.92	1118.43
	(128.48)	(396.61)
NonAdj	825.77	2276.67
	(462.86)	(480.73)

- We reduce the cost parameters by the ratio of the average Japan-USA regional distances

Sub-National Flow Estimates

Table 7b. Percent Difference in Estimated and Benchmark Omegas

	Chubu	Chugoku	Hokkaido	Kanto	Kinki	Kyushu	Okinawa	Shikoku	Tohoku
Chubu	706%	-98%	-98%	-98%	-98%	-98%	-98%	-97%	-96%
Chugoku	-90%	403%	-92%	-94%	-94%	-93%	-98%	-94%	-89%
Hokkaido	-92%	-93%	370%	-93%	-87%	-90%	-96%	-95%	-91%
Kanto	-98%	-98%	-98%	97%	-98%	-99%	-99%	-99%	-98%
Kinki	-97%	-98%	-98%	-98%	362%	-98%	-98%	-97%	-96%
Kyushu	-93%	-94%	54%	-97%	-97%	423%	-98%	-92%	-93%
Okinawa									
Shikoku	-58%	-74%	-70%	-88%	-88%	-39%	-90%	137%	-88%
Tohoku	-85%	-92%	-90%	-96%	-93%	-94%	-91%	-94%	695%

Table 8b. Percent Difference in Estimated and Benchmark Omegas

	Chubu	Chugoku	Hokkaido	Kanto	Kinki	Kyushu	Okinawa	Shikoku	Tohoku
Chubu	292%	-58%	-56%	-40%	-32%	-57%	-54%	-52%	0%
Chugoku	8%	41%	-6%	-22%	-11%	15%	-79%	-4%	24%
Hokkaido	-15%	-28%	22%	-12%	37%	7%	-59%	-50%	34%
Kanto	-30%	-60%	-55%	49%	-60%	-67%	-63%	-70%	-18%
Kinki	-21%	-42%	-63%	-45%	151%	-61%	-59%	-9%	-14%
Kyushu	12%	48%	2429%	-45%	-51%	118%	-73%	88%	23%
Okinawa									
Shikoku	185%	144%	102%	-6%	18%	465%	-32%	-61%	-19%
Tohoku	119%	-17%	53%	-33%	-25%	-37%	-5%	-33%	118%

Conclusions

- Modified Riker (2019) method shows promise but requires refinement.
- Further work is needed to test the method against a wider set of sectors.
- More work is needed to refine trade cost parameters.

Thank you!

Ross J. Hallren
International Economist
U.S. International Trade Commission
Ross.Hallren@usitc.gov