Non-Equivalent Ad Valorem Tariff Equivalents, Volatility and Gravity

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-One of the main achievements of the Uruguay Round was the tariffication of non-tariff barriers;

-Import quotas were unflexible and not transparent, hence needed to be replaced by tariffs;

-Tariff simplification is an important issue in the Doha Round;
-Why? There are many kinds of tariffs :

- -An ad valorem tarif is a percentage of the world price (%);
- -A specific tariff is a currency amount per unit of volume (e.g., $/kg);
- -A mixed tariff is a conditional combination of an “ad valorem” duty and a “specific” duty, one applying below a limit, the other applying above it;
- -A compound tariff is a combination of an “ad valorem” duty and a “specific” duty, added together or one subtracted from the other;
- -Technical tariffs have their rate or level set as a function of input content, like alcohol or sugar content;

Non-ad valorem tariffs, particularly specific tariffs, are more common in agriculture than in the rest of the economy.

Bottom Line: Should countries replace non-ad valorem tariffs?
What are the consequences of converting non-ad valorem tariffs by ad valorem equivalents for policymakers and modellers?

Table 1. Average tariffs and proportions of duty free tariff lines and lines with non-ad valorem tariffs for selected countries

Country	**Average Import Tariff**			**% Duty Free Tariff Lines**		**% Non Ad Valorem Tariff Lines**		
	All Products	**Ag Products**	**Non-Ag Products**	**Ag Products**	**Non-Ag Products**	**All Products**	**Ag Products**	**Non-Ag Products**
Australia	2,8	1,4	3,1	74,9	44,9	0,2	1	0
Botswana	7,7	9,2	7,4	45,3	63,7	2,2	14,3	0,4
Canada	4,5	18	2,5	57,9	73,4	1,6	11,9	0
Chili	6	6	6	0	0,3	0,1	0,9	0
China	9,6	15,6	8,7	5,9	7,8	0,5	0,5	0,5
European Union	5,3	13,9	4	30,1	26,7	4,7	32,4	0,6
India	12,6	31,4	9,8	5,9	3,1	5	0,3	5,7
Indonesia	7	8,1	6,9	9,5	10,9	0,5	3,5	0,1
Japan	5,3	23,3	2,6	34,9	57,1	3,3	12,1	2
Mexico	8,3	21,4	6,3	17,7	52,4	0,7	5,1	0,1
Norway	7,8	55,8	0,5	45	95,2	6,8	51,3	0,1
New Zealand	2,1	1,4	2,1	72,6	63,5	0,4	0,1	0,5
Russia	9,4	13,4	8,7	7,8	14,5	13,1	29,8	10,5
South Africa[1]	7,7	9,1	7,5	45,3	63,7	2,2	14,3	0,4
Switzerland	7,8	43,5	2,4	29,3	18,8	79,7	70,4	81,2
Thailand	9,8	22	8	5	24,2	10	30,6	6,9
Turkey	9,6	41,7	4,8	16	25,4	0,6	0,6	0,6
United States	3,5	5	3,3	30,3	47,6	8,2	40,8	3,3
Vietnam	9,8	17	8,7	16	40,2	0,1	0	0,2

Source: http://www.wto.org

[1] South Africa, Botswana, Lesotho, Namibia and Swaziland belong to a custom union and hence have the same external tariffs.

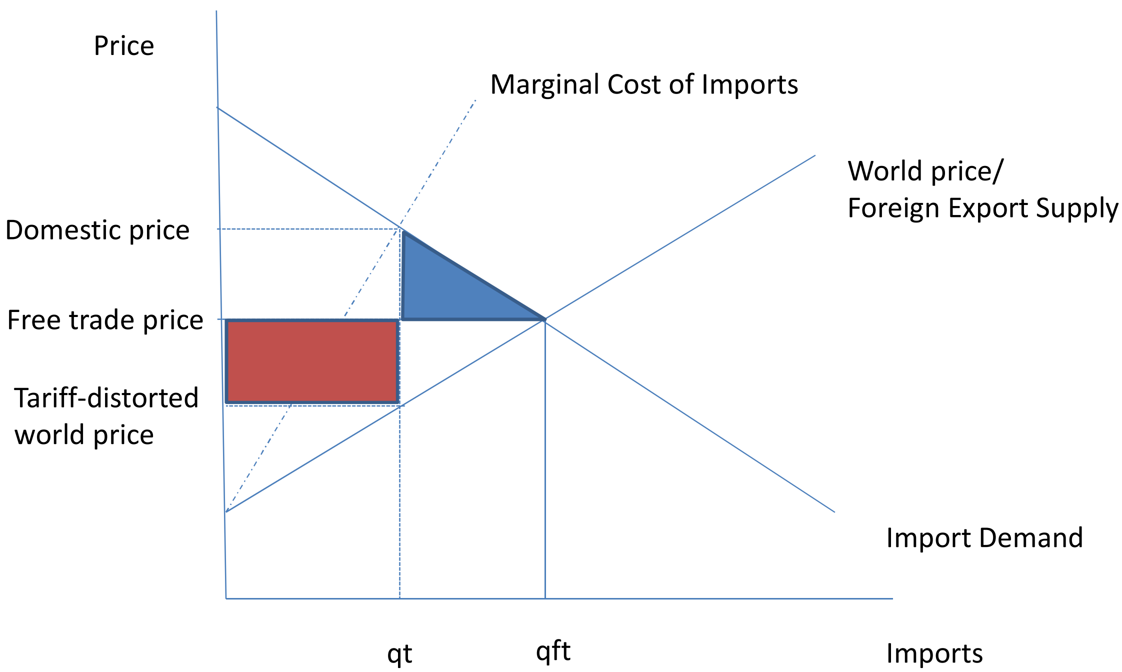
How are tariffs set?

-Optimal tariff argument is back in fashion;

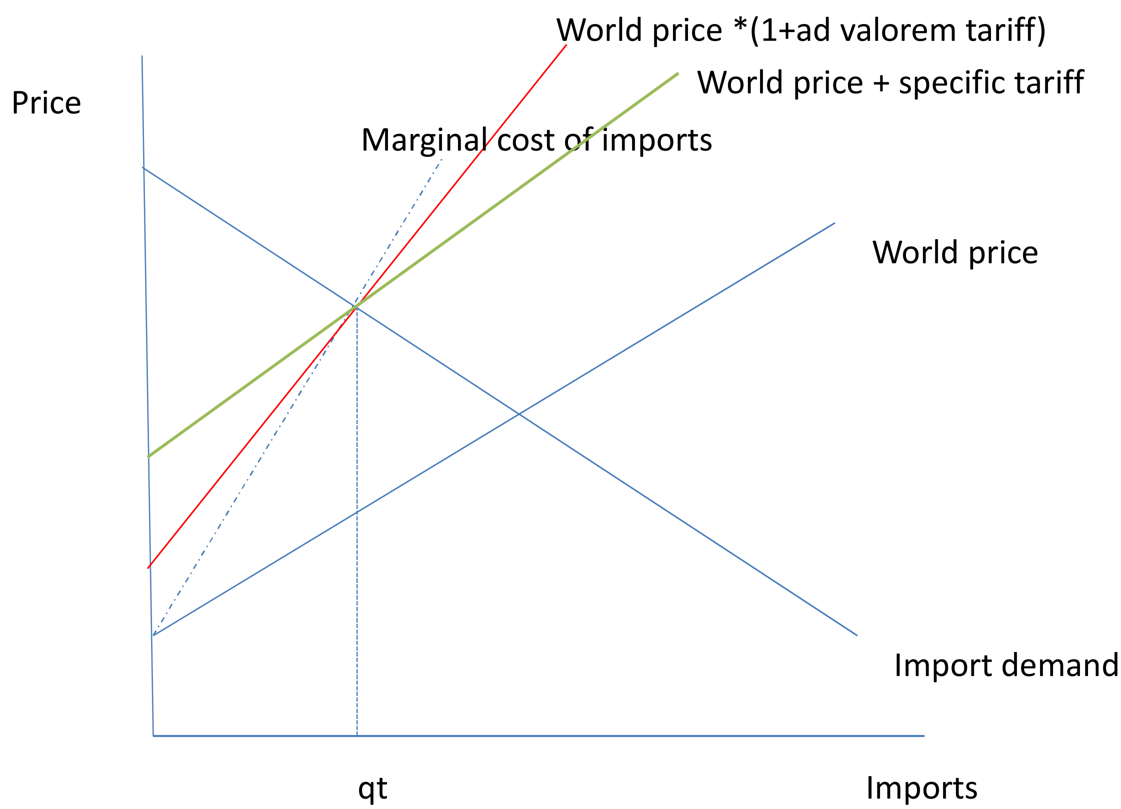
-Bagwell and Staiger: countries try to exploit their terms of trade and trade agreements are negotiated to neutralize terms of trade effects;

-Empirical evidence: Broda and Weinstein (2008)

-The optimal tariff argument is about internalizing a terms of trade **externality.**



For a given foreign export supply function, an ad valorem tariff or a specific tariff can do the job:



The problem is that world markets are volatile, especially in agriculture. What if the foreign export supply shifts up and down?

Let's add a bit of structure:

$p^d = a - bq, \forall q \in \left[0, \frac{a}{b}\right]$, where p^d is the domestic price in the importing country and q is the volume of imports.

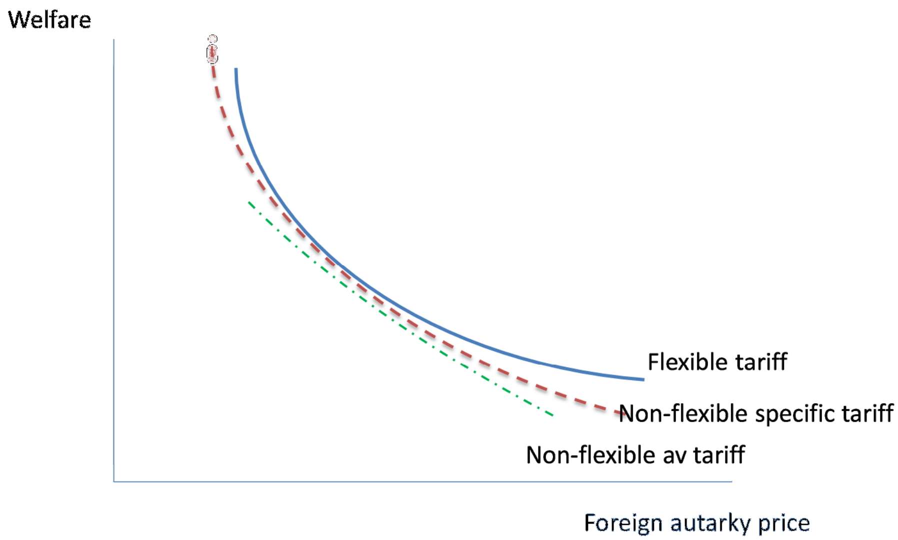
The foreign export supply function is given by: $p^s = c + dq, \forall q > 0$, where p^s is the price received by foreign firms and $a > c > 0, b > 0, d > 0$.

Parameter « c » is the foreign autarky price. We can use it to make the foreign export supply curve shifts up and down.

The ad valorem tariff is a high-maintenance instrument :

$$-\frac{\partial t^o / \partial c}{t^o} = \frac{1}{a-c} < -\frac{\partial \tau^o / \partial c}{\tau^o} = \left(\frac{1}{a-c}\right)\left(\frac{ab+2ad}{bc+ad+cd}\right)$$

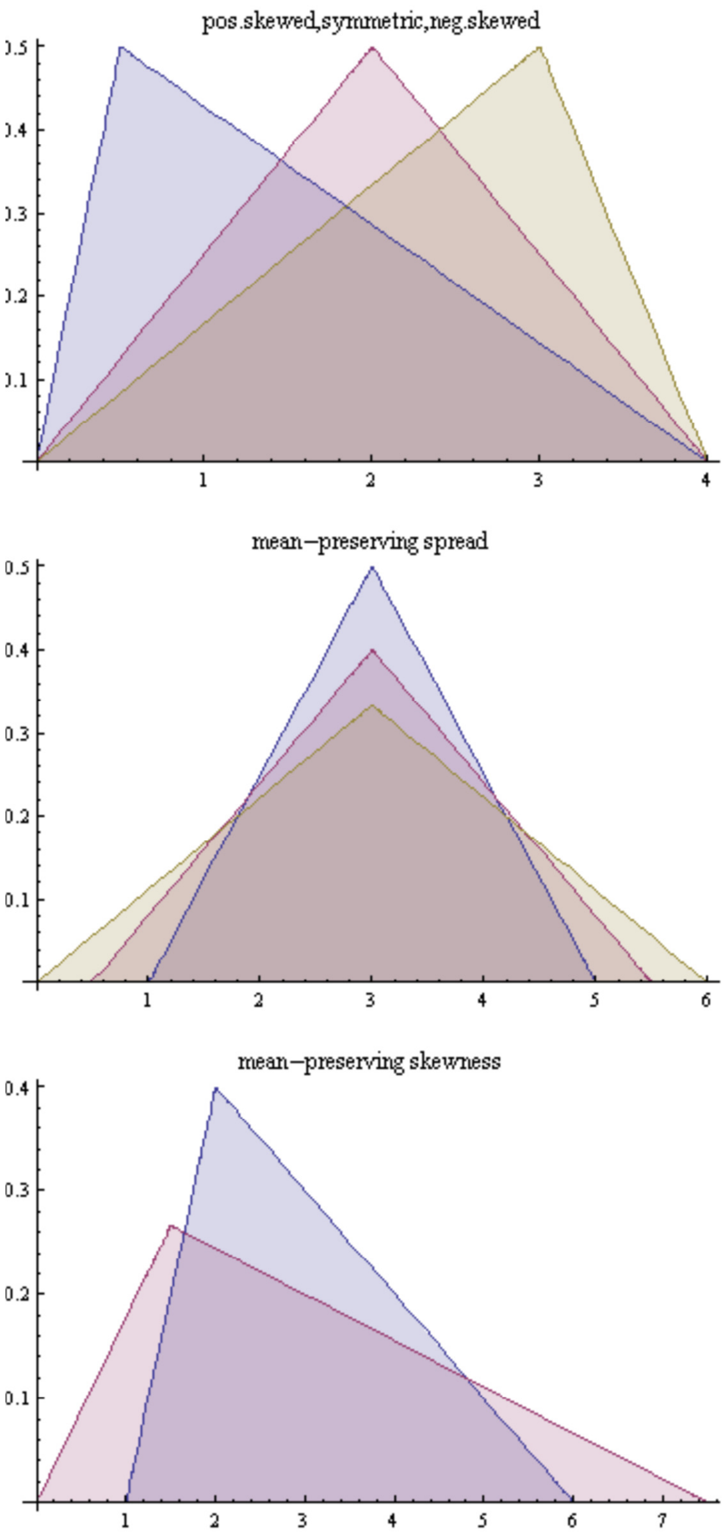
When the export supply functions « shifts up », the optimal tariff should be reduced, more so for the ad valorem tariff.



PROPOSITION 2: *The best non-flexible specific tariff dominates its ad valorem counterpart in terms of expected welfare. Thus, some specific tariffs cannot be replicated by ad valorem tariff ones.*

Let us assume that parameter *c* in the foreign export supply function is random and distributed according to a triangular distribution with mean c_{moy}, mode c_m and lower and upper bounds c_l and c_u. The density of the triangular distribution is given by:

$$\phi(x)=\begin{cases} 0 & \text{for } x<c_l, \\ \dfrac{2(x-c_l)}{(c_u-c_l)(c_m-c_l)} & \text{for } c_l \le x \le c_m, \\ \dfrac{2(c_u-x)}{(c_u-c_l)(c_u-c_m)} & \text{for } c_m < x \le c_u, \\ 0 & \text{for } c_u < x. \end{cases}$$


pos.skewed,symmetric,neg.skewed
0.5
0.4
0.3
0.2
0.1
1
2
3
4
mean−preserving spread
0.5
0.4
0.3
0.2
0.1
1
2
3
4
5
6
mean−preserving skewness
0.4
0.3
0.2
0.1
1
2
3
4
5
6
7

The government maximizes $E[w_k] = \int_{c_l}^{c_m} w_k \phi dc + \int_{c_m}^{c_u} w_k \phi dc$, where $k = \{t, \tau\}$.

PROPOSITION 1: *The non-flexible specific tariff that maximizes expected welfare is given by:*

$$t^{nf} = -\frac{(c_u{}^3 + c_l{}^3 - 3c_u c_m{}^2 - 3c_l c_m{}^2 + 4c_m{}^3 - 3a(c_u{}^2 + c_l{}^2 - 2c_u c_m - 2c_l c_m + 2c_m{}^2))d}{3(c_u{}^2 + c_l{}^2 - 2c_u c_m - 2c_l c_m + 2c_m{}^2)(b+2d)} \quad (1)$$

It is increasing, invariant or decreasing with respect to mean-preserving spreads depending on whether the distribution of the foreign autarky price is negatively skewed, symmetric or positively skewed. The non-flexible ad valorem counterpart:

$$\tau^{nf} = \frac{(d(-bA + 2aB(b-d) + 6a^2Cd))}{(b^2A + b(A+4aB)d + 2a(B+3aC)d^2)} \quad (2)$$

where $A \equiv (c_u{}^4 + c_l{}^4 - 4c_u c_m{}^3 - 4c_l c_m{}^3 + 6c_m{}^4), B \equiv (c_u{}^3 + c_l{}^3 - 3c_u c_m{}^2 - 3c_l c_m{}^2 + 4c_m{}^3)$ *and* $C \equiv (c_u{}^2 + c_l{}^2 - 2c_u c_m - 2c_l c_m + 2c_m{}^2)$. *It is declining with the mean-preserving spread when the distribution of the foreign autarky price is symmetric or positively skewed. When the distribution of the autarky price is negatively skewed, a mean-preserving spread has an ambiguous effect on the optimal ad valorem tariff.*

But Larue and Ker (1993) argued that protectionism rises in response to volatility…

Table 2. Performance of fixed and downward-flexible specific (t) and valorem tariff (τ) under mean-preserving spreads and mean-preserving skews.

	Non-flexible tariffs				Downward-flexible tariffs			
	base	spread	neg.skew	pos.skew	base	spread	neg.skew	pos.skew
	$c_l = 0.5$ $c_m = 2$ $c_u = 3.5$	$c_l = 0$ $c_m = 2$ $c_u = 4$	$c_l = 0$ $c_m = 2.5$ $c_u = 3.5$	$c_l = 0.5$ $c_m = 1.5$ $c_u = 4$	$c_l = 0.5$ $c_m = 2$ $c_u = 3.5$	$c_l = 0$ $c_m = 2$ $c_u = 4$	$c_l = 0$ $c_m = 2.5$ $c_u = 3.5$	$c_l = 0.5$ $c_m = 1.5$ $c_u = 4$
mean t (variance)	2.6667 na	2.6667 Na	2.7241 na	2.6092 na	2.5827 (0.0140)	2.5538 (0.0250)	2.5653 (0.0160)	2.5673 (0.0232)
mean τ (variance)	0.5667 na	0.5630 Na	0.5921 na	0.5401 na	0.5366 (0.0023)	0.5259 (0.0038)	0.5294 (0.0026)	0.5314 (0.0035)
mean w_t (variance)	10.7002 (2.6587)	10.7422 (4.8363)	10.7446 (4.0328)	10.7553 (3.6668)	10.7081 (2.6222)	10.7563 (4.7497)	10.7557 (3.9435)	10.7691 (3.6309)
mean w_τ (variance)	10.6727 (2.6433)	10.6923 (4.7814)	10.702 (4.0144)	10.7138 (3.6253)	10.6944 (2.5557)	10.7312 (4.5849)	10.7327 (3.7939)	10.7515 (3.5467)
mean q_t (variance)	2.6642 (0.0935)	2.6649 (0.1696)	2.6400 (0.1365)	2.6998 (0.1336)	2.7062 (0.0656)	2.7214 (0.1194)	2.7194 (0.1008)	2.7207 (0.0894)
mean q_τ (variance)	2.6723 (0.1393)	2.6799 (0.2523)	2.6319 (0.2059)	2.7295 (0.1965)	2.7336 (0.0854)	2.7586 (0.1558)	2.7537 (0.1342)	2.7548 (0.1139)
mean p_t^s (variance)	4.6691 (0.0935)	4.6684 (0.1696)	4.6359 (0.1365)	4.6911 (0.1336)	4.7111 (0.1283)	4.7249 (0.2323)	4.7153 (0.1801)	4.7120 (0.1894)
mean p_τ^s (variance)	4.6773 (0.0567)	4.6834 (0.1033)	4.6278 (0.0812)	4.7208 (0.0828)	4.7385 (0.1069)	4.7621 (0.1931)	4.7496 (0.1450)	4.7461 (0.1617)

The average world price under a rigid specific tariff is given by:

$$\overline{p}_t^s \equiv \int_{c_l}^{c_m} (c + dq_t)\frac{2(c-c_l)}{(c_u-c_l)(c_m-c_l)}dc + \int_{c_m}^{c_u} (c + dq_t)\frac{2(c_u-c)}{(c_u-c_l)(c_m-c_l)}dc$$

$$= \frac{b(c_u{}^3 + c_l{}^3 - 3c_u c_m{}^2 - 3c_l c_m{}^2 + 4c_m{}^3) + 3(c_u{}^2 + c_l{}^2 - 2c_u c_m - 2c_l c_m + 2c_m{}^2)d(a-t)}{3(c_u-c_l)(c_m-c_l)(b+d)}$$

We can compute ad valorem equivalents for different specific tariffs under different distributions: $\tau^{eq} \equiv \dfrac{t}{\overline{p}_t^s}$.

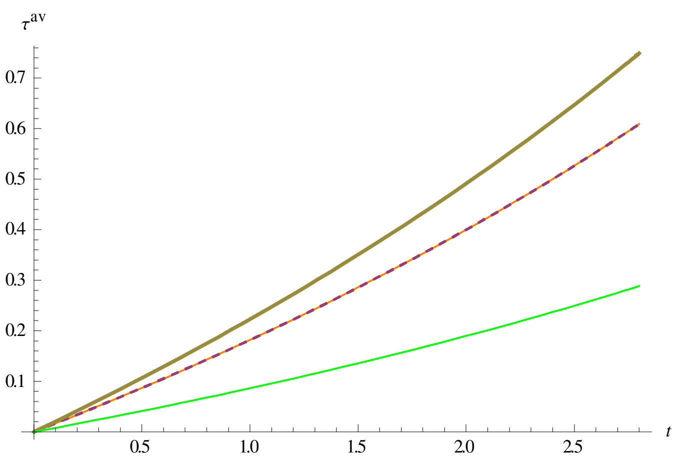


Figure 1. Ad valorem equivalents under different mean-preserving skewed and symmetric distributions.

Ad valorem equivalents are higher (lower) when the distribution of foreign shocks is negatively (positively) skewed.

Table 3: Ad valorem equivalents and specific tariffs

	t=3				t=2				t=1			
	base	spread	neg.skew	pos.skew	base	spread	neg.skew	pos.skew	base	spread	neg.skew	pos.skew
	$c_l = 0.5$ $c_m = 2$ $c_u = 3.5$	$c_l = 0$ $c_m = 2$ $c_u = 4$	$c_l = 0$ $c_m = 2.5$ $c_u = 3.5$	$c_l = 0.5$ $c_m = 1.5$ $c_u = 4$	$c_l = 0.5$ $c_m = 2$ $c_u = 3.5$	$c_l = 0$ $c_m = 2$ $c_u = 4$	$c_l = 0$ $c_m = 2.5$ $c_u = 3.5$	$c_l = 0.5$ $c_m = 1.5$ $c_u = 4$	$c_l = 0.5$ $c_m = 2$ $c_u = 3.5$	$c_l = 0$ $c_m = 2$ $c_u = 4$	$c_l = 0$ $c_m = 2.5$ $c_u = 3.5$	$c_l = 0.5$ $c_m = 1.5$ $c_u = 4$
τ^{eq}	0.6667	0.6667	0.8203	0.3158	0.4	0.4	0.4912	0.1898	0.1818	0.1818	0.2229	0.0864
mean w_t (variance)	10.6493 (2.8332)	10.6908 (5.0492)	10.6971 (4.1678)	10.7448 (3.9816)	10.5263 (2.3417)	10.5674 (4.1739)	10.5716 (3.4535)	10.615 (3.28417)	9.6534 (1.897)	9.6940 (3.3821)	9.6962 (2.8064)	9.7353 (2.6539)
mean w_τ (variance)	10.6165 (2.9635)	10.633 (5.2778)	10.4288 (5.0256)	10.3578 (2.8053)	10.5075 (2.1877)	10.5332 (3.8971)	10.6702 (3.5326)	9.7670 (2.4423)	9.6454 (1.7251)	9.6790 (3.0746)	9.9194 (2.6428)	9.0021 (2.2180)
mean q_t (variance)	2.4959 (0.0937)	2.4968 (0.1669)	2.5009 (0.1344)	2.5096 (0.1344)	2.9959 (0.0937)	2.9968 (0.1669)	3.0009 (0.1344)	3.0096 (0.1344)	3.4959 (0.0937)	3.4968 (0.1669)	3.5009 (0.1343)	3.5096 (0.1344)
mean q_τ (variance)	2.4949 (0.1464)	2.4960 (0.2607)	2.2560 (0.2239)	3.19268 (0.1736)	2.9952 (0.1275)	2.9963 (0.2271)	2.8180 (0.1926)	3.4903 (0.1587)	3.4956 (0.1100)	3.4965 (0.1958)	3.3993 (0.1627)	3.7614 (0.1458)
mean p_t^s (variance)	4.5041 (0.0937)	4.5032 (0.1669)	4.4991 (0.1344)	4.4904 (0.1344)	5.0041 (0.0937)	5.0032 (0.1669)	4.9991 (0.1344)	4.9904 (0.1344)	5.5041 (0.0937)	5.5032 (0.1669)	5.4991 (0.1344)	5.4904 (0.1344)
mean p_τ^s (variance)	4.5031 (0.0527)	4.5024 (0.0939)	4.2542 (0.0676)	5.1736 (0.1003)	5.0034 (0.0651)	5.0027 (0.1159)	4.8162 (0.0866)	5.4712 (0.1121)	5.5038 (0.0787)	5.5029 (0.1402)	5.3975 (0.1088)	5.7423 (0.1235)

Table 4. Gravity results

	param.	p-val,
'Ln_Distance'	**-0,904**	**0,000**
'Contig'	**0,793**	**0,000**
'Colony'	**0,745**	**0,000**
'Ln_Beefprodimp'	0,012	0,847
'Ln_Beefprodexp'	0,029	0,698
'Ln_Popimp'	**4,022**	**0,093**
'Ln_Popexp'	3,233	0,178
'Ln_Gdpimp_Pc'	0,322	0,310
'Ln_Gdpexp_Pc'	-0,215	0,296
'Ln_Beef_Tariffs'	**-0,319**	**0,000**
'Beef_Tariffspec'	**-1,908**	**0,000**
'Beef_Trq'	0,233	0,569
'Esbimp'	-0,051	0,751
'Esbexp'	**-0,499**	**0,028**
'Avfluimp'	-0,427	0,246
'Avfluexp'	0,613	0,363
'Hmdimp'	0,010	0,963
'Hmdexp'	-0,236	0,198
'Beef_Agree'	-0,218	0,257
'Beef_Agree_Esbimp'	-0,255	0,138
'Beef_Agree_Esbexp'	0,383	0,198
'Beef_Agree_Avfluimp'	**-3,666**	**0,101**
'Beef_Agree_Avfluexp'	-0,219	0,852
'Beef_Agree_Hmdimp'	-0,070	0,831
'Beef_Agree_Hmdexp'	**-0,608**	**0,027**
theta0 (hetsc intercept)	0,615	0,817
theta1(hetsc slope)	**0,157**	**0,000**
delta (hetg)	0,015	0,952
r (hetg)	**-1,725**	**0,000**
alpha (agregate shocks)	**1,113**	**0,000**