Trade modelling through partial and general equilibrium models:Some Applications

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- GRAVITY ANALYSIS WITH FOCUS ON STRUCTURAL GRAVITY MODEL AND FIRM LEVEL TRADE ANALYSIS
- APPLIED GENERAL EQUILIBRIUM MODELS : GTAP 10 and GTAP E
- SINGLE MARKET PARTIAL EQUILIBRIUM MODEL
- APPLICATIONS

India’s Trade in Goods and Services with the World

- We have negative trade balance of merchandise where in we export 323 billion us dollars in 2019 but import 478 billion us dollars of merchandise from the world. This shortfall is met by positive trade balance in terms of exports of services of the level of 321 billion us dollars and imports of 188 billion dollars, but not enough to cover up for having net current account deficit. This current account deficit are more than matched by capital account surplus leading to have BOP surplus. The latter has lead to appreciation of Indian rupee.
- What is surprising to note is that we have Capital account surplus at the time of pandemic. Second ,all GTAP simulations of trade Liberalization show that India’s trade balance falls negative with external Liberalization. Meaning our exchange rate may be overvalued and may see depreciation in coming months.
- What is disturbing is however to note that exports are not increasing while tariff increase has led to constrains on imports and especially intermediate imports where in such protectionism in the economy may force other countries to adopt tit for tat strategy of imposing duties on our products.
- We need to focus on three Es, Electronics, Engineering and Electrical products and boost trade in services and investments. For latter regulatory burdens and competition need to go up with fall in non-tariff barriers. Our manufacturing, trade and MSMEs trade all are intertwined with each other . Our overvalued exchange rate and lower growth in pandemic may be the reason that we saw our PCY fell below that of Bangladesh.

Table 1: Average Tariff Rates between India and Indo-Pacific Regions

Products	India-Chile & Peru		India-France & UK		India-Oceania		India-East Asia		India-ASEAN 10	
	Exports to	Import from	Exports to	Import from	Exports to	Import from	Exports to	Import from	Exports to	Import from
Grain Crops	5.6168	35.3860	3.7919	21.5138	0.3176	25.3430	26.8246	24.9264	4.6317	27.2592
Meat & Meat Products	4.7986	1.8771	3.8358	10.3816	1.4532	5.0889	1.7700	22.2374	14.6930	13.1839
Extraction	4.0669	1.9234	0.5124	12.1262	0.3680	3.2537	0.3964	0.9899	3.2482	3.4194
Processed Food	4.2696	42.0045	5.1471	117.7235	1.7317	45.6213	5.8585	35.1448	12.2293	73.6284
Textiles	6.2258	10.9575	8.4278	12.4080	7.0822	11.6822	3.7826	13.0624	3.7581	11.4759
Light Manufacturing	5.4446	5.0432	2.1381	10.0529	9.4509	9.4734	1.5078	9.4988	5.8107	7.9824
Heavy Manufacturing	2.7496	6.5332	1.2658	7.6128	1.8933	8.3175	1.6686	5.5867	1.5506	5.5155

Source: GTAP10

Average Tariff Rates between India and Indo-Pacific Regions Continued….

Products	India-Other South Asian Countries		India-MENA Countries		India-Sub-Saharan Africa		India-North America	
	Exports to	Import from	Exports to	Import from	Exports to	Import from	Exports to	Import from
Grain Crops	6.5999	13.1421	10.5430	23.7527	5.7209	18.9022	0.2010	32.9911
Meat & Meat Products	6.1216	3.8573	4.8359	2.8144	4.1765	3.2811	0.7126	14.4015
Extraction	12.2931	13.3748	2.0294	1.0679	1.6531	3.8734	0.0474	4.4547
Processed Food	9.9807	10.5107	15.0092	12.4915	20.3097	26.5611	0.4820	52.7287
Textiles	9.3689	2.4520	7.0895	13.0073	25.1234	7.6307	9.6045	10.5533
Light Manufacturing	7.1520	1.9657	4.7434	9.9016	11.5696	7.2385	1.0549	8.2117
Heavy Manufacturing	7.9749	1.4283	4.2494	6.0961	4.4669	6.9926	0.6327	7.1560

Source: GTAP10

Tariff Barriers among Indo-Pacific Nations

Table 1: Effectively Applied Weighted Average Tariff Rates between India and Indo-Pacific Regions

Product	India-ASEAN	ASEAN-India	India-East Asia	East Asia-India	India-EU-26	EU26-India	India-France & Germany	France & Germany - India	India - Indo-Pacific Latin America	IndoPacific Latin America - India	India to Latin America Indo-Pacific	Latin America Indo-Pacific -- India
Extraction	0.02	3.98	8.91	0.75	9.65	0.06	6.5	0.4	0.37	4.33	0.67	4.32
GrainCrops	10.94	2.69	17.66	7.71	14.62	2.5	6.67	2.08	49.28	2.68	48.46	5.51
Heavymanu	1.48	1.52	5.58	2.99	8.28	2.59	8.38	3.11	2.37	3.24	4.62	3.21
Lightmanu	2	7.81	10.98	4.4	13.49	4.86	12.95	4.5	1.37	5.51	2.9	11.16
Meatandmeatprod	0	0.05	11.16	4.45	13.78	2.71	16.77	1.98	6.55	5.91	2.52	5.82
ProcessedFood	40.41	5.51	34.65	5.1	49.22	7.63	49.28	5.96	36.19	3.97	35.15	5.62
Textile	4.5	3.85	16.74	3.07	17.96	9.82	17.8	10.42	19.76	6.37	19.66	7.88

Source: WITS Database

Tariff Barriers among Indo-Pacific Nations

Effectively Applied Weighted Average Tariff Rates between India and Indo-Pacific Regions Continued….

Product	India - North America	North America - India	India - Oceania	Oceania -India	India - South East Asia	South East Asia - India	India - SSA	SSA - India	India - West Asia	West Asia - India
Extraction	1.49	0.35	2.92	0.1	0.64	7.54	1.48	1.97	2.34	1.42
GrainCrops	23.35	3.23	30.88	0.09	2.26	11.18	11.06	8.23	15.23	10.84
Heavymanu	7.62	1.54	7.58	2.45	0.44	6.34	4.18	4.18	7.33	5.02
Lightmanu	9.26	2.86	7.74	4.36	0.1	17.33	8.58	14.64	9.15	6.3
Meatandmeat prod	23.25	1.08	2.88	2.42	1.24	6.68	2.88	13.34	2.94	1.74
ProcessedFood	53.91	2.74	42.99	2.24	0.71	11.13	56.61	20.64	48.45	14.89
Textile	15.16	9.62	17.25	4.52	0.65	9.65	15.7	22.16	17.76	7.53

Source: WITS Database

Tariff Profile Conti….

Products	India-East Asia		India-ASEAN 10		India-Other South Asian Countries	
	Exports to	Import from	Exports to	Import from	Exports to	Import from
Grain Crops	26.8246	24.9264	4.6317	27.2592	6.5999	13.1421
Meat & Meat Products	1.77	22.2374	14.693	13.1839	6.1216	3.8573
Extraction	0.3964	0.9899	3.2482	3.4194	12.2931	13.3748
Processed Food	5.8585	35.1448	12.2293	73.6284	9.9807	10.5107
Textiles	3.7826	13.0624	3.7581	11.4759	9.3689	2.452
Light Manufacturing	1.5078	9.4988	5.8107	7.9824	7.152	1.9657
Heavy Manufacturing	1.6686	5.5867	1.5506	5.5155	7.9749	1.4283

Source: GTAP10

Tariff Profile

Country	Overall	Agriculture	Manufacturing
Republic of Korea	4.8	44.7	3.1
Cambodia	3.3	0.6	4.0
China	2.8	6.7	3.1
Japan	1.7	10.2	1.2
Thailand	1.7	1.0	2.0
Vietnam	1.2	1.1	1.3
Indonesia	0.9	1.0	1.0
Malaysia	0.9	0.1	1.1
Philippines	0.7	0.4	0.8
Myanmar	0.6	0.2	0.7
Lao PDR	0.2	0.2	0.2
Australia	0.0	0.0	0.0
Brunei Darussalam	0.0	0.0	0.0
New Zealand	0.0	0.0	0.0
Singapore	0.0	0.0	0.0

Note: Tariffs are trade weighted averages

Source: UNCTAD secretariat based on Nicita (2021)

Tariff Profile of Countries

Table 1: Tariff Profile of Major IPEF Countries

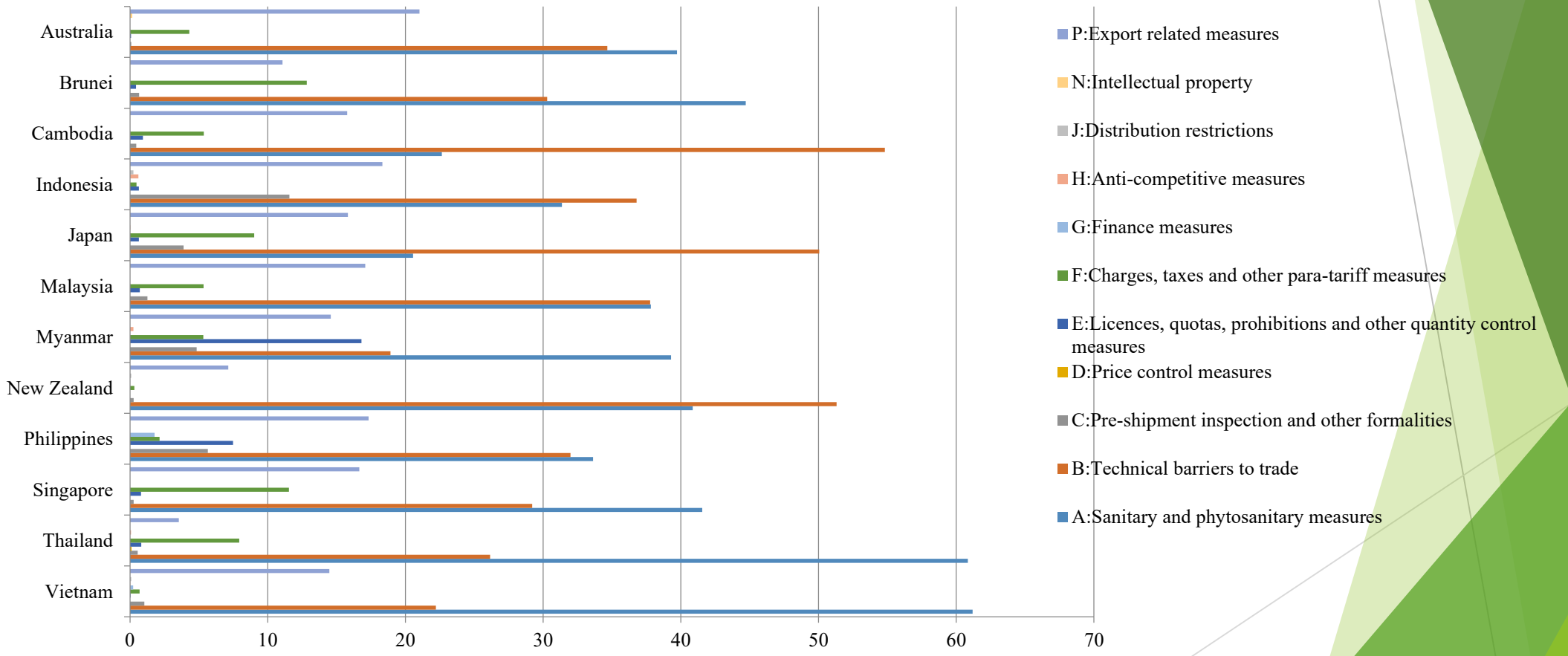
Tariff rate among IPEF 10	IPEF-10 to IPEF-10	Japan Exporting to IPEF 10	IPEF 10 exporting to japan	US export to IPEF 10	IPEF 10 export to USA	India exports to IPEF 10	IPEF to India	India exporting to Japan	Japan Exporting to India	India to US	US to India
Agriculture and allied activities	5.98	8.04	12.8	25.84	1.47	16.4021	60.62	2.27	32.61	0.312	26.14
Coal	0.02	0.34	0	0.0018	0	0.0825	3.38	0	0	0	3.404
Oil	0.003	0.0002	0	0.0006	0	0	0.033	0	0	0	0.0022
Gas	0.099	0	0	0	0	0	5.03	0	0	0	0
Oil and petroleum	0.6521	1.42	0.8828	0.49	0.024	0.647	4.5856	0	0	0	4.85
Electricity	0	0	0	0	0	0.1172	0	0	0	0	0
Energy intensive industry	0.89	2.95	0.366	1.54	0.8	1.7419	6.82	0.32	7.0085	0.51	8.1627
Industry	0.966	4.76	0.409	1.33	2.51	4.61	5.68	0.5199	7.725	3.955	7.1374
Average	1.076263	2.188775	1.807225	3.6503	0.6005	2.950088	10.76858	0.388738	5.917938	0.597125	6.212038

Source: Author's own simulations via GTAP E.

Non Tariff Barriers

- Non tariff measures in India product wise distinguished by technical and non technical or price measures. Footwear, fuels and wood faces price measures in India like licensing, quotas, paratariffs, anti competitive export measures. Animals, chemical, hides , vegetables and skin imports face TBTs and SPS non tariff measures.
- AMS command is used in GTAP to account for NTMs in the general equilibrium model. The NTMs data comes from UNESCAP, WTO designed TINA and WITS platforms. Textile and clothing faces both price and non price measures to safeguard our economic interest. NTMs and NTBs have very thin line separating them, meaning when NTMs are used as protectionist device they become barriers and therefore are subject to discussion. Stones ,plastics and rubber imports faces more price measures.
- Anti Competitive measures include state trading enterprises for importing and measures affecting competition. SPS includes registration requirements for importers, tolerance limits for residue and restricted use of substance, prohibitions and temporary geographic prohibitions. TBT includes licensing, marking and packaging requirements, and other prohibitions.

Non-Tariff Barriers Profile of Selected RCEP Nations



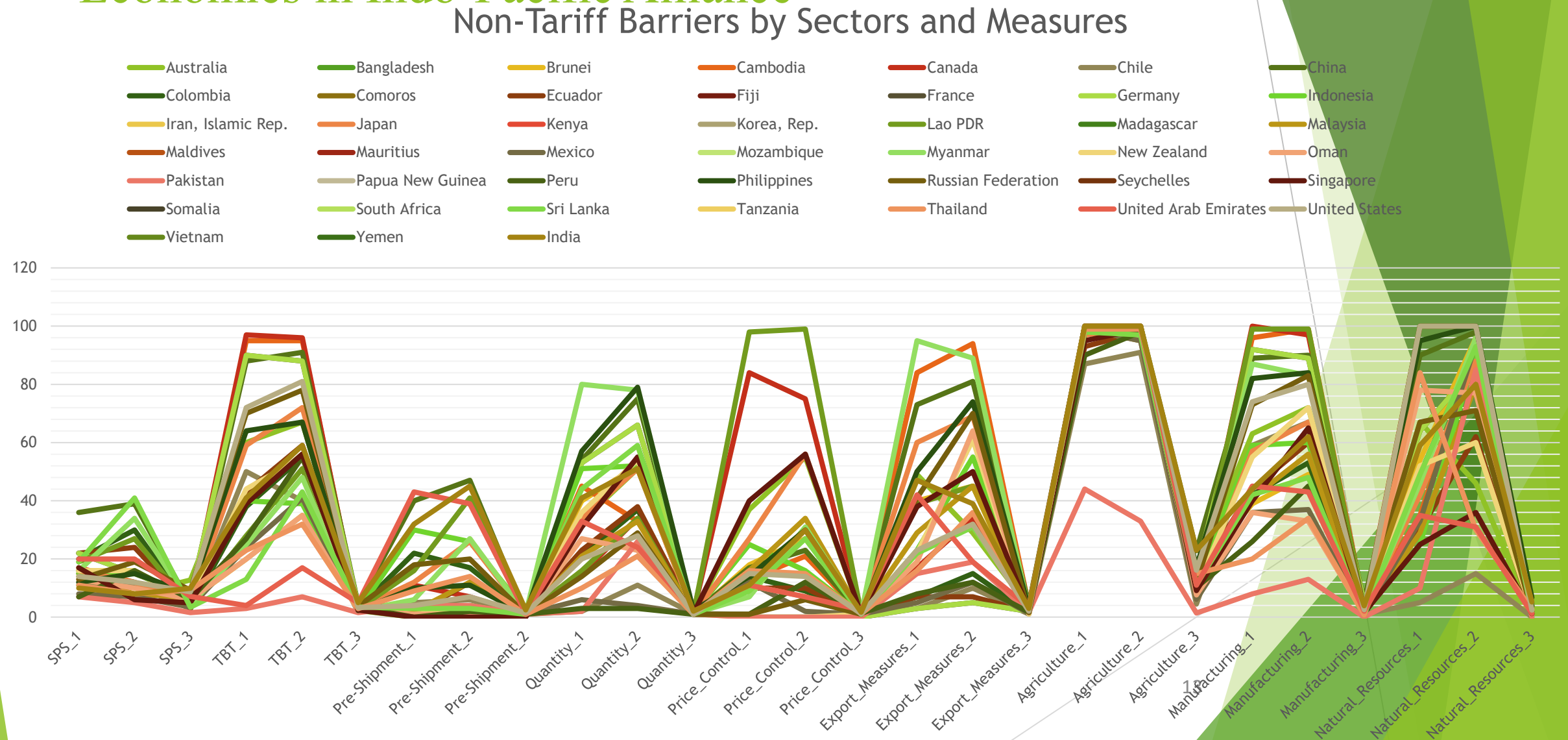
Source: Prepared by Authors using Non-Tariff Barriers data from World Integrated Trade Solutions (WITS database)

Non-Tariff Measures among Indo-Pacific Nations (UNCTAD)

Developing Country	Frequency Index	Coverage Ratio	Prevalance Score	Developed Country	Frequency Index	Coverage Ratio	Prevalance Score
Cambodia	96	98	4.4	Australia	67	70	3.5
China	90	92	6.8	Brunei	46	60	2.4
Colombia	46	63	2.5	Canada	100	98	4.2
Ecuador	46	64	2.6	Chile	61	61	1.3
Indonesia	61	70	3	France	92	89	6.3
Malaysia	48	63	2.4	Germany	92	89	6.3
Mexico	38	45	1	Japan	61	76	3.3
Myanmar	88	88	2.6	New Zealand	59	73	2.5
Oman	45	46	1.7	Russian Federation	76	85	4.2
Pakistan	11	33	0.2	Singapore	47	60	2.6
Peru	29	59	1.4	United Arab Emirates	52	46	3.4
Philippines	84	88	4	United States	77	83	4.1
Sri Lanka	47	63	1.7	**Average**	**69.16667**	**74.16667**	**3.675**
Thailand	28	38	2.1				
Vietnam	89	92	5				
India	47	69	4.9				
Average	**55.8125**	**66.9375**	**2.89375**				

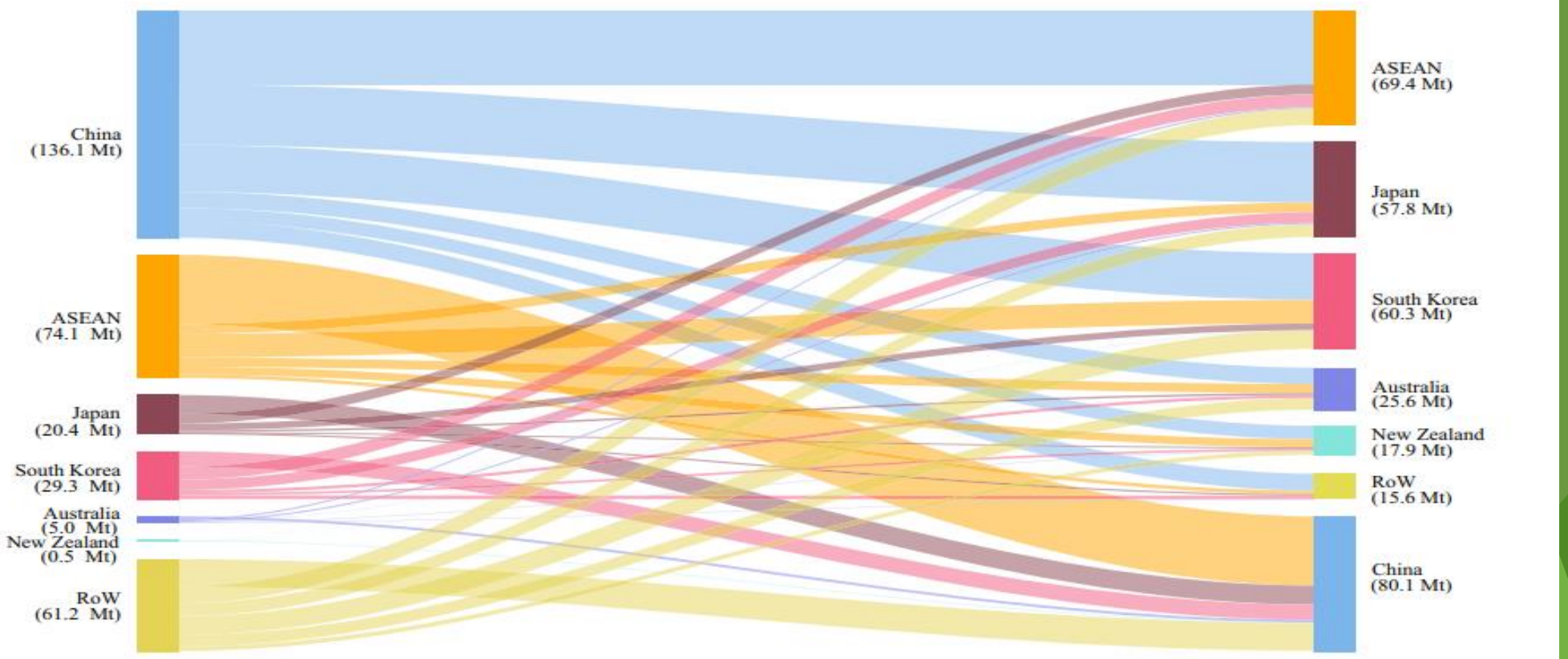
Note: The coverage ratio (CR) measures the percentage of trade subject to NTMs, the frequency index (FI) indicates the percentage of products to which NTMs apply, and the prevalence score (PS) is the average number of NTMs applied to products.

Non-Tariff Barriers Distinguishing the Developed and Developing Economies in Indo-Pacific Alliance



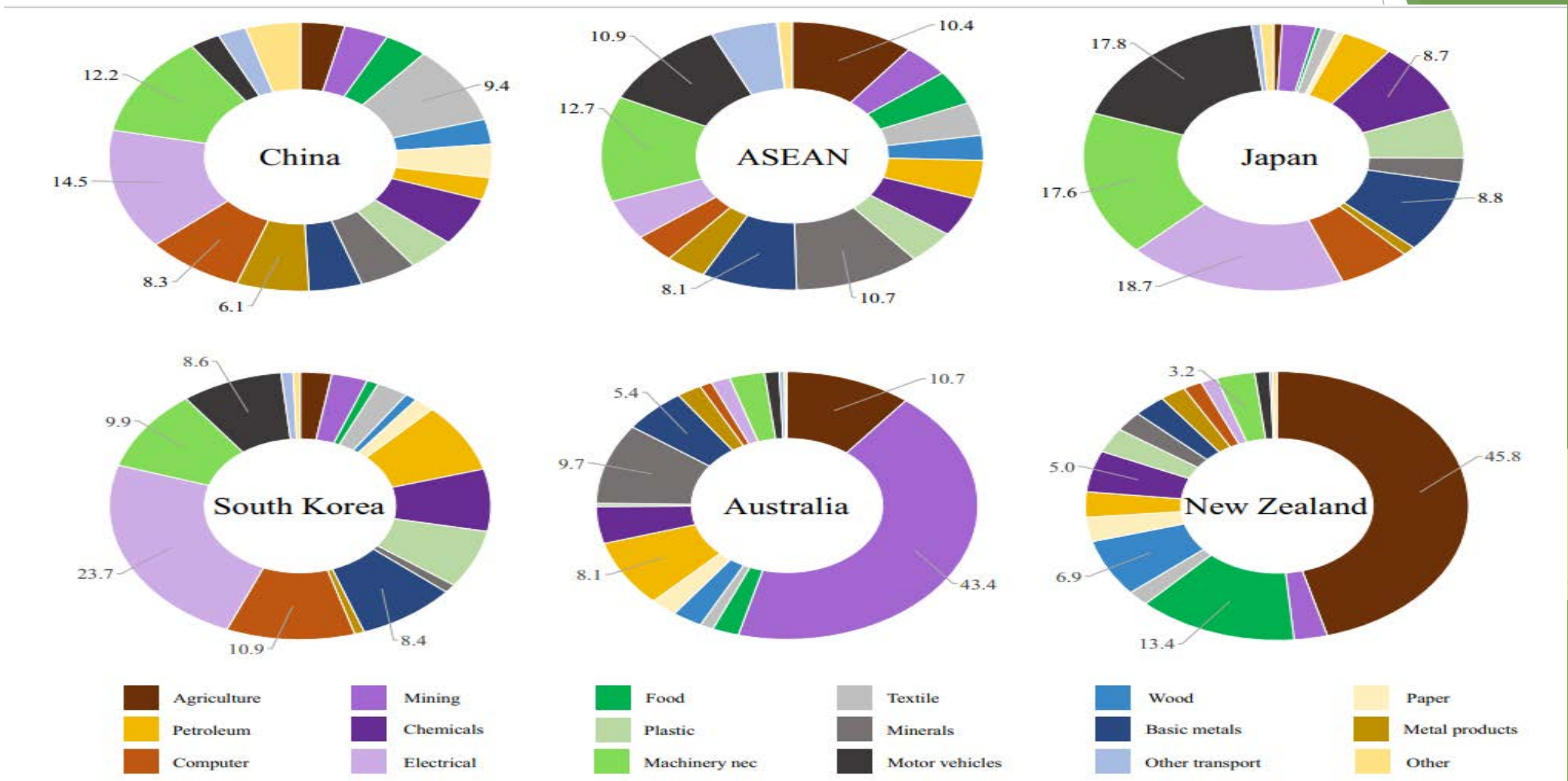
Source: UNCTAD NTM Measures

Increased Bilateral CO_2 Emissions in Trade



Source: Tian, K., Zhang, Y., Li, Y., Ming, X., Jiang, S., Duan, H., ... & Wang, S. (2022). Regional trade agreement burdens global carbon emissions mitigation. *Nature Communications*, *13*(1), 1-12.
Note: The figure presents the increased amount of CO2 emitted in the region of origin (left) for its production
of exports to a destination (the right)

Sectoral Contribution to CO2 Emissions in Trade



Source: Tian, K., Zhang, Y., Li, Y., Ming, X., Jiang, S., Duan, H., ... & Wang, S. (2022). Regional trade agreem burdens global carbon emissions mitigation. *Nature Communications*, *13*(1), 1-12.

Gravity Model: Origin

Firstly given by Tinbergen (1962)

$$F_{ij} = \frac{M_i^{\alpha} M_j^{\beta}}{D_{ij}^{\delta}}$$

- F_{ij} is the flow of trade (exports or imports) from origin *i* to destination *j*;
- M_i and M_j are the economic masses (GDPs) of these two nations; and
- D_{ij} is the distance between these countries.

Econometric Model :

$$\ln(X_{ij}) = \beta_0 + \beta_1 \ln(GDP_i) + \beta_2 \ln(GDP_j) + \beta_3 \ln(D_{ij}) + \varepsilon_{it}$$

Border Puzzle: McCallum (1995)

He estimated the following Gravity equation to see the trade pattern between Canada and U.S. :

$$X_{ij} = \alpha + \beta_1 y_i + \beta_2 y_j + \beta_3 dist_{ij} + \beta_4 DUMMY_{ij} + u_{ij}$$

Where:

- X_{ij} is the logarithm of shipments of goods from region *i* to region *j*,
- y_i and y_j are the logarithms of gross domestic product in regions *i* and *j*,
- $dist_{ij}$ is the logarithm of the distance from *i* to *j*,
- $DUMMY_{ij}$ is a dummy variable equal to 1 for interprovincial trade and 0 for province-to-state trade

The study found that U.S.-Canadian border led to the trade between Canadian provinces that is a factor 22 (2200 percent) times trade between U.S. and Canadian provinces.

Gravity Model: Evolution

- Anderson (1979)
- Anderson and Wincoop (2003)

  - All goods are differentiated by the place of origin,
  - Each region is specialized in the production of one good only,
  - The supply of each good is fixed, and
  - Identical homothetic preferences approximated by CES utility function

Gravity Model →

$$X_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\pi_i p_j}\right)^{1-\sigma}$$

$$\pi_i^{1-\sigma} = \sum_j p_j^{\sigma-1}\theta_j t_{ij}^{1-\sigma}\ \forall_i$$

$$p_j^{1-\sigma} = \sum_i \pi_i^{\sigma-1}\theta_i t_{ij}^{1-\sigma}\ \forall_j$$

- $\sigma = \frac{1}{1-\rho} > 1$ and $0 < \rho < 1$
- π_i is the MR for Country i (Outward MR)
- p_j is the MR for Country j (Inward MR)
- θ_j is the world income share of country j, $\theta_j = \frac{Y_j}{Y^w}$

Anderson and Wincoop (2003):

were of the opinion that it is not only the bilateral trade barriers but also multilateral trade barriers that determine the trade flows between two countries and the trade cost function is:

$$t_{ij} = b_{ij} d_{ij}^{\rho}$$

Where: b_{ij} is the Border related indicator variable;

and d_{ij} is the distance between i and j

Comparison of Gravity Equations with Value of Exports for Province/State Pairs as Dependent Variable

	McCallum (1995) and Other Samples			*Anderson and van Wincoop 2001*	*With Fixed Effects*[a]
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Year of data	*1988*	*1993*	*1993*	*1993*	*1993*
Regions included	CA-CA CA-US	CA-CA CA-US	US-US CA-CA CA-US	US-US CA-CA CA-US	US-US CA-CA CA-US
Independent variables					
$\ln Y^i$	1.21 (0.03)	1.22 (0.04)	1.13 (0.02)	1	1
$\ln Y^j$	1.06 (0.03)	0.98 (0.03)	0.97 (0.02)	1	1
$\ln d^{ij}$	−1.42 (0.06)	−1.35 (0.07)	−1.11 (0.03)	−0.79 (0.03)	−1.25 (0.04)
Indicator Canada	3.09 (0.13)	2.80 (0.14)	2.75 (0.11)		
Indicator U.S.			0.40 (0.05)		
Indicator border				−1.65 (0.08)	−1.55 (0.06)
Border effect Canada[b]	22.0 (2.9)	16.4 (2.0)	15.7 (1.9)	10.5 (1.2)	
Border effect U.S.[b]			1.5 (0.1)	2.6 (0.1)	
Border effect-average[c]			4.8 (0.3)	5.2 (0.4)	4.7 (0.3)
R^2	0.81	0.76	0.85	n.a.	0.66
Observations	683	679	1511	1511	1511

Source: McCallum 1995; Anderson and van Wincop 2003, Table 2; Feenstra 2002; and empirical exercises 5.1 and 5.2.

Note: Standard errors are in parentheses.

[a] Includes fixed effects for source and destination provinces or states.

[b] Computed as the exponent of the Canada or U.S. indicator variable, except for the calculation in column (4), which is explained in the text.

[c] Computed as the geometric mean of the Canada and U.S. border effects in columns (3)–(4), and as the exponent of the (absolute value of the) coefficient on the border indicator in columns (4)–(5).

ble 3.2 The Estimators Used in this Study

obrev.	Description	Introduced by
S	Linear-in-logs with GDPs	Tinbergen (1962)
S	Structurally Iterated Least Squares	Anderson and van Wi
V	Least squares w/country dummies	Harrigan (1996)
M	Double-Demeaning of LHS & RHS	None
	Bonus Vetus OLS, simple averages	Baier and Bergstran
	Bonus Vetus OLS, GDP-weighted	Baier and Bergstran
s	Ratios of reference exporter & importer	Head et al. (2010)

.2 explains how SILS differs from the original method.

R Packhage Gravity

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R topics documented:

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bvu *Bonus vetus OLS (BVU)*

Description

bvu estimates gravity models via Bonus vetus OLS with simple

Usage

```
bvu(
  dependent_variable,
  distance,
  additional_regressors = NULL,
  income_origin,
  income_destination,
  code_origin,
  code_destination,
  robust = FALSE,
  data,
  ...
)
```

MTR

- **Model 1: Capturing Multilateral Trade Resistance Term with Country Fixed Effects**
- Under this approach the multilateral trade resistance terms can be captured by the usage of country specific effects in the model. These effects will automatically take care of the country specific characteristics and multilateral trade resistance terms. Under this model, the equation can be written as:

$$\ln\left(X_{ijt}^{k}\right) = \beta_0 + \alpha_i + \gamma_j + \beta_1 \ln\left(TC_{ijt}^{k}\right) + \varepsilon_{ijt} \boldsymbol{(Model\ 1)}$$

$$\beta_0 = -\log(y^w)$$

$$\alpha_i = \log(y_i) - \log(\pi_i)$$

$$\gamma_j = \log(y_j) - \log(p_j)$$

MTR

- **Model 2: Capturing Multilateral Trade Resistance Term with the Method Developed by Baier and Bergstrand (2009)**
- This is another way to capture the multilateral resistance terms by making the proper adjustments in the trade cost factor that will automatically capture the trade resistance terms. Hence, there is no need to apply the fixed effects. Under this approach, the gravity model can be written as:
- Where: $\ln(TC_{ij}^{k^*})$ are the modified trade costs and the modification has been done by using the following formula:

$$\ln(X_{ijt}^{k}) = \beta_0 + \beta_1 \ln(y_i) + \beta_2 \ln(y_j) - \beta_3 \{\ln(TC_{ij}^{k^*})\} + \varepsilon_{ijt} \; (\boldsymbol{Model\ 2})$$

$$\ln(TC_{ij}^{k^*}) = \ln(TC_{ij}^{k}) - \sum_{j=1}^{N} \theta_i \ln(TC_{ij}^{k}) - \sum_{i=1}^{N} \theta_j \ln(TC_{ji}^{k}) + \sum_{i=1}^{N}\sum_{j=1}^{N} \theta_i \theta_j \ln(TC_{ij}^{k})$$

Bonus Vetus OLS (BB 2009)

Original form of Theoretical Gravity

$$\log X_{ij}^{k} = \log Y_{i}^{k} + \log E_{j}^{k} - \log Y^{k} + (1 - \sigma_{k})\left[\log \tau_{ij}^{k} - \log \Pi_{i}^{k} - \log P_{j}^{k}\right]$$

Baier and Bergstrand transformation

$$\log X_{ij}^{k} = \log Y_{i}^{k} + \log E_{j}^{k} - \log Y^{k} + (1 - \sigma_{k})\left[\log \tau_{ij}^{k^{*}}\right]$$

by using the 1st order Taylor series approximation of MTR:

$$\log \tau_{ij}^{k^{*}} = \log \tau_{ij}^{k} - \sum_{j=1}^{N} \theta_{j}^{k} \log \tau_{ij}^{k} - \sum_{i=1}^{N} \theta_{i}^{k} \log \tau_{ji}^{k} + \sum_{i=1}^{N} \sum_{j=1}^{N} \theta_{i} \theta_{j} \log \tau_{ij}^{k}$$

weighted by GDP shares $\boldsymbol{O}_{i}^{k} = \frac{Y_{i}^{k}}{Y^{k}}$

Bonus Vetus OLS (BB 2009) Contd.

BB estimation procedures

1. Calculate the weight terms
2. Calculate log τ_{ij}^{*} for EACH trade-cost variable

$$\ln \text{dist}_{ij}^{*} = \ln \text{dist}_{ij} - \sum_i \theta_i \ln \text{dist}_{ij} - \sum_j \theta_j \ln \text{dist}_{ij} + \sum_i \sum_j \theta_i \theta_j \ln \text{dist}_{ij}$$

$$\text{contig}_{ij}^{*} = \text{contig}_{ij} - \sum_i \theta_i \text{contig}_{ij} - \sum_j \theta_j \text{contig}_{ij} + \sum_i \sum_j \theta_i \theta_j \text{contig}_{ij}$$

3. Estimate the BB gravity model with OLS

$$\log X_{ij}^{k} = \log Y_i^{k} + \log E_j^{k} - \log Y^{k} + (1 - \sigma_k)\left[\log \tau_{ij}^{k^{*}}\right]$$

Find the weight term: $\theta_i^{k} = \frac{1}{N_i^{k}}$

Calculate log τ_{ij}^{*}

Variable	Obs	Mean	Std. Dev.	Min	Max
ln_exporte~P	583	26.85428	1.837116	23.32071	30.31317
ln_importe~P	583	26.80706	1.988583	23.32071	30.31317

MTR

- In the above equation, θ_i and θ_j and are the income shares of country I and county j in the word income; and TC_{ij}^{k} are the calculated trade costs between the trading nations for the trade of k^{th} product.

MTR

- **Model 3: Capturing Multilateral Trade Resistance Terms withthe Method Developed by Novy (2013)**
- Novy(2013) decomposed the growth of trade into three factors: the growth of income of the trading partners; decline in the trade costs between them; and the decrease in the multilateral trade resistance term. His final equation of decomposition of trade is given by

- Where: (I) is the contribution of growth in income; (II) is the contribution of decline in trade costs; and (III) is the contribution of increase in the multilateral trade resistance term. From equation the part (III) can be picked to replace the multilateral trade resistance terms in the gravity equation. The final gravity equation can be written as:

$$\Delta ln(x_{ij}x_{ji}) = \underbrace{2\Delta ln\left(\frac{y_i y_i}{y^w}\right)}_{(I)} + \underbrace{2(1-\sigma)\,\Delta ln(\tau_{ij}+1)}_{(II)} - \underbrace{2(1-\sigma)\Delta ln(\varphi_i \varphi_j)}_{(III)}$$

MTR

$$\ln\left(X_{ijt}^{k}\right) = \beta_0 + \beta_1 \ln\left(Y_i\right) + \beta_2 \ln\left(Y_j\right) + \beta_3 \ln\left(TC_{ijt}^{k}\right) + \beta_4 \ln\left(MTR_{ijt}\right) + \varepsilon_{ijt} \; (\boldsymbol{Model\ 3})$$

- Where, MTR_{ijt} is the multilateral trade resistance terms and calculated as:

$$MTR_{ijt} = 2(1-\sigma)\Delta ln\left(\varphi_i \varphi_j\right) = \Delta ln\left(\frac{y_i/y^w}{x_{ii}^{k}/y_i}\right) + \Delta ln\left(\frac{y_j/y^w}{x_{jj}^{k}/y_j}\right)$$

- In the above equation y_i,y_j and y_w denotes the GDPs of country *i*, country *j* and world respectively, and x_{ii} and x_{jj} denotes the domestic trade of country *i* and country *j* respectively.

Trade Costs are Symmetric i.e. $t_{ij} = t_{ji}$

Measurement of Trade Costs (Novy, 2008)

- No need to assume $t_{ij} = t_{ji}$ and any particular trade cost function;
- Change in bilateral trade costs also affects the Intra-national trade; &
- Trade Costs vary overtime.

Final equation of Anderson and Wincoop(2003) can be used for the intra-national trade of country i:

$$x_{ii} = \frac{y_i y_i}{y^w}\left(\frac{t_{ii}}{\pi_i p_i}\right)^{1-\sigma}$$

$$\pi_i p_i = \left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1}{(\sigma-1)}} t_{ii}$$

Continued…

Making the bilateral equation:

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2 \left(\frac{t_{ij}t_{ji}}{\pi_i p_i \pi_j p_j}\right)^{1-\sigma}$$

By substituting the values of $\pi_i p_i$ and $\pi_j p_j$:

$$\tau_{ij} = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1$$

- τ_{ij} represents the tariff equivalents of trade costs,;
- x_{ii} and x_{jj} are the intranational trade flows of country *i* and *j* respectively;
- x_{ij} and x_{ji} are the international bilateral trade flows of country *i* and *j*;&
- σ is the elasticity of substitution across goods.

"Trade costs depend upon the ratio of intra-national trade to international trade"

Decomposition of Growth of Trade

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + (1-\sigma)\Delta ln(t_{ij}t_{ji}) - (1-\sigma)\Delta ln(\pi_i p_i \pi_j p_j)$$

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 \quad => \quad \tau_{ij} + 1 = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}}$$

$$(\tau_{ij}+1)^2 = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)$$

$$(t_{ij}t_{ji}) = (\tau_{ij}+1)^2(t_{ii}t_{jj})$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + (1-\sigma)\Delta ln\left((\tau_{ij}+1)^2(t_{ii}t_{jj})\right) - (1-\sigma)\Delta ln(\pi_i p_i \pi_j p_j)$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + (1-\sigma)\Delta ln(\tau_{ij}+1)^2 + (1-\sigma)\Delta ln(t_{ii}t_{jj}) - (1-\sigma)\Delta ln(\pi_i p_i \pi_j p_j)$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + (1-\sigma)\Delta ln(\tau_{ij}+1)^2 - (1-\sigma)\left(\Delta ln(\pi_i p_i \pi_j p_j) + \Delta ln(t_{ii}t_{jj})\right)$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - (1-\sigma)\left(\Delta ln(\pi_i p_i \pi_j p_j) - \Delta ln(t_{ii}t_{jj})\right)$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - (1-\sigma)\Delta ln\left(\frac{\pi_i p_i \pi_j p_j}{t_{ii}t_{jj}}\right)$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - (1-\sigma)\Delta ln\left(\frac{\pi_i p_i}{t_{ii}}\frac{\pi_j p_j}{t_{jj}}\right)$$

Cntd…..

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - (1-\sigma)\Delta ln\left(\left(\frac{\pi_i p_i}{t_{ii}}\right)^{\frac{1}{2}}\left(\frac{\pi_j p_j}{t_{jj}}\right)^{\frac{1}{2}}\right)^2$$

$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - 2(1-\sigma)\Delta ln\left(\left(\frac{\pi_i p_i}{t_{ii}}\right)^{\frac{1}{2}}\left(\frac{\pi_j p_j}{t_{jj}}\right)^{\frac{1}{2}}\right)$$

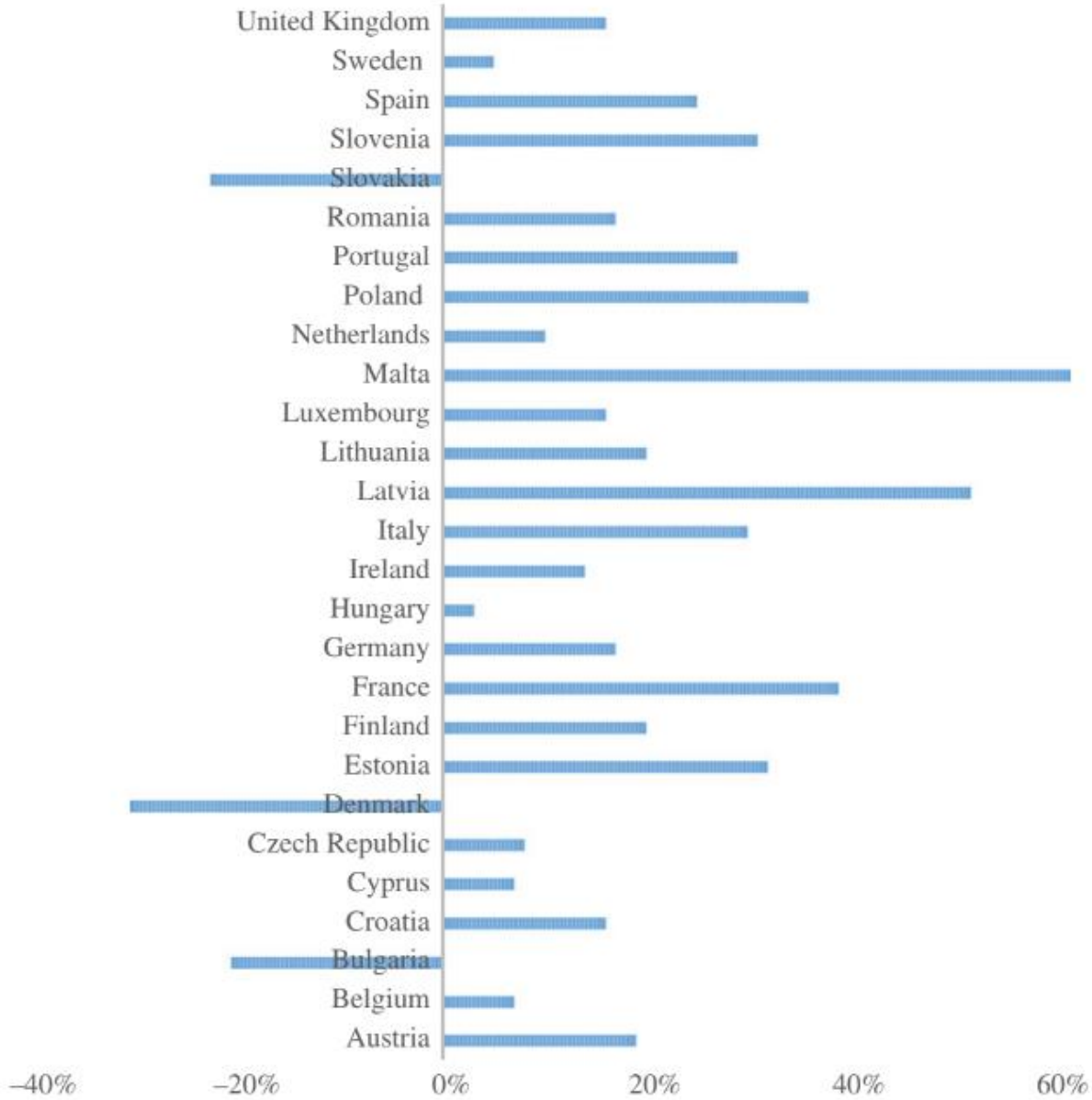
$$\Delta ln(x_{ij}x_{ji}) = 2\Delta ln\left(\frac{y_i y_i}{y^w}\right) + 2(1-\sigma)\Delta ln(\tau_{ij}+1) - 2(1-\sigma)\Delta ln(\Phi_i\Phi_j)$$

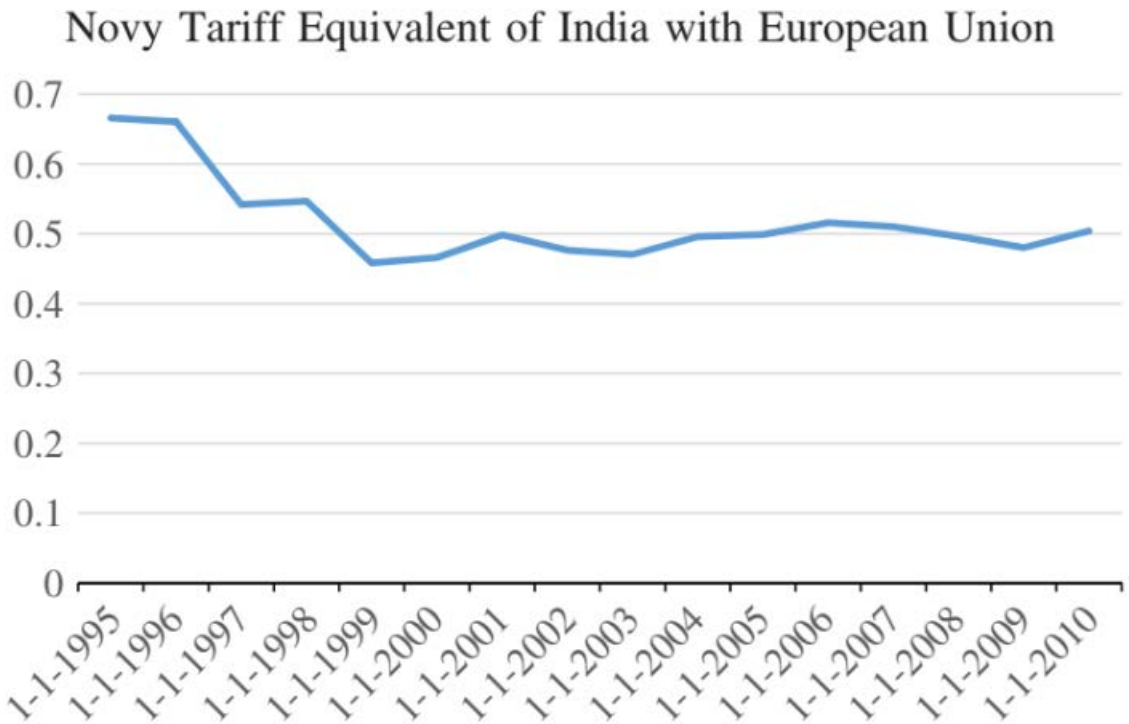
$$\mathbf{100\% = \underbrace{\frac{2\Delta ln\left(\frac{y_i y_j}{y^w}\right)}{\Delta ln(x_{ij}x_{ji})}}_{(a)} + \underbrace{\frac{2(1-\sigma)\Delta ln(1+\tau_{ij})}{\Delta ln(x_{ij}x_{ji})}}_{(b)} - \underbrace{\frac{2(1-\sigma)\Delta ln(\Phi_i\Phi_j)}{\Delta ln(x_{ij}x_{ji})}}_{(c)}}$$

Where:

- (a) is the Contribution of Income Growth;
- (b) is the Contribution of the Decline in Relative Bilateral Trade Costs; and
- (c) is the Contribution of the Decline in Relative Multilateral Resistance.

FIGURE 1
Percentage Decline in Novy Tariff Equivalent (1995–2010)

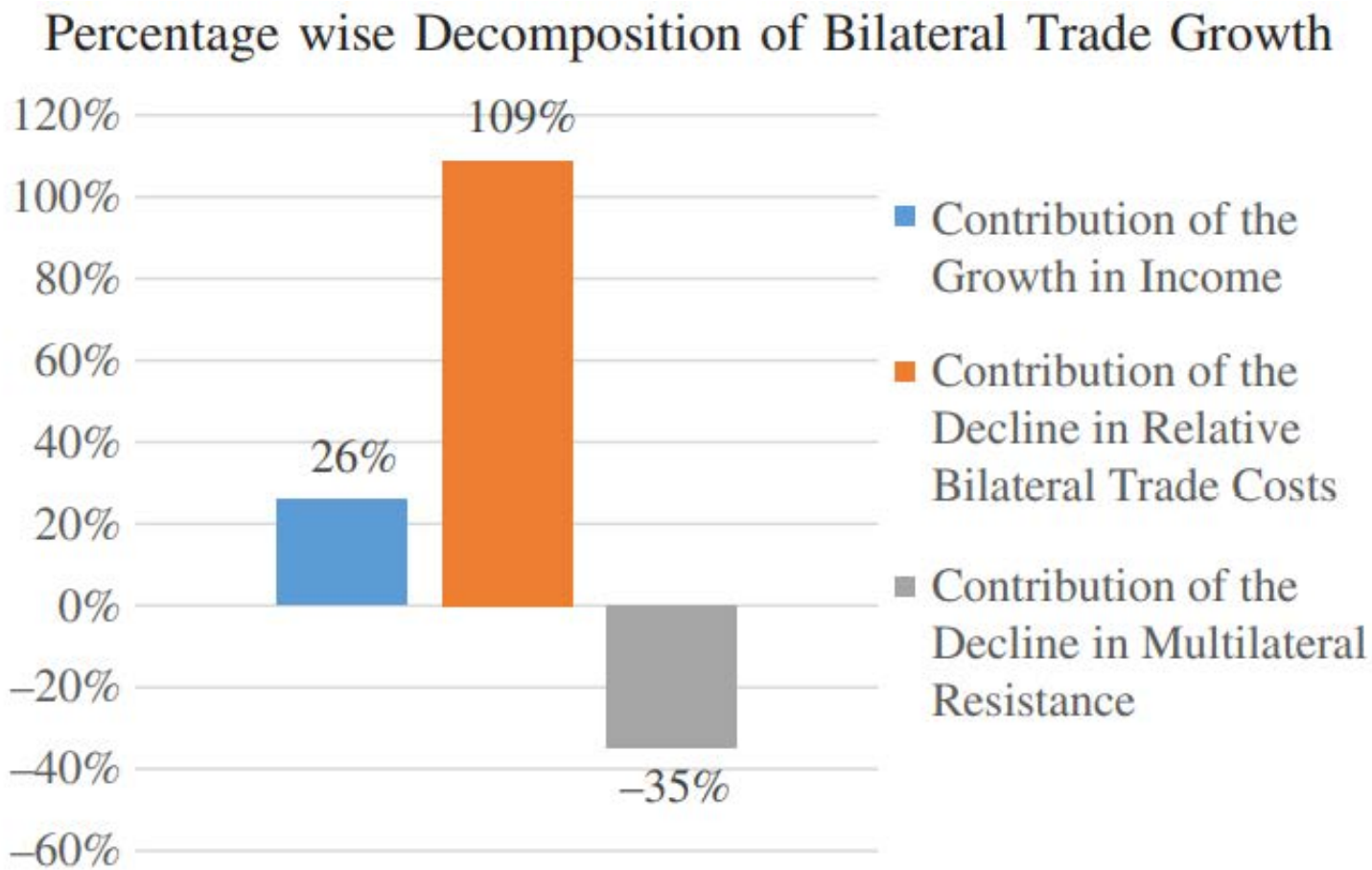


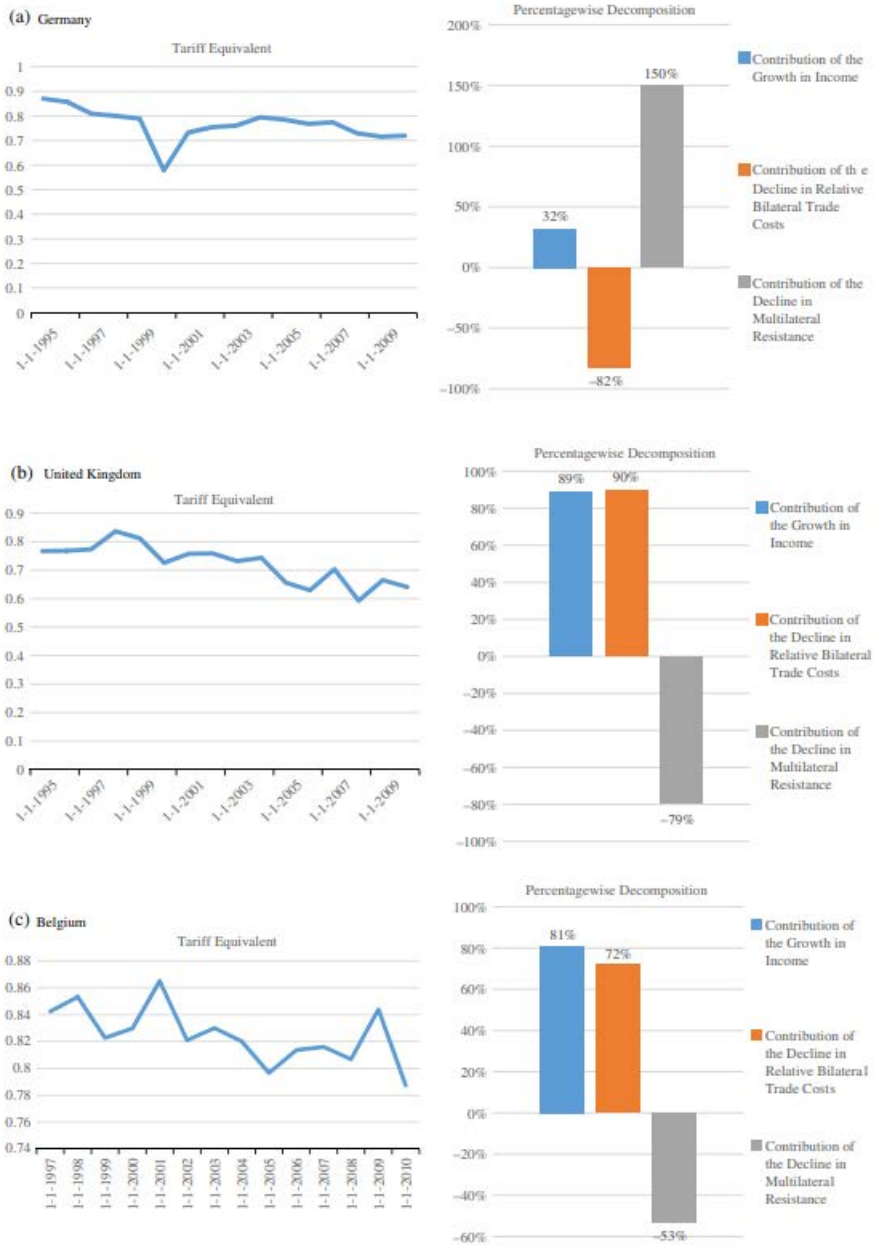


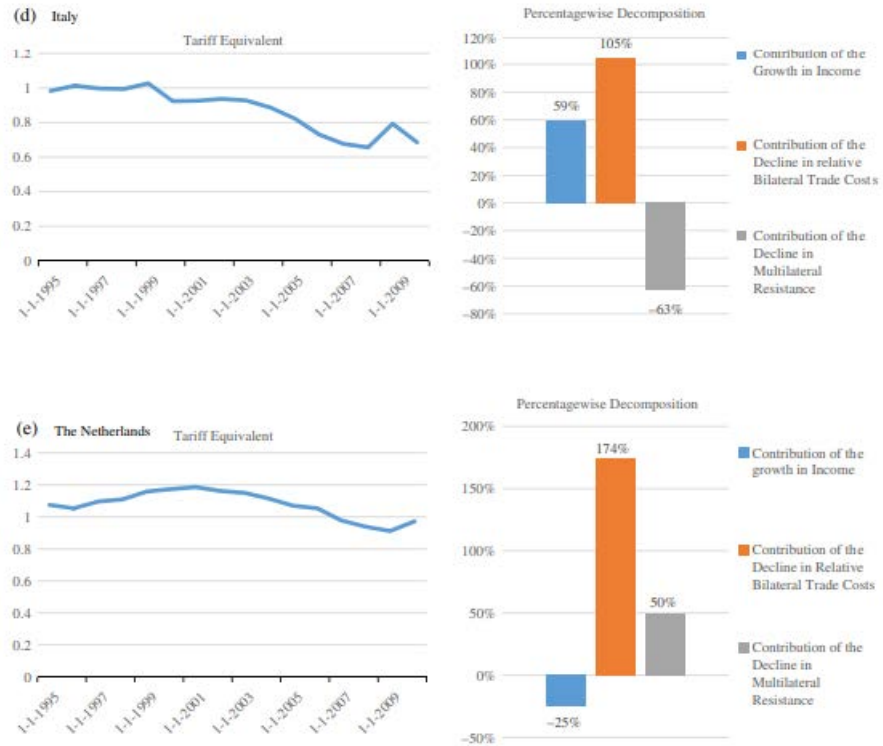
Trade Growth Accounting Figures between Indian and EU (1995–2010)

Column 1 Partner Country	*Column 2 Average Bilateral Trade Volume (in Million USD)*	*Column 3 Percentage Growth in Bilateral Trade*	*Column 4 Average Novy's Tariff Equivalent*	*Column 5 Contribution of the Growth in Income, %*	*Column 6 Contribution of the Decline in Relative Bilateral Trade Costs, %*	*Column 7 Contribution of the Decline in Multilateral Resistance, %*	*Column 8 Total, %*
Germany	22,123,085.893	248	0.765	32	−82	150	100
United Kingdom	16,403,803.781	195	0.679	89	90	−79	100
Belgium	15,072,182.617	256	0.825	81	72	−53	100
Italy	5,788,532.936	286	0.850	59	105	−63	100
France	4,937,667.515	326	0.766	84	9	7	100
Netherlands	4,115,913.027	376	1.076	−25	174	−50	100
Spain	905,534.618	362	1.227	50	67	−17	100
Sweden	329,639.787	319	1.103	55	49	−4	100
Denmark	106,998.472	165	1.160	21	104	−25	100
Austria	101,082.612	390	1.307	44	−12	68	100
Finland	60,764.359	304	1.000	42	136	−78	100
Poland	45,158.352	357	1.381	52	−37	84	100
Czech Republic	35,877.076	437	1.441	−16	101	15	100
Romania	31,279.841	333	1.557	30	40	30	100
Ireland	28,768.510	366	1.597	64	68	−32	100
Hungary	14,468.488	501	1.707	98	11	−8	100
Portugal	9,483.872	276	1.505	26	154	−80	100
Slovenia	5,507.145	412	1.694	88	−31	42	100
Lithuania	2,136.857	684	1.843	−135	86	149	100
Slovakia	1,304.179	169	1.874	22	73	5	100
Bulgaria	1,167.995	292	1.613	−50	−78	227	100
Malta	918.376	852	1.857	−10	389	−279	100
Latvia	439.451	1,023	1.920	35	−22	86	100
Croatia	387.344	343	2.217	0	100	0	100
Cyprus	354.052	326	1.946	−10	97	13	100
Estonia	302.634	759	2.117	−4	66	38	100
Luxembourg	229.819	422	2.283	32	29	39	100

Source: A. GAURAV AND S. K. MATHUR 2013


Percentage wise Decomposition of Bilateral Trade Growth
120%
100%
80%
60%
40%
20%
0%
–20%
–40%
–60%
26%
109%
–35%
Contribution of the Growth in Income
Contribution of the Decline in Relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance


(a) Germany
Tariff Equivalent
Percentagewise Decomposition
150%
32%
−82%
Contribution of the Growth in Income
Contribution of th e Decline in Relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance
(b) United Kingdom
Tariff Equivalent
Percentagewise Decomposition
89%
90%
−79%
Contribution of the Growth in Income
Contribution of the Decline in Relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance
(c) Belgium
Tariff Equivalent
Percentagewise Decomposition
81%
72%
−53%
Contribution of the Growth in Income
Contribution of the Decline in Relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance


(d) Italy
Tariff Equivalent
Percentagewise Decomposition
59%
105%
−63%
Contribution of the Growth in Income
Contribution of the Decline in relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance
(e) The Netherlands
Tariff Equivalent
Percentagewise Decomposition
−25%
174%
50%
Contribution of the growth in Income
Contribution of the Decline in Relative Bilateral Trade Costs
Contribution of the Decline in Multilateral Resistance

Traditional Way for Measuring MTR

- Remoteness Index

$$\mathrm{Re}\, m_i = \sum_j \frac{\mathrm{dist}_{ij}}{GDP_j/GDP_W}$$

PPML Model

- PPML model is another estimation method for the gravity models in their multiplicative forms.
- The model belongs to generalized linear models using quasi-poisson distribution and log-link.
- The model is present by Silva and Tenreyro (2006).
- The estimation method can be used for cross sectional and panel data sets.

The PPML equation is:

$$\log Lamda = Cons\tan t + \alpha_i + \alpha_j + \beta_1 tariff + \beta_2 dis\tan ce +$$
$$\beta_3 NTM\ \mathrm{Re}\ porter\ \mathrm{Pr}\ evelanceSCore + \beta_4 NTMPartner\ \mathrm{Pr}\ evelanceScore +$$
$$\beta_5 RCEPTCdummy_{ij} + \beta_6 RCEPTD-1dummy_{ij} + \beta_7 RCEPTD-2dummy_{ij} + \beta_8 ASEANTCdummy_{ij} +$$
$$\beta_9 ASEANTD-1dummy_{ij} + \beta_{10} ASEANTD-2dummy_{ij} + error$$

α_i i and α_j are modelled through 16 exporter and 16 importer dummies. ASEAN TC dummy takes the value 1 if i and j are part of the ASEAN agreement (ten ASEAN nations). RCEP TC dummy takes the value 1 if i and j are part of the RCEP agreement (15 RCEP nations). RCEP TD-1 dummy takes the value 1 if *i* is part of the RCEP agreement and *j* is not part of the RCEP agreement, 0 otherwise. RCEP TD-2 dummy takes the value 1 if *i* is not part of the RCEP agreement while *j* is part of the RCEP agreement, 0 otherwise. ASEAN TD-1 dummy takes the value 1 if *i* is part of the ASEAN agreement and *j* is not part of the ASEAN agreement, 0 otherwise. ASEAN TD-2 dummy takes the value 1 if *i* is not part of the ASEAN agreement while *j* is part of the ASEAN agreement, 0 otherwise. The above equation uses OLS for estimating the equation. If the dependent variable takes the value 0, we use the PPML (Poisson Pseudo Maximum Likelihood Procedure) for estimation of our model.

Applications of Gravity Modelling

- Trade Creation and Trade Diversion
- Trade policies and Welfare
- Counterfactuals

	U.S. Tariff		
	0%	10%	20%
From Mexico, before NAFTA	$20	$22	$24
From Asia, before NAFTA	$19	$20.90	$22.80
From Mexico, after NAFTA	$20	$20	$20
From Asia, after NAFTA	$19	$20.90	$22.80
From the United States	$22	$22	$22

- Cost of Importing an Automobile Part This table shows the cost to the United States of purchasing an automobile part from various source countries, with and without tariffs. If there is a 20% tariff on all countries, then it would be cheapest for the United States to buy the auto part from itself (for $22).
- But when the tariff is eliminated on Mexico after NAFTA, then the United States would instead buy from that country (for $20), which illustrates the idea of trade creation.
- If instead we start with a 10% tariff on all countries, then it would be cheapest for the United States to buy from Asia (for $20.90). When the tariff on Mexico is eliminated under NAFTA, then the United States would instead buy there (for $20), illustrating the idea of trade diversion.

Structural Gravity Analysis to Understand the Trade Creation and Trade Diversion Impact of Indo-ASEAN FTA on Trade of India with IPEF and Indo-Pacific Nations

Linear regression

Number of obs	= 162
F(80, 79)	= .
Prob > F	= .
R-squared	= 0.9903
Root MSE	= 1.7541

ln_imports	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
aseanindiadummy	-6.603546	1.38802	-4.76	0.000	-9.366331	-3.84076
indiasaarc	-6.581357	2.391198	-2.75	0.007	-11.34092	-1.821796
indianafta	-.3805292	1.244318	-0.31	0.761	-2.857282	2.096224
India_bimstec	6.722608	1.694277	3.97	0.000	3.350234	10.09498
India_APTA	2.928443	1.213292	2.41	0.018	.5134447	5.343441
ln_tariff	-1.907785	.3043887	-6.27	0.000	-2.513656	-1.301915
exp_dum_1	2.043786	1.246856	1.64	0.105	-.438018	4.525591
exp_dum_2	-2.541852	1.238126	-2.05	0.043	-5.00628	-.0774249
exp_dum_3	2.049199	1.7206	1.19	0.237	-1.375569	5.473967
exp_dum_4	0	(omitted)				
exp_dum_5	4.468545	1.710765	2.61	0.011	1.063353	7.873737
exp_dum_6	1.775879	.7092455	2.50	0.014	.3641611	3.187597
exp_dum_7	-2.406074	1.66797	-1.44	0.153	-5.726085	.9139368
exp_dum_8	.003784	1.263484	0.00	0.998	-2.511118	2.518686
exp_dum_9	0	(omitted)				
exp_dum_10	-1.917322	2.144246	-0.89	0.374	-6.185337	2.350692
exp_dum_11	-5.08697	3.910104	-1.30	0.197	-12.86984	2.695896
exp_dum_12	-1.655584	1.484855	-1.11	0.268	-4.611114	1.299947
exp_dum_13	-10.43789	3.534985	-2.95	0.004	-17.4741	-3.401682
exp_dum_14	.9148329	1.248028	0.73	0.466	-1.569305	3.39897
exp_dum_15	1.315755	1.610281	0.82	0.416	-1.889429	4.52094

Linear regression

Number of obs	98
F(12, 46)	.
Prob > F	.
R-squared	0.8060
Root MSE	1.5619

ln_imports	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_distance	490.1438	160.7288	3.05	0.004	166.6136	813.674
ln_tariff	-1.936098	.2956416	-6.55	0.000	-2.531194	-1.341003
ln_gdp_exporter	-493.5303	161.6903	-3.05	0.004	-818.996	-168.0645
ln_gdp_importer	245.2259	80.30836	3.05	0.004	83.57355	406.8782
ln_ntb_parterner3	-555.6581	182.9638	-3.04	0.004	-923.9451	-187.3712
ln_ntb_reporter3	-807.8203	265.0542	-3.05	0.004	-1341.347	-274.294
aseanindiadummy	2350.852	770.718	3.05	0.004	799.4777	3902.227
indianafta	48.69947	15.40544	3.16	0.003	17.68992	79.70902
India_APTA	3027.83	992.1614	3.05	0.004	1030.712	5024.947
India_bimstec	-1603.066	526.1434	-3.05	0.004	-2662.138	-543.9946
indiasaarc	0	(omitted)				
exp_dum_1	1023.577	335.0801	3.05	0.004	349.0957	1698.058
exp_dum_2	0	(omitted)				
exp_dum_3	-3502.718	1146.421	-3.06	0.004	-5810.343	-1195.092
exp_dum_4	-569.4581	185.8697	-3.06	0.004	-943.5944	-195.3219
exp_dum_5	-2722.083	890.8971	-3.06	0.004	-4515.366	-928.8005
exp_dum_6	1054.539	346.2638	3.05	0.004	357.5461	1751.532
exp_dum_7	-1482.944	485.3756	-3.06	0.004	-2459.955	-505.934
exp_dum_8	-649.5882	213.4235	-3.04	0.004	-1079.187	-219.9889
exp_dum_9	0	(omitted)				
exp_dum_10	-148.0569	47.92544	-3.09	0.003	-244.5258	-51.58803
exp_dum_11	0	(omitted)				
exp_dum_12	-719.5146	235.1515	-3.06	0.004	-1192.85	-246.1792
exp_dum_13	0	(omitted)				
exp_dum_14	1806.846	592.6462	3.05	0.004	613.911	2999.781
exp_dum_15	2007.024	658.1086	3.05	0.004	682.3198	3331.728
exp_dum_16	714.0471	234.9066	3.04	0.004	241.2047	1186.889
exp_dum_17	-1250.327	410.8326	-3.04	0.004	-2077.291	-423.3643
exp_dum_18	0	(omitted)				
exp_dum_19	1805.396	591.6578	3.05	0.004	614.4505	2996.341
exp_dum_20	0	(omitted)				
exp_dum_21	0	(omitted)				
exp_dum_22	0	(omitted)				
exp_dum_23	0	(omitted)				
exp_dum_24	-1778.702	583.8267	-3.05	0.004	-2953.884	-603.52
exp_dum_25	0	(omitted)				
exp_dum_26	0	(omitted)				
exp_dum_27	0	(omitted)				
exp_dum_28	0	(omitted)				
exp_dum_29	0	(omitted)				
exp_dum_30	-258.0938	84.37137	-3.06	0.004	-427.9245	-88.26303
exp_dum_31	0	(omitted)				
exp_dum_32	0	(omitted)				
exp_dum_33	-741.6393	242.8762	-3.05	0.004	-1230.524	-252.7548
exp_dum_34	-1574.078	515.4251	-3.05	0.004	-2611.575	-536.5809
exp_dum_35	1520.983	498.4775	3.05	0.004	517.5997	2524.366
exp_dum_36	0	(omitted)				
exp_dum_37	-1772.445	581.7132	-3.05	0.004	-2943.373	-601.5175

ln_imports	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
exp_dum_38	-1281.007	419.9222	-3.05	0.004	-2126.266	-435.7472
exp_dum_39	0	(omitted)				
exp_dum_40	0	(omitted)				
exp_dum_41	0	(omitted)				
exp_dum_42	1056.294	345.8801	3.05	0.004	360.0737	1752.515
exp_dum_43	0	(omitted)				
exp_dum_44	2259.18	740.3188	3.05	0.004	768.9956	3749.365
exp_dum_45	0	(omitted)				
imp_dum_1	597.9201	196.4924	3.04	0.004	202.4013	993.4388
imp_dum_2	0	(omitted)				
imp_dum_3	-515.9224	167.1738	-3.09	0.003	-852.4258	-179.4191
imp_dum_4	0	(omitted)				
imp_dum_5	627.2775	206.7526	3.03	0.004	211.1061	1043.449
imp_dum_6	0	(omitted)				
imp_dum_7	0	(omitted)				
imp_dum_8	-1955.408	641.323	-3.05	0.004	-3246.324	-664.4916
imp_dum_9	534.0176	175.1231	3.05	0.004	181.5131	886.5222
imp_dum_10	0	(omitted)				
imp_dum_11	829.0038	271.8892	3.05	0.004	281.7191	1376.288
imp_dum_12	0	(omitted)				
imp_dum_13	1184.165	388.2855	3.05	0.004	402.5864	1965.743
imp_dum_14	1127.712	369.4527	3.05	0.004	384.0426	1871.382
imp_dum_15	0	(omitted)				
imp_dum_16	-1413.931	464.2519	-3.05	0.004	-2348.422	-479.4404
imp_dum_17	0	(omitted)				
imp_dum_18	572.0046	187.53	3.05	0.004	194.5263	949.4829
imp_dum_19	0	(omitted)				
imp_dum_20	0	(omitted)				
imp_dum_21	0	(omitted)				
imp_dum_22	0	(omitted)				
imp_dum_23	-1202.39	394.4769	-3.05	0.004	-1996.431	-408.349
imp_dum_24	0	(omitted)				
imp_dum_25	0	(omitted)				
imp_dum_26	0	(omitted)				
imp_dum_27	1559.97	511.1838	3.05	0.004	531.0109	2588.93
imp_dum_28	720.908	237.0478	3.04	0.004	243.7556	1198.06
imp_dum_29	0	(omitted)				
imp_dum_30	0	(omitted)				
imp_dum_31	129.4213	43.18272	3.00	0.004	42.49896	216.3436
imp_dum_32	-908.3187	297.9955	-3.05	0.004	-1508.152	-308.485
imp_dum_33	1194.407	391.2606	3.05	0.004	406.8403	1981.974
imp_dum_34	0	(omitted)				
imp_dum_35	0	(omitted)				
imp_dum_36	-472.2296	155.6774	-3.03	0.004	-785.592	-158.8671
imp_dum_37	0	(omitted)				
imp_dum_38	1659.409	543.3509	3.05	0.004	565.7005	2753.118
imp_dum_39	0	(omitted)				
imp_dum_40	0	(omitted)				
_cons	3276.695	1068.639	3.07	0.004	1125.636	5427.753

Poisson regression

Number of obs	=	418
Wald chi2(27)	=	.
Prob > chi2	=	.
Pseudo R2	=	0.6806

Log pseudolikelihood = -1.029e+09

importsvaluein1000usd	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
simpleaverage	-.0691638	.022402	-3.09	0.002	-.1130709	-.0252568
dist	-.0000951	.0000682	-1.39	0.163	-.0002288	.0000387
ASEAN_dummy	.6564269	.4488839	1.46	0.144	-.2233694	1.536223
RCEP	-81.79974	28.50674	-2.87	0.004	-137.6719	-25.92756
ntm_prevalence_score_reporter	.1878332	.2113526	0.89	0.374	-.2264103	.6020767
ntm_prevalence_score_partner	-.0729022	.2421786	-0.30	0.763	-.5475636	.4017592
Importer_GDP	-3.72e-11	1.31e-11	-2.83	0.005	-6.29e-11	-1.14e-11
Exporter_GDP	-1.58e-12	4.79e-12	-0.33	0.742	-1.10e-11	7.81e-12
exp_dum_1	2.73775	5.563334	0.49	0.623	-8.166185	13.64169
exp_dum_2	-3.888845	1.794285	-2.17	0.030	-7.405579	-.3721104
exp_dum_3	-2.767692	1.524393	-1.82	0.069	-5.755448	.2200626
exp_dum_4	25.33672	68.85755	0.37	0.713	-109.6216	160.295
exp_dum_5	-78.55126	29.40864	-2.67	0.008	-136.1911	-20.91138
exp_dum_6	.9437666	3.232177	0.29	0.770	-5.391183	7.278716
exp_dum_7	7.760518	19.27666	0.40	0.687	-30.02104	45.54207
exp_dum_8	0	(omitted)				
exp_dum_9	-4.043461	1.658839	-2.44	0.015	-7.294726	-.7921965
exp_dum_10	.1637734	.4347899	0.38	0.706	-.6883992	1.015946
exp_dum_11	-2.859459	1.43152	-2.00	0.046	-5.665187	-.0537306
exp_dum_12	-1.121573	.9111991	-1.23	0.218	-2.90749	.6643442
exp_dum_13	-1.07384	.5746888	-1.87	0.062	-2.20021	.0525291
exp_dum_14	0	(omitted)				
exp_dum_15	0	(omitted)				
exp_dum_16	0	(omitted)				
imp_dum_1	43.37915	15.11416	2.87	0.004	13.75593	73.00237
imp_dum_2	-15.93184	4.341535	-3.67	0.000	-24.44109	-7.422588
imp_dum_3	-13.51729	4.180156	-3.23	0.001	-21.71024	-5.324333
imp_dum_4	532.7952	187.5731	2.84	0.005	165.1586	900.4317
imp_dum_5	0	(omitted)				
imp_dum_6	25.48799	9.03891	2.82	0.005	7.772052	43.20393
imp_dum_7	151.0027	52.80643	2.86	0.004	47.504	254.5014
imp_dum_8	0	(omitted)				
imp_dum_9	-14.95024	4.258614	-3.51	0.000	-23.29697	-6.603509
imp_dum_10	.354885	.4567717	0.78	0.437	-.540371	1.250141
imp_dum_11	-6.154781	1.929284	-3.19	0.001	-9.936109	-2.373453
imp_dum_12	0	(omitted)				
imp_dum_13	0	(omitted)				
imp_dum_14	0	(omitted)				
_cons	109.3989	33.35224	3.28	0.001	44.02971	174.7681

VARIABLES	(1) BB 2009	(3) BB (3) 2009	(4) BB (3)PPML 2009
ln_distance_star	-0.878***	-0.493**	-0.325
	(0.256)	(0.235)	(0.267)
ASEAN_dummy	-0.0181	0.715	0.275
	(0.625)	(0.565)	(0.581)
RCEP	-0.0803	1.332***	1.660**
	(0.436)	(0.490)	(0.653)
ln_ntm_prevalence_score_reporter	-0.497	-0.279	
	(0.467)	(0.463)	
ln_ntm_prevalence_score_partner	-1.263***	-0.881**	
	(0.443)	(0.399)	
ASEAN_td_1	-0.918*	-1.081**	0.844**
	(0.535)	(0.446)	(0.388)
ASEAN_td_2	-0.797*	-0.0418	1.990***
	(0.478)	(0.484)	(0.426)
o.RCEP_td_1	-		
RCEP_td_2	-1.028		
	(0.646)		
ln_exporter_GDP	1.128***	1.299***	
	(0.105)	(0.100)	
ln_importer_GDP	1.137***	1.078***	
	(0.0909)	(0.0911)	
ln_tariff			
RCEP_td_1		1.273**	0.531
		(0.591)	(0.787)
o.RCEP_td_2		-	-
ln_tariff_star		0.360**	1.202***
		(0.157)	(0.212)
ntm_prevalence_score_reporter			-0.242
			(0.297)
ntm_prevalence_score_partner			-0.0970
			(0.221)
Importer_GDP			0*
			(0)
Exporter_GDP			0***
			(0)
Constant	-53.06***	-54.17***	11.80***
	(3.804)	(4.089)	(2.862)
Observations	499	327	327
R-squared	0.419	0.593	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) BB/Bonus vetus OLS	(2) LSDV	(3) PPML
ln_tariff		-0.959***	
		(0.299)	
ln_distance		-1.110***	
		(0.246)	
ln_ntm_reporter_prevelence		-1.012	
		(0.960)	
ln_ntm_partner_prevelence		-1.136	
		(0.696)	
CPTPP	0.766*	-1.270	12.02
	(0.454)	(0.934)	(8.778)
ln_exporter_GDP	1.012***	1.190***	
	(0.192)	(0.185)	
ln_importer_GDP	0.787***	1.404***	
	(0.120)	(0.203)	
		(1.148)	
ln_tariff_star	0.367**		
	(0.158)		
ln_distance_star	-1.101***		
	(0.231)		
ln_ntm_reporter_prevelencestar	0.855**		
	(0.383)		
ln_ntm_partner_prevelencestar	0.259		
	(0.281)		
CPTPP_td_two	-0.834		
	(0.704)		
simpleaverage			-0.0857***
			(0.0193)
dist			-0.000168***
			(3.17e-05)
ntm_reporter			0.329*
			(0.194)
ntm_partner			-0.0884
			(0.183)
CPTPP_td_one			-1.041
			(11.07)
exporter_GDP			0
			(0)
importer_GDP			0
			(0)
Constant	-43.83***	-45.19***	-1.036
	(8.087)	(6.760)	(9.562)
Observations	210	210	271
R-squared	0.477	0.585	

- **Codes in STATA for Multilateral Trade Resistance terms**

```
egen exporters=group(reporter)
egen importers=group(partner)
quietly tabulate exporters, generate(exp_dum_)
quietly tabulate importers, generate(imp_dum_)
```

- **Codes for generating variable for Bonus vetus OLS (BVU) in stata**

```
egen temp1 = mean(ln_distance), by ( productname )
egen temp2 = mean(ln_distance), by ( productname )
egen temp3 = sum(ln_distance), by ( productname )
gen ln_distance_star = ln_distance - temp1 - temp2 + (1/(30.31*30.31))*temp3

egen temp4 = mean(ln_tariff), by ( productname )
egen temp5 = mean(ln_tariff), by ( productname )
egen temp6 = sum(ln_tariff), by ( productname )
gen ln_tariff_star = ln_tariff - temp4 - temp5 + (1/(30.31*30.31))*temp6

egen temp14 = mean(ln_ntm_prevalence_score_reporter), by ( productname )
egen temp15 = mean(ln_ntm_prevalence_score_reporter), by ( productname )
egen temp16 = sum(ln_ntm_prevalence_score_reporter), by ( productname )
gen  ln_ntm_prevalence_reporterstar = ln_ntm_prevalence_score_reporter - temp14 - temp15 + (1/(30.31*30.31))*temp16

egen temp17 = mean(ln_ntm_prevalence_score_partner), by ( productname )
egen temp18 = mean(ln_ntm_prevalence_score_partner), by ( productname )
egen temp19 = sum(ln_ntm_prevalence_score_partner), by ( productname )
gen  ln_ntm_prevalence_partnerstar = ln_ntm_prevalence_score_partner - temp17 - temp18 + (1/(30.31*30.31))*temp19
```

- **Codes for two-way fixed effect model in STATA**

regress ln_imports ln_gdp_exporter ln_gdp_importer ln_distance ln_tariff ASEAN_dummy ASEAN_td_1 ASEAN_td _2 RCEP RCEP_td_1 RCEP_td_2 ln_ntm_prevalence_score_reporter ln_ntm_prevalence_score_partner exp1_dum_1 exp1_dum_2 exp1_dum_3 exp1_dum_4 exp1_dum_5 exp1_dum_6 exp1_dum_7 exp1_dum_8 exp1_dum_9 exp1_dum_10 exp1_dum_11 exp1_dum_12 exp1_dum_13 exp1_dum_14 exp1_dum_15 exp1_dum_16 imp1_dum_1 imp1_dum_2 imp1_dum_3 imp1_dum_4 imp1_dum_5 imp1_dum_6 imp1_dum_7 imp1_dum_8 imp1_dum_9 imp1_dum_10 imp1_dum_11 imp1_dum_12 imp1_dum_13 imp1_dum_14 imp1_dum_15 imp1_dum_16, vce(robust)

- **Codes for PPML in STATA: Poisson Pseudo Maximum Likelihood**

poisson importvaluesper1000usd gdp_exporter gdp_importer distance simpleaverage ASEAN_dummy ASEAN_td_1 ASEAN_td _2 RCEP RCEP_td_1 RCEP_td_2 ln_ntm_prevalence_score_reporter ln_ntm_prevalence_score_partner exp1_dum_1 exp1_dum_2 exp1_dum_3 exp1_dum_4 exp1_dum_5 exp1_dum_6 exp1_dum_7 exp1_dum_8 exp1_dum_9 exp1_dum_10 exp1_dum_11 exp1_dum_12 exp1_dum_13 exp1_dum_14 exp1_dum_15 exp1_dum_16 imp1_dum_1 imp1_dum_2 imp1_dum_3 imp1_dum_4 imp1_dum_5 imp1_dum_6 imp1_dum_7 imp1_dum_8 imp1_dum_9 imp1_dum_10 imp1_dum_11 imp1_dum_12 imp1_dum_13 imp1_dum_14 imp1_dum_15 imp1_dum_16, vce(robust)

- **Codes for PPML in R: Poisson Pseudo Maximum Likelihood**

ppml (dependent_variable, distance, additional_regressors, robust = FALSE, data=…)

- **Codes for Structural Iterated Least Squares in R**

sils(dependent_variable, distance, additional_regressors = NULL, income_origin, income_destination, code_origin, code_destination, maxloop = 100, decimal_places = 4, robust = FALSE, verbose = FALSE, data, ...)

- **Codes for Bonus vetus OLS (BVU) in R**

bvu(dependent_variable, distance, additional_regressors = NULL, income_origin, income_destination, code_origin, code_destination, robust = FALSE, data, ...)

FIRM LEVEL ANALYSIS THROUGH GRAVITY MODELLING AND EMPRICAL FACTS RELATED TO FIRM LEVEL TRADE

Exporter Premia in U.S. Manufacturing, 2002

	Exporter premia		
	(1)	*(2)*	*(3)*
Log employment	1.19	0.97	
Log shipments	1.48	1.08	0.08
Log value-added per worker	0.26	0.11	0.10
Log TFP	0.02	0.03	0.05
Log wage	0.17	0.06	0.06
Log capital per worker	0.32	0.12	0.04
Log skill per worker	0.19	0.11	0.19
Additional covariates	None	Industry fixed effects	Industry fixed effects, log employment

Sources: Data are for 2002 and are from the U.S. Census of Manufactures.
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic in the first column on a dummy variable indicating firm's export status. Regressions in column 2 include industry fixed effects. Regressions in column 3 include industry fixed effects and log firm employment as controls. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982). "Capital per worker" refers to capital stock per worker. "Skill per worker" is nonproduction workers per total employment. All results are significant at the 1 percent level.

The Intensive and Extensive Margins of Exporters, 1997

	Exporter premia	
	(1)	*(2)*
Log number of products	0.23	0.27
Log mean shipments/# products	1.25	0.73
Additional covariates	None	Industry fixed effects

Sources: Data are for 1997 and are from the U.S. Census of Manufactures.
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic in the first column on a dummy variable indicating firm export status. Regressions in column two include four-digit SIC industry fixed effects. The first dependent variable is the log of the number of five-digit SIC products produced by the firm in 1997. The second dependent variable is the log of total firm shipments divided by the number of products.

Gravity and Aggregate U.S. Exports, 2000

	Log of total exports value	*Log of number of exporting firms*	*Log of number of exported products*	*Log of export value per product per firm*
Log of GDP	0.98	0.71	0.52	−0.25
	(0.04)	(0.04)	(0.03)	(0.04)
Log of distance	−1.36	−1.14	−1.06	0.84
	(0.17)	(0.16)	(0.15)	(0.19)
Observations	175	175	175	175
R^2	0.82	0.74	0.64	0.25

Sources: Data are from the 2000 Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: Each column reports the results of a country-level ordinary least squares regression of the dependent variable noted at the top of each column on the covariates noted in the first column. Results for the constant are suppressed. Standard errors are noted below each coefficient. Products are defined as ten-digit Harmonized System categories. All results are statistically significant at the 1 percent level.

Trading Premia in U.S. Manufacturing, 1997

	(1) Exporter premia	*(2) Importer premia*	*(3) Exporter & importer premia*
Log employment	1.50	1.40	1.75
Log shipments	0.29	0.26	0.31
Log value-added per worker	0.23	0.23	0.25
Log TFP	0.07	0.12	0.07
Log wage	0.29	0.23	0.33
Log capital per worker	0.17	0.13	0.20
Log skill per worker	0.04	0.06	0.03

Sources: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufacturers and the Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic listed on the left on a dummy variable noted at the top of each column as well as industry fixed effects and firm employment as additional controls. Employment regressions omit firm employment as a covariate. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982).

Gravity and Aggregate U.S. Imports, 2000

	Log of total import value	*Log of number of importing firms*	*Log of number of imported products*	*Log of import value per product per firm*
Log of GDP	1.14***	0.82***	0.71***	−0.39***
	(0.06)	(0.03)	(0.03)	(0.05)
Log of Distance	−0.73***	−0.43***	−0.61***	0.31
	(0.27)	(0.15)	(0.15)	(0.24)
Observations	175	175	175	175
R^2	0.69	0.78	0.74	0.25

Sources: Data are from the 2000 Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: Each column reports the results of a country-level ordinary least squares regression of the dependent variable noted at the top of each column on the covariates listed on the left. Results for constants are suppressed. Standard errors are noted below each coefficient. Products are defined as ten-digit Harmonized System categories.
*, **, and *** represent statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 3: Market structure distorts gravity.

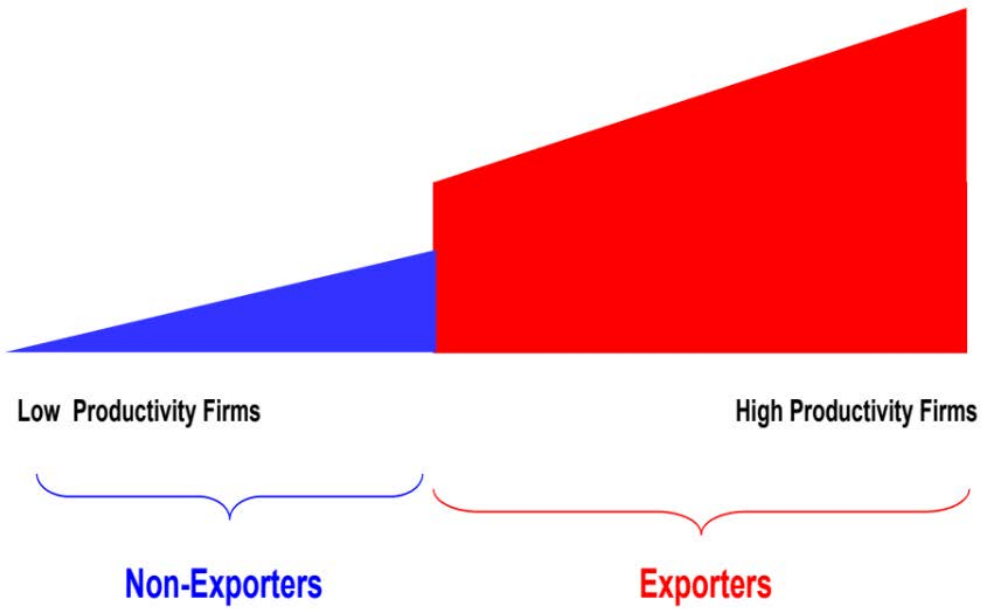
Variable	(1)	(2)	(3)	(4)	(5)
$\ln(\text{Distance}_{ij})$	-.8	-1			-.9
	(.02)***	(.02)***			(.02)***
$\hat{\sigma}_h \times \ln(\text{Distance}_{ij})$		.02			.015
		(.001)***			(.001)***
Language_{ij}	.4		1.2		.5
	(.04)***		(.09)***		(.05)***
$\hat{\sigma}_h \times \text{Language}_{ij}$			-.02		-.02
			(.004)***		(.004)***
Border_{ij}	.5			2.3	.6
	(.08)***			(.1)***	(.09)***
$\hat{\sigma}_h \times \text{Border}_{ij}$				-.04	-.01
				(.006)***	(.006)*
R^2	39%	40%	33%	35%	41%
Number of obs.	270,607	257,583	257,583	257,583	257,583

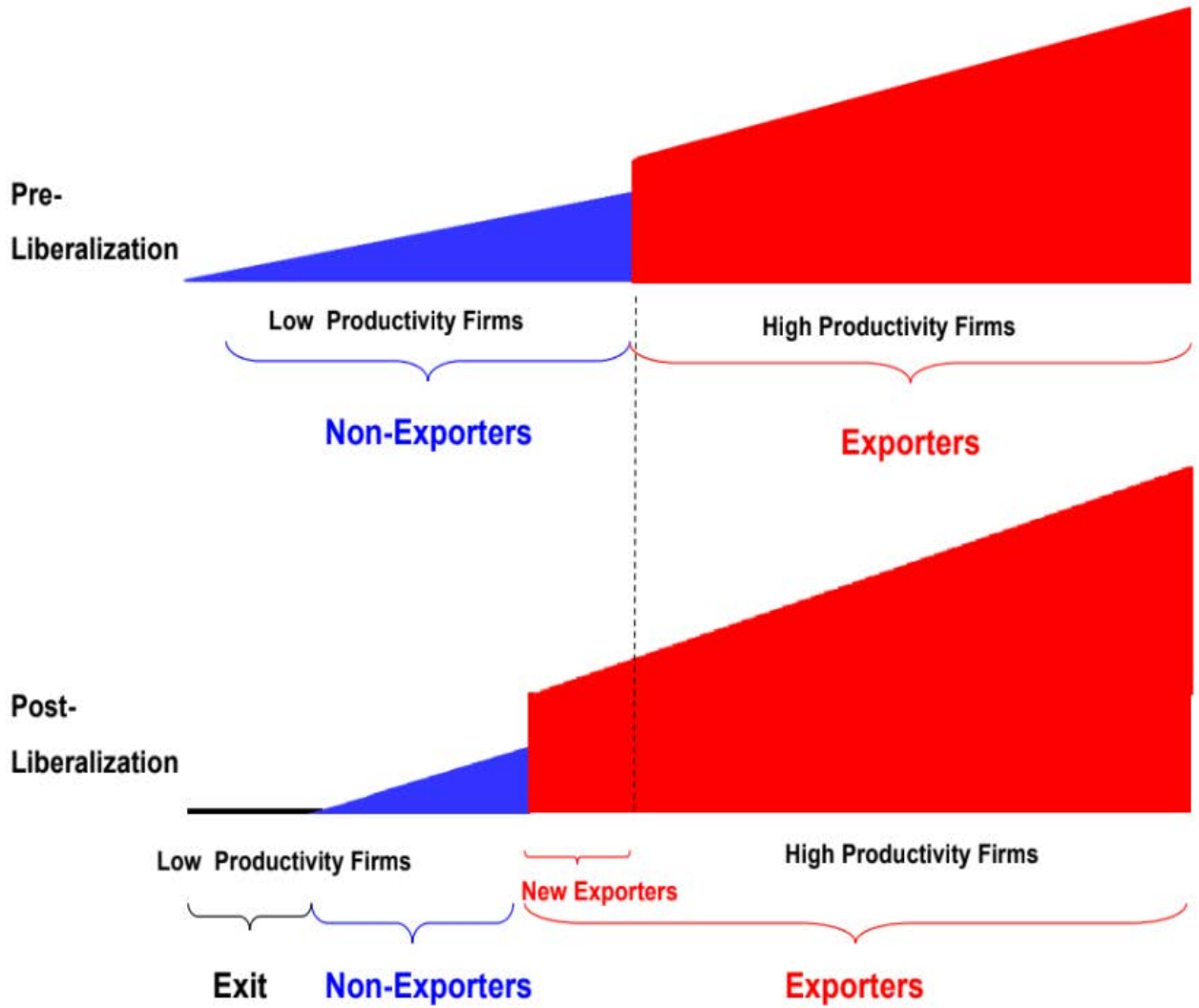
Note: Dependent variable, log of exports from country i to country j in sector h in 1997. All regressions include sector dummies, origin country and destination country dummies. Observations are clustered within country pairs. Robust standard errors are given in parentheses. Significant at the 1% (***), 5%(**), 10% level (*). Source: 1997 bilateral trade flows, Feenstra (2000); elasticities of substition, Broda and Weinstein (2004), 1980-1997 estimates; data are aggregated at the 3-digit SITC level; countries with a GDP/capita lower than $3000 (in PPP) or a population smaller than 1 million have been ignored.

Table 2: Firm heterogeneity distorts gravity.

Variable	(1)	(2)	(3)	(4)	(5)
$\ln(\text{Distance}_{ij})$	-.9	-.8			-.7
	(.04)***	(.04)***			(.04)***
$\frac{\widehat{\gamma_h}}{\sigma_h - 1} \times \ln(\text{Distance}_{ij})$		-.09			-.09
		(.002)***			(.003)***
Language_{ij}	.3		1.6		-.4
	(.1)***		(.2)***		(.02)**
$\frac{\widehat{\gamma_h}}{\sigma_h - 1} \times \text{Language}_{ij}$			-.4		.4
			(.05)***		(.05)***
Border_{ij}	.8			3.9	1.4
	(.02)***			(.3)***	(.3)***
$\frac{\widehat{\gamma_h}}{\sigma_h - 1} \times \text{Border}_{ij}$				-.7	-.3
				(.008)***	(.08)*
R^2	30%	31%	23%	25%	32%
Number of obs.	65,687	65,687	65,687	65,687	65,687

Note: Dependent variable, log of exports from country i to country j in sector h in 1996. All regressions include sector dummies, origin country and destination country dummies. Observations are clustered within country pairs. Robust standard errors are given in parentheses. Significant at the 1% (***), 5%(**), 10% level (*). Source: 1996 bilateral trade flows, Feenstra (2000); firm heterogeneity, Compustat, rank-size scaling coefficient of sales in 1996; data are aggregated over 35 BEA sectors; countries with a GDP/capita lower than $3000 (in PPP) or a population smaller than 1 million have been ignored.


Low Productivity Firms
High Productivity Firms
Non-Exporters
Exporters

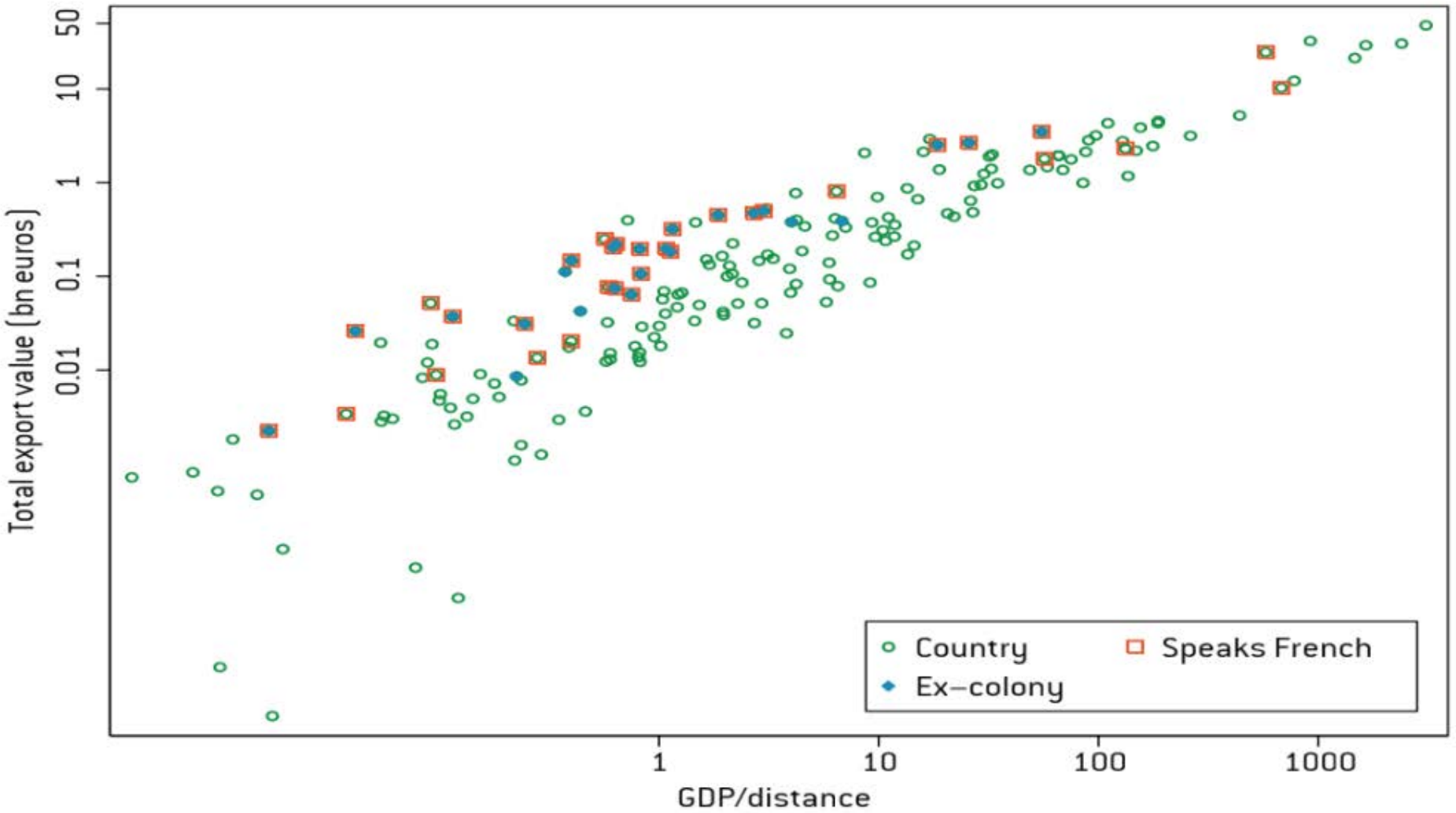

Pre-
Liberalization
Low Productivity Firms
High Productivity Firms
Non-Exporters
Exporters
Post-
Liberalization
Low Productivity Firms
New Exporters
High Productivity Firms
Exit
Non-Exporters
Exporters

Estimates of effects of US-CFTA on Canadian manufacturing productivity:

Source	Productivity Increase
Growth of most productive plants	4.1%
Contraction & exit of least productive plants	4.3%
Incumbent exporters' investments	1.4%
New exporters' investments	3.5%

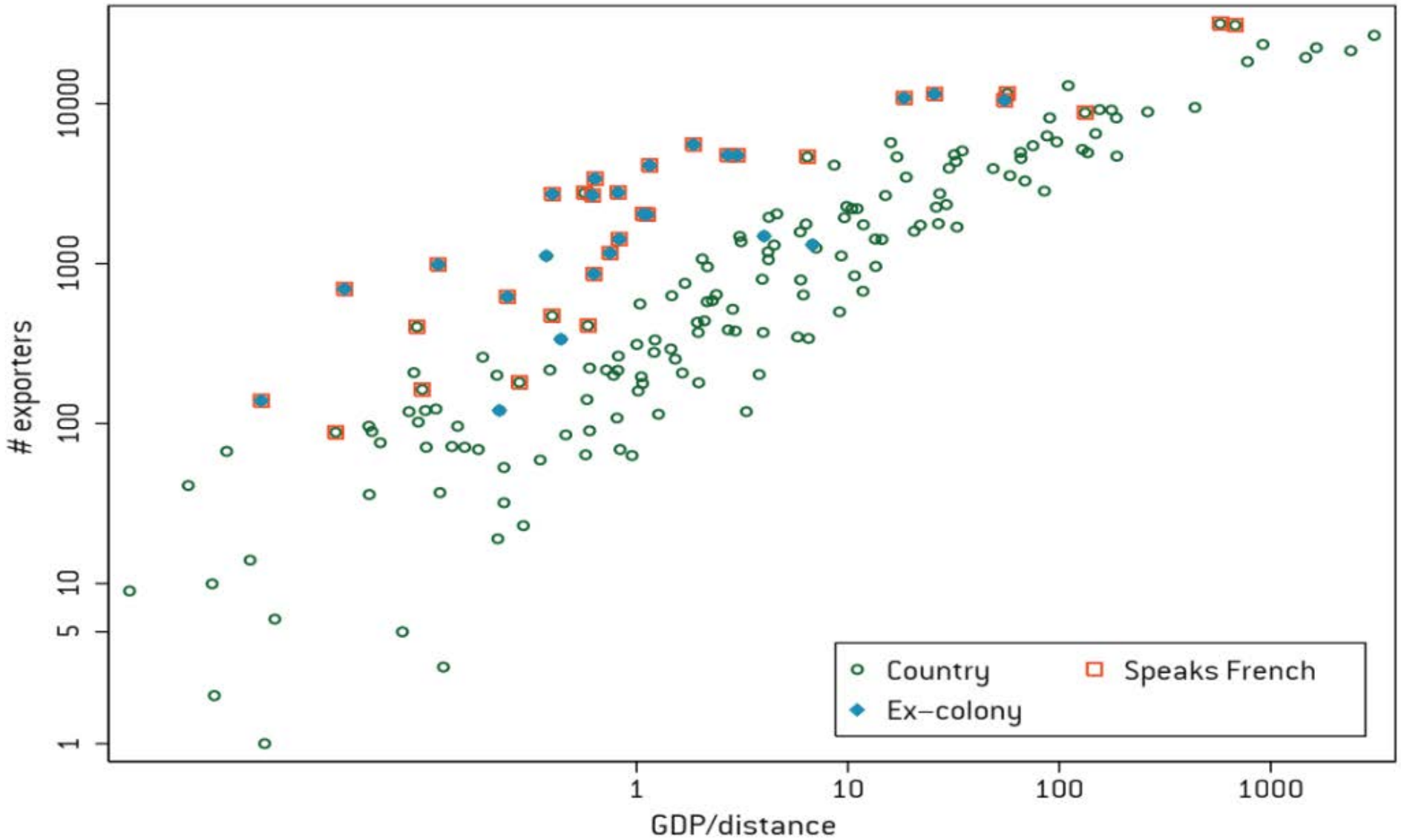
Sources: Trefler (2004) and Lileeva and Trefler (2010)

Figure 16: The forces of gravity for France in 2003



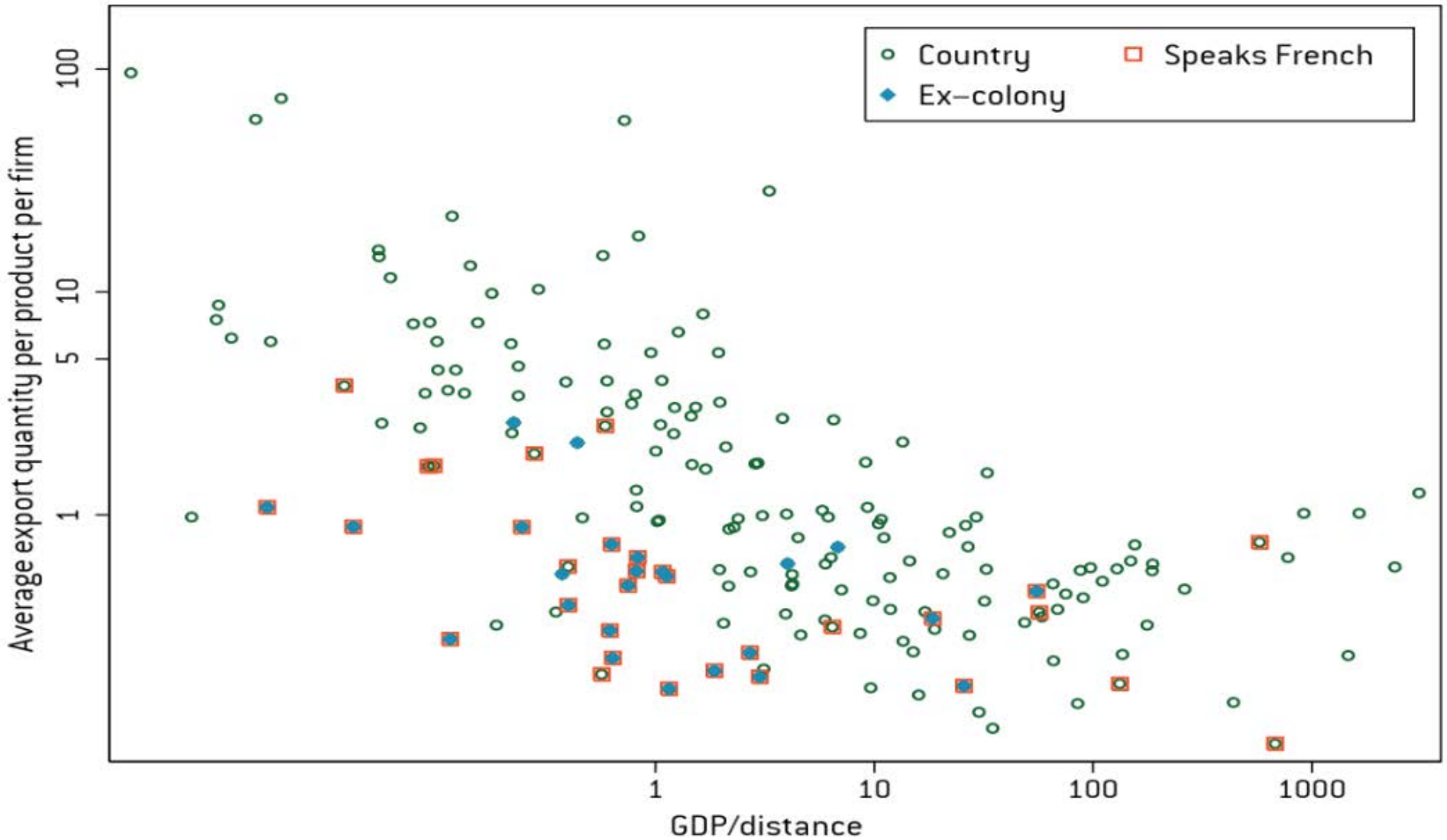
Source: Mayer and Ottaviano (2007)

Figure 17: The extensive margin



Source: Mayer and Ottaviano (2007)

Figure 18: The intensive margin



Source: Mayer and Ottaviano (2007)

Empirical Gravity Estimation Results

	Traditional Gravity	**Structural Gravity**	
Bilateral Resistance Variable	Impact on Volume of Trade	Impact on Trade Volume Per Exporter **(Intensive Margin)**	Impact on Probability of Trade **(Extensive Margin)**
Distance (1% increase)	-1.17%	-0.81%	-0.21%
Language	14.70%	-3.00%	10.10%
FTA	97.60%	12.40%	34.30%

(116 countries)

Source: Helpman, Melitz, Rubenstein (2008)

General Equilibrium Methodology

- GTAP – E a energy environment variant of the General Equilibrium Model
- We have used the GTAP-E with 10^{th} version of database and the data year is 2014 for simulation. The main feature of GTAP-E model is to evaluate the impact of alternative climate change policies among other policies like trade, industrial, freer capital flows and human capital formation on economic variables and carbon emissions, among others.

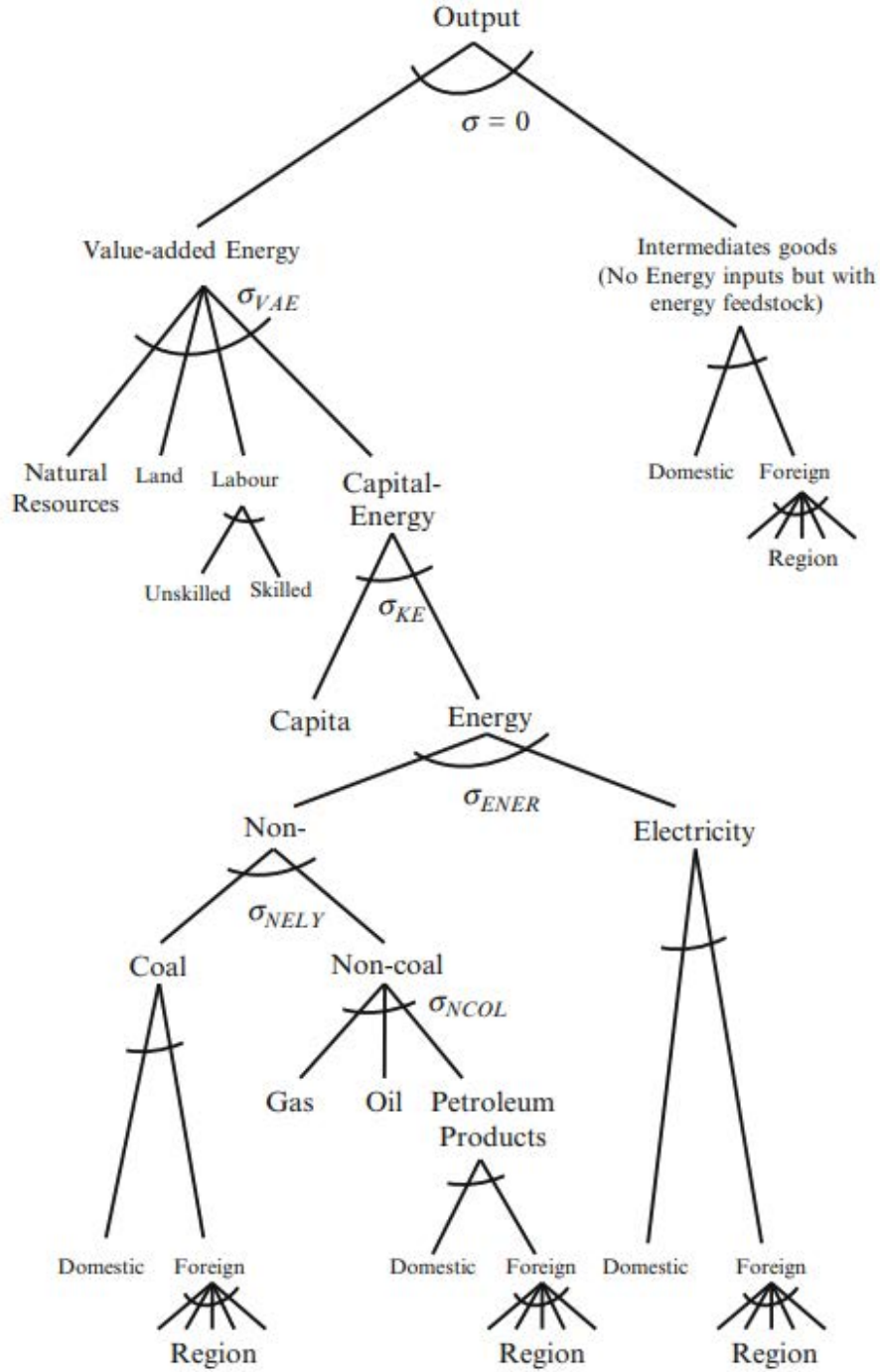
Introduction

- GTAP E model is a computable general equilibrium model of world economy.
- The standard GTAP Model of Center for Global Trade Analysis, Purdue University, Indiana, United States has revamped to form a CGE model containing energy and environmental modeling
- It was revised by McDougall and Golub 2007.
- GTAP-E with 10^{th} version of database has the data year as 2014 for simulation.
- The main feature of GTAP-E model is to evaluate the impact of alternative climate change policies on economic and carbon emissions also.

- According to the Burniaux and Truong 2002,
  - GTAP-E allows for inter-fuel and inter-factor substitution in the production structure of firms and in the consumption behavior of private households and the government sector. Apart from standard macroeconomic results, GTAP-E captures the effects arising from changes in energy-environmental policy strategies, both in terms of economic and environmental indicators.
  - Since this model is specifically designed to be used in the context of greenhouse gases (GHG) mitigation policies which also includes modified treatment of energy demand energy-capital and inter-fuel substitution, carbon dioxide accounting, taxation and emission trading, The major prospective feature of the GTAP-E in existing debate on climate change is illustrated by some illustrative simulations of the implementation of the Kyoto Protocol.
- According to the Antimiani et al 2012,
  - GTAP-E represents a top-down approach of energy policy simulation because it estimates the demand of energy inputs in terms of sectoral demand producing detailed macroeconomic projections.
  - *The main change in the amended GTAP to GTAP-E is the inclusion of the possibility of energy input substitution in production and consumption,* allowing for a more detailed description of substitution possibilities in different energy sources.
  - GTAP E model has incorporated the energy substitution, both in the production and consumption structure. The important issue of capital-energy substitutability vs. complementarily is also explicitly considered.

Production Structure

- Antimiani et al 2012 states that GTAP-E model incorporates energy in the value-added nest in two different steps.
  - First, energy commodities are separated into 'electricity' and 'non-electricity' groups, where a substitution elasticity (σ_{ENER}) operates. The following nest separates nonelectric into coal and non-coal with a specific substitution elasticity (σ_{NELY}) and non-coal into gas, oil, and oil-refined products, with a specific substitution elasticity (σ_{NCOL}).
  - Secondly, energy composite is combined with capital to produce energy-capital composite to be incorporated in the value-added nest. This production structure can be further enriched to include biofuel production (Taheripour et al. 2007) or clean energy technologies as in the ICES model (Bosello et al. 2011).
- According to this approach, energy inputs are part of the endowment commodities owned by producers. Capital and energy use mainly depends on the model parameters (elasticity values) and the policy simulated
- GTAP-E model incorporates energy directly in the value-added nest as compared to the standard GTAP model which energy inputs are treated as intermediate inputs (outside the value-added nest).
- In the GTAP-E case, energy inputs are combined with capital to produce an energy-capital composite; the latter is combined with other primary inputs in a value-added-energy nest using a CES function.


Output
σ = 0
Value-added Energy
σVAE
Intermediates goods
(No Energy inputs but with
energy feedstock)
Natural
Resources
Land
Labour
Capital-
Energy
Domestic
Foreign
Region
Unskilled
Skilled
σKE
Capita
Energy
σENER
Non-
Electricity
σNELY
Coal
Non-coal
σNCOL
Gas
Oil
Petroleum
Products
Domestic
Foreign
Region
Domestic
Foreign
Region
Domestic
Foreign
Region

Consumption Structure

- In consumption, GTAP-E modifies both private and government consumption whereas in standard GTAP model, private and government consumption are separated from private savings.
- Government consumption has a Cobb-Douglas structure (with a substitution elasticity equal to one), where energy commodities are separated from nonenergy commodities by a nested-CES structure.
- Household private consumption follows the standard GTAP model, using the constant-difference-of-elasticity (CDE) functional form previously described, but in the second-level nest, the GTAP-E model further specifies the energy composite using a CES functional form.
- A further significant change in the consumption structure is the possibility of adding carbon tax to private expenditure, as well as to public (government) expenditure, for goods that emit carbon dioxide when used.

- **Lee 2002**

They follow the Tier 1 method as suggested in the revised 1996 IPCC Guidelines (IPCC/OECD/IEA, 1997) to estimate CO2 emissions, based on the GTAP energy volume data. The formula to calculate CO2 emissions is as follows:

$$CO2_{isjr} = \left(FC_{isjr} \times CC_i \times (1 - CST_{ijr}) \times EF_i \times FOC_i \times \left(\frac{44}{12}\right)\right)/1000,$$

$$i \in EGY\_COMM, s \in SRC, j \in ALLSEC, r \in REG. \quad (1)$$

Set EGY_COMM contains six energy commodities by GTAP classification: coal, crude oil, natural gas, petroleum products, electricity, and gas;
set SRC refers to two sources of commodities: domestically-produced and imports;
set ALLSECT contains all producers and households; and
set REG contains all 66 regions of GTAP version 6 data base classification.

Coefficients are defined as follows:
$CO2_{isjr}$: CO_2 emissions (Gg) from energy commodity i of source s used by sector j of region r;
FC_{isjr}: fuel consumption (1000 toe) of energy commodity i of source s by sector j of region r;
CC_i: conversion coefficient (TJ/1000 toe) of energy commodity i;
CST_{ijr}: ratio of carbon stored of energy commodity i used by sector j of region r;
EF_i: emission factor (tones Carbon/TJ) of energy commodity i; and
FOC_i: fraction of carbon oxidized of energy commodity i.
(TJ: Tera Joule; Gg: Giga-gram; 1 Gg = 10^3 tonne)

Experimental Design

- The present study analyses India's gains and losses in three experimental scenarios:
- First scenario is when India bilaterally liberalizes with the RCEP nations on one to one basis.

✓This bilateral liberalization includes removal of bilateral tariff levels to zero, reduction in NTB levels leading to harmonization of standards and raising of productivity of the level of 2 per cent (assumed) and freer capital flows leading to a productivity improvement of 2 per cent, carbon taxation of the level 2 per cent and improvement in productivity of the skilled labor along with the promotion of transport and communication sector under the aegis of the industrial policies adopted by the entire region. The 2 per cent technological improvement in consonance with the study done by Barro and Sala-I-Martin (1995).

- Second scenario is the one in which India becomes part of comprehensive treaty and India bilaterally liberalizes with all the RCEP nations along with the other RCEP nations also bilaterally liberalizing among themselves.

✓This higher level of integration additionally includes whole gamut of policies ranging from trade and capital liberalization, reduction in NTBs, making concentrated efforts to improve productivity of skilled labor in the region and imposing carbon taxation to address climate change and adoption of industrial policy for promoting transport and communications.

- In the third scenario, we evaluate the RCEP in its present form.

Scenario I, II, II: EV, VGDP, Carbon Emissions and Trade Balance

Scenario I: When India Bilaterally Liberalizes with RCEP Nations					Scenario II: When India becomes Part of Comprehensive Trade Deal				Scenario III: RCEP in Present Form and its Impact on India and ROW			
Country	EV	VGDP	Carbon Emissions	Trade Balance	EV	VGDP	Carbon Emissions	Trade Balance	EV	VGDP	Carbon Emissions	Trade Balance
USA	-1716.4	-0.28	-0.08	-56459	-15637	-0.92	-0.15	35283.9	-12846	-0.81	-0.13	30401.98
EU27	-4969	-0.31	-0.08	11360.7	-18569	-0.81	-0.16	29384.3	-14819	-0.7	-0.15	25594.03
EEFSU	1748.41	-0.1	-0.04	11325.9	-645.42	-0.58	-0.06	2090.49	-1083.6	-0.52	-0.04	1757.41
JPN	78811.7	2.13	1.15	-14230	119176	5.06	3.96	-41482	118966	5	3.93	-41878.71
N-ZEALAND	3630.46	1.93	0.36	-260.27	5339.16	4.13	0.43	-927.7	5354.13	4.14	0.46	-940.52
AUSTRALIA	24975.4	2.14	0.07	427.24	34591.3	3.74	-0.59	-7681.1	33891.9	3.55	-0.62	-7083.7
EEx	3441.84	-0.13	-0.12	24859.1	254.81	-0.55	-0.16	5533.45	152.4	-0.47	-0.09	4834.42
CHN	158103	1.79	-1.49	59395.6	195918	2.32	-1.69	-8845.4	192886	2.25	-1.81	-5888.68
IND	34795	1.56	0.06	-13597	25074.4	0.17	-0.15	1523.52	-2376.9	-0.73	-0.05	3562.48
ROW	-1073.4	-0.25	-0.03	-18445	-14702	-0.87	-0.01	20142	-12224	-0.76	0	17723.9
ASEAN10	51257.2	2.99	-0.41	7.6	60473.5	2.7	-0.5	-8307.6	50606.3	1.7	-0.33	-5818.91
KOREA	23386.6	1.7	0.6	-4494.9	43037.9	4.5	3.32	-26802	39096.6	4.25	3.27	-22255.43

Source: Author's own simulations using GTAP –E

Scenario I: Sectoral Growth

Scenario I: When India Bilaterally Liberalizes with RCEP Nations												
Qo	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	0	0	0	0	0	0	0	0	0	0	0	0
UnSkLab	0	0	0	0	0	0	0	0	0	0	0	0
SkLab	0	0	0	2	2	2	0	2	2	0	2	2
Capital	0	0	0	2	2	2	0	2	2	0	2	2
NatRes	0	0	0	0	0	0	0	0	0	0	0	0
Agr	0.1	0.31	-0.02	0.96	1.17	1.29	0.14	0.74	2.98	0.22	0.69	-10.69
Coal	0.18	0.3	0.75	-3.06	5.43	2.79	0.43	-1.88	-4.86	0.5	1.7	-3.39
Oil	0.19	0.26	0.18	0.36	0.45	0.21	0.28	0.18	0.81	0.29	-0.26	-0.09
Gas	0.45	0.6	0.36	0.66	1.26	-0.22	0.43	-9.37	1.26	0.51	-2.14	-12.52
Oil_pcts	-0.15	-0.15	-0.11	1.36	0.32	0.59	-0.13	0.86	1.78	-0.11	0.43	1.07
Electricity	0.01	0.08	-0.01	1.61	2.03	1.2	-0.08	0.62	1.87	0.01	1.26	1.02
En_Int_ind	0.25	0.25	-0.09	1.22	1.82	1.27	-0.18	1.2	0.81	0.17	0.01	1.43
Oth_ind_ser	0.01	0.03	-0.01	1.82	1.81	1.7	-0.01	1.36	1.16	0.02	2.16	1.96
Transport	-0.11	-0.07	-0.11	0.68	-0.26	-0.35	-0.21	-0.3	1.13	-0.11	-0.51	0.17
Communicatio	-0.63	-0.71	-0.62	-0.18	0.15	-0.41	-1.04	1.84	1.86	-1.11	0.23	0.28
CGDS	-0.09	-0.19	-0.03	3.34	2.75	2.73	-0.04	1.96	3.05	-0.12	2.79	4.65

Source: Author's own simulations using GTAP –E

Scenario II: Sectoral Growth

Scenario II: When India becomes Part of Comprehensive Trade Deal												
Qo	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	0	0	0	0	0	0	0	0	0	0	0	0
UnSkLab	0	0	0	0	0	0	0	0	0	0	0	0
SkLab	0	0	0	2	2	2	0	2	2	0	2	2
Capital	0	0	0	2	2	2	0	2	2	0	2	2
NatRes	0	0	0	0	0	0	0	0	0	0	0	0
Agr	0.14	0.34	-0.07	-1.64	0.97	3.85	0.11	0.96	2.41	0.26	0.66	-15.02
Coal	0.49	0.63	0.91	-8.94	1.66	1.39	1.14	-2.5	-3.77	1.53	2.64	-6.43
Oil	0.4	0.41	0.31	-1.78	-1.18	-0.7	0.43	-0.47	1.33	0.54	-0.28	-2.28
Gas	0.89	0.72	0.25	-4.02	-0.52	-0.74	0.27	-11.11	2.5	0.89	-0.51	-0.72
Oil_pcts	-0.27	-0.29	-0.22	4.4	-0.94	0.25	-0.38	0.98	1.62	-0.2	-0.34	5.06
Electricity	0	0.07	-0.05	2.79	1.34	0.5	-0.15	0.49	1.63	-0.06	1.12	2.33
En_Int_ind	0.62	0.35	-0.19	1.86	-1.87	-1.58	-0.35	0.59	1.16	0.22	-0.07	2.81
Oth_ind_ser	-0.03	0.01	-0.05	1.86	2.35	2.34	-0.05	1.67	1.05	0	2.1	1.82
Transport	-0.07	-0.07	0.07	3.73	-3.39	-3.31	-0.05	-1.07	1.89	0.14	-1.24	1.15
Communicatio	-0.48	-0.61	-0.53	-1.71	-1.55	-2.08	-0.74	1.51	2.29	-1.62	1.22	1.94
CGDS	-0.92	-0.85	-0.44	6.6	4.9	4.89	-0.48	2.85	1.77	-0.82	4.07	10.01

Source: Author's own simulations using GTAP –E

Scenario III: Sectoral Growth

Scenario III: RCEP in Present Form and its Impact on India and ROW												
Qo	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	0	0	0	0	0	0	0	0	0	0	0	0
UnSkLab	0	0	0	0	0	0	0	0	0	0	0	0
SkLab	0	0	0	2	2	2	0	2	0	0	2	2
Capital	0	0	0	2	2	2	0	2	0	0	2	2
NatRes	0	0	0	0	0	0	0	0	0	0	0	0
Agr	0.25	0.3	-0.01	-1.46	1.12	3.99	0.09	1.33	0.09	0.28	0.55	-7.17
Coal	0.44	0.5	0.58	-9.51	-2.05	-0.02	0.79	-2.71	1.02	2.03	2.56	-6.72
Oil	0.34	0.33	0.25	-1.75	-1.24	-0.59	0.33	-0.44	0.39	0.44	0.38	-1.98
Gas	0.72	0.54	0.12	-3.83	-0.59	-0.33	0.06	-10.89	0.58	0.7	2.16	-0.62
Oil_pcts	-0.22	-0.25	-0.18	4.39	-0.88	0.23	-0.22	0.82	-0.23	-0.12	-0.02	4.96
Electricity	0	0.08	-0.03	2.79	1.32	0.44	-0.08	0.41	-0.01	0	1.04	2.37
En_Int_ind	0.57	0.4	-0.1	1.67	-2.02	-1.73	-0.07	0.37	0.15	0.4	0.98	2.42
Oth_ind_ser	-0.02	0.03	-0.03	1.88	2.36	2.38	-0.02	1.67	-0.05	0.02	1.47	1.58
Transport	-0.11	-0.15	0.03	3.76	-3.37	-3.13	-0.09	-1.1	-0.11	0.08	-0.4	1.47
Communicatio	-0.63	-0.74	-0.61	-1.83	-1.6	-2.02	-0.97	1.57	-1.01	-1.93	3.85	2.68
CGDS	-0.79	-0.74	-0.39	6.65	4.93	4.69	-0.42	2.77	-0.52	-0.71	3.38	8.77

Source: Author's own simulations using GTAP –E

Scenario I: Welfare Decomposition

WELFARE	1 co2trd	2 alloc_A1	3 endw_B1	4 tech_C1	6 tot_E1	7 IS_F1	Total
1 USA	0	-633	0	0	-534	-549	-1716
2 EU27	0	-2206	0	0	-2832	65.1	-4973
3 EEFSU	0	637	0	0	1093	18.2	1748
4 JPN	0	19830	37748	22198	-907	-56.7	78812
5 NEWZEALAND	0	952	1871	803	4.42	-0.606	3630
6 AUSTRALIA	0	6279	11732	5803	1113	47.1	24975
7 EEx	0	70.2	0	0	3300	71.7	3442
8 CHN	0	30160	61989	69558	-5114	1510	158103
9 IND	0.001	8331	18682	10309	-1449	-1155	34717
10 ROW	0	-984	0	0	51.7	-142	-1074
11 ASEAN10	0	6583	23735	14490	6469	-18.4	51258
12 KOREA	0	4722	10967	8705	-1211	207	23390
Total	0.001	73741	166724	131866	-15.7	-2.53	372312

Source: Author's own simulations using GTAP –E

Scenario II: Welfare Decomposition

WELFARE	1 co2trd	2 alloc_A1	3 endw_B1	4 tech_C1	6 tot_E1	7 IS_F1	Total
1 USA	0	-2521	0	0	-10487	-2629	-15636
2 EU27	0	-7349	0	0	-12057	834	-18572
3 EEFSU	0	-698	0	0	-454	507	-646
4 JPN	0.043	29592	38025	31327	19511	722	119177
5 NEWZEALAND	0	1202	1882	1334	905	16.6	5339
6 AUSTRALIA	-0.002	8895	11799	8660	5277	-39.5	34591
7 EEx	0	-1166	0	0	344	1077	255
8 CHN	0.024	46089	62282	86133	84.5	1332	195920
9 IND	-0.023	7913	18625	4210	-4492	-1234	25022
10 ROW	0	-4701	0	0	-9616	-381	-14699
11 ASEAN10	0.022	7924	23863	25560	2851	276	60474
12 KOREA	0	10168	11151	14533	7694	-503	43043
Total	0.064	95347	167627	171756	-441	-20.5	434269

Source: Author's own simulations using GTAP –E

Scenario III: Welfare Decomposition

WELFARE	1 co2trd	2 alloc_A1	3 endw_B1	4 tech_C1	6 tot_E1	7 IS_F1	Total
1 USA	0	-2061	0	0	-8549	-2236	-12846
2 EU27	0	-6096	0	0	-9259	536	-14818
3 EEFSU	0	-1076	0	0	-341	334	-1083
4 JPN	0.004	29478	38023	31137	19676	651	118966
5 NEWZEALAND	0	1202	1882	1321	937	12.1	5354
6 AUSTRALIA	0	8732	11794	8565	4860	-60.2	33892
7 EEx	0	-1009	0	0	460	701	152
8 CHN	-0.003	44667	62259	85630	-582	906	192881
9 IND	0	-639	0	0	-1570	-168	-2377
10 ROW	0	-3998	0	0	-7813	-414	-12225
11 ASEAN10	-0.002	6998	23809	24811	-5277	264	50605
12 KOREA	0	7118	11123	14322	7064	-539	39087
Total	0	83317	148891	165786	-395	-11.1	397588

Source: Author's own simulations using GTAP –E

Scenario I: Real Returns to the Factors of Production

Scenario I: When India Bilaterally Liberalizes with RCEP Nations												
Pfactreal	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	0.53	1.45	-0.12	5.79	5.99	6.96	0.62	5.04	20.15	1.05	6.12	-49.42
UnSkLab	-0.03	-0.02	-0.01	1.57	1.61	1.46	-0.02	1.24	1.51	-0.04	1.8	2.52
SkLab	-0.01	-0.03	-0.01	0	-0.05	-0.02	-0.03	-0.33	-0.53	-0.05	0.23	1.31
Capital	-0.01	-0.05	-0.01	-0.01	-0.07	-0.12	-0.01	-0.55	-0.67	-0.05	-0.05	1.12
NatRes	0.68	0.85	0.64	5.14	3.69	1.6	0.9	1.96	6.65	0.91	0.8	-36.41

Source: Author's own simulations using GTAP –E

Scenario II: Real Returns to the Factors of Production

Scenario II: When India becomes Part of Comprehensive Trade Deal												
Pfactreal	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	0.66	1.52	-0.41	-6.72	5.92	22.09	0.4	6.86	15.96	1.14	6.66	-61.14
UnSkLab	-0.1	-0.08	-0.09	2.56	2.67	2.44	-0.11	1.72	1.29	-0.17	2.54	4.78
SkLab	-0.11	-0.1	-0.1	1.03	0.93	1.02	-0.11	0.24	-0.76	-0.19	0.98	3.6
Capital	-0.1	-0.12	-0.09	1.19	0.97	0.66	-0.07	-0.01	-0.92	-0.19	0.8	3.85
NatRes	1.38	1.09	0.9	-6.46	1.21	0.69	1.25	2.03	5.94	1.53	2.11	-45.58

Source: Author's own simulations using GTAP –E

Scenario III: Real Returns to the Factors of Production

pfactreal	USA	EU27	EEFSU	JPN	NEWZEALAND	AUSTRALIA	EEx	CHN	IND	ROW	ASEAN10	KOREA
Land	1.26	1.35	-0.12	-5.86	6.63	22.85	0.37	9.02	0.44	1.29	5.42	-36.17
UnSkLab	-0.09	-0.06	-0.07	2.56	2.67	2.41	-0.08	1.67	-0.14	-0.15	2.01	4.14
SkLab	-0.09	-0.07	-0.08	1.03	0.93	0.99	-0.08	0.17	-0.17	-0.16	0.45	2.79
Capital	-0.08	-0.1	-0.07	1.18	0.97	0.58	-0.05	-0.1	-0.19	-0.17	0.4	3.07
NatRes	1.17	0.92	0.7	-5.78	1.16	0.42	0.94	2.63	0.59	1.32	3.12	-27

Source: Author's own simulations using GTAP –E

Conclusions

- This study indicates that India gains more in terms of welfare and VGDP growth when India bilaterally liberalizes trade with the RCEP trading nations as compared to the scenario when India joins the RCEP trade deal either in the nascent form or when it has a comprehensive trade deal with its expanding members.
- India needs capital flows from Japan, Korea, Australia, Singapore and other RCEP nations and Indian capital is also needed across the ASEAN countries. India is also connected to the RCEP nations through enhanced trade in services, transport and communications and GVCs.
- Therefore, greater trade in agriculture, light manufacturing and meat and meat products will bring dividends to India besides enhancing agricultural productivity in the country. Trade liberalization with carbon taxations in the RCEP expanding region may tackle climate change partly by reducing carbon emissions but compromising our growth rates and consumption marginally.

Theoretical Understanding: International Trade Agreements and Single Market Partial Equilibrium Analysis

- Trade Creation and Trade Diversion
  - When trade agreements are made, the increased trade can be of two types.
  1. **Trade creation**
     - Gain in consumer surplus for importing country due to lower prices.
     - Gain in producer surplus for exporting country due to increased sales.

     welfare gains for both countries.

2. **Trade diversion** occurs when one member country imports a product from another member country that it was previously importing from an outside country.

- Trade is taken away from one country and moved to another country.

- This is not always the most efficient move since the former country might have been producing at lower costs, but due to changes in tariffs, it ends up cheaper to import from the member country.

Equations for Trade Creation and Trade Diversion

- $P^{d}_{g,c} = P^{w}_{g,c}(1+t_{g,c})$
- $t_{g,c} = t_{g}^{MFN}(1-\theta_{g,c})$
- $\theta_{g,c} = 1-\frac{t_{g,c}}{t^{MFN}}$
- Total trade effect = Quantity effect + price effect

- **Trade creation**

- Trade creation is defined as the direct increase in imports following a reduction on the tariff imposed on good *g* from country *c*. To obtain this, SMART uses the definition of price elasticity of import demand:
- $\mathcal{E}_{g,c} = \frac{dm_{g,c}/m_{g,c}}{dp^{d}{}_{g,c}/p^{d}{}_{g,c}}$

- Solving for *dm g ,c* we obtain the trade creation (*TC g ,c*) evaluated at world prices and associated with the tariff reduction on good *g*

  when imported from country *c*:

- $TC_{g,c} = P^{w}{}_{g,c} dm_{g,c} = P^{w}{}_{g,c} \mathcal{E}_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c})} = \mathcal{E}_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c})}$

- If the tariff reduction on good *g* from country *c* is a preferential tariff reduction (i.e., it does not apply to other countries, *c* , then imports from country), then imports of good *g* from country *c* are further going to increase due to the substitution away from imports of good *g* from other countries that becomes relatively more expensive. This is the definition of trade diversion in the SMART model.

- $TD_{g,c} = dm_{g,c} = \frac{m_{g,\neq c}\, m_{g,c}}{m_{g,\neq c} + m_{g,c}} \frac{dt_{g,c}}{(1+t_{g,c})} \sigma_{g,c,\neq c}$

- Where $\sigma_{g,c,\neq c}$ is the substitution elasticity .

Price Effect: This is a third component reported in the Trade Total effect and occurs only with a finite export supply elasticity assumption

Revenue effect = tariff rate * value of imports

A tariff revenue change = final tariff * final import value - initial tariff * initial import value.

Welfare effect =CS +PS + Govt revenue

SMART Model

Tariff Revenue Effect

In the SMART model, change in tariff revenue can be easily calculated using the following formula:

$$dTR_i = TR_i^1 - TR_i^0 \quad \dots (3.24)$$

$$TR_i^0 = \sum_k t_{k,j}^0 \left(p_{k,j}^w m_{k,j}^0\right) \quad \dots (3.24A)$$

$$TR_i^1 = \sum_k t_{k,j}^1 \left(p_{k,j}^w m_{k,j}^1\right) \quad \dots (3.24B)$$

Where, TR_i^0 and TR_i^1 are the total tariff revenues incurred by the importing country (i) before and after the change in trade policy; $t_{k,j}^0$ and $t_{k,j}^1$ are the tariff rates before and after trade policy shock; and $\left(p_{k,j}^w m_{k,j}^0\right)$ and $\left(p_{k,j}^w m_{k,j}^1\right)$ are the value of imports before and after the trade policy change at world prices.

Welfare Effect

The net welfare effect is estimated by multiplying the change in imports with the average between the incidence of tariff barriers before and after their change (Laird and Yeats, 1986).

$$w_{k,i} = \frac{\left[dm_{k,j} \times \frac{(t_{k,j}^0 + t_{k,j}^1)}{2}\right]}{100} \quad \dots (3.25)$$

Generally, welfare effect is defined as the sum of producer and consumer surplus in the economy due to the adoption of tariff reduction policy. With the infinite export supply elasticity, the whole welfare effect is composed of consumer surplus only, which arises because of decrease in price of imported product with the reduction of tariffs on that product. However, with less than infinite export supply elasticity, one can calculate the producer surplus existed in the exporting country due to increment in the world price of imports due to increment in demand for imported product.

Ukraine Russia War and India: A General Equilibrium Analysis

- How does the war between Ukraine and Russia affects us? We use the General equilibrium model GTAP 10 to include all simulations to restrict trade, capital, natural resource flows to Russia and Ukraine including displacement of skilled and unskilled labour from Ukraine to EU 28. The simulations include the impact of restricted transport and communications, restricted trade in services links and restricted flow of natural resource and extraction products between India and Russia due to the impact of the war and the sanctions imposed by the west on Russia.Indias welfare becomes negative 6000 million us dollars with negative .83 vgdp growth rates. The sector which gets impacted the most negatively in India are the extraction sector and public utilities like gas, water and construction along with domestic investments. Russian and Ukrainian economy also gets impacted drastically over the years with negative 4 percent growth rates. EU gains in terms of welfare and vgdp growth rates because of the displacement of labour from Ukraine. Oceania, MENA and SSA gains in terms of vgdp growth and welfare due to diversion of natural resource intensive trade from Russia to natural resource rich countries. India imports from Russia coal, oils, diamonds, newsprint, fertilizer, vegetable oil, asbestos among others. India exports to Russia telephones for cellular networks,medicaments, fish, tobacco, coffee, meat,fruits and grapes. Ukraine trade with Russia would be highly restricted as well. Ukraine exports to Russia ,aluminium oxide,iron ore, railway locomotives, uranium , coal , titanium ores among others. Russia exports to Ukraine include petroleum oil, coal, ammonia anhydrous, fuel elements like cartridges, fertilizers, medicaments, coke and semi coke, among others. India may have abstained from voting against Russia in the UN but geopolitical reality is pushing it towards the west. Severing transport and service links between India and Russia may be the fallout of the war and the sanctions. Sanctions ,however take a while to have its full impact. Surely oil prices have gone beyond 105 us dollars a barrel and gas availability has been restricted with substitution happening across countries. MENA, SSA , EU and Oceania are the major gainers of this imbroglio. EU only because of the displacement of labour both skilled and unskilled from Ukraine. Otherwise EU 28 also witnesses negative growth

Russian Sanctions

- The sanctions on Russia whether it is increase in tariff and non tariff barriers or embargo on extraction industries like fishing, coal, oil and gas exploration or barriers on trade in services and manufacturing has negative welfare and brings vgdp loss for the EU 28 and India. Russians will suffer the most in terms of vgdp loss exceeding negative 4.94 if tariff and non tariff barriers are raised in agriculture and allied activities including extraction with negative output oriented technological progress in light and heavy manufacturing. The vgdp loss is less of negative 4.34 percent if tariff and non tariff barriers are raised with negative output oriented technological progress in extraction . Then comes negative loss of vgdp reaching negative 3.93 if output oriented technological progress becomes negative in services, transport and communications and public utilities like electricity, gas manufacturing and distribution, water and electricity. Sanctions in agriculture and allied activities has the least impact on the Russian economy. Services sector sanctions though bring maximum welfare loss of 74 billion US dollars in Russia. If sanctions are imposed on all sectors Russian economy will suffer a loss of negative 7.35 percent with 113 billion US dollars as welfare loss. All trade policy instruments and embargo have differential impacts. MENA and SSA regions gain while EU 28 and India loose in terms of welfare and vgdp loss due to these developments. Sanctions seems to favour real returns to land and natural resource in Russia indicating that Russia will divert it's energy trade to South Asia, Oceania, MENA and Sub Saharan African countries. Unskilled labour, skilled labour and investments will suffer in Russia pulling down it's growth rates. We use GTAP 10 and GTAP Energy Environment variant of the General equilibrium models for our analysis.

The Economic Impact of Sanctions : A General Equilibrium Analysis with impacts on Carbon Emissions

- It is technological blockade in industry and services rather than sanctions on gas production , exports and distribution with tariff escalation on energy intensive industries and industry and services which brings negative vgdp growth in Russia at the level of nearly 3 percent in Russia. The trade gets diverted to land intensive and natural resource intensive products from Russia which improves upon its trade balance with the Rest of world putting pressure on its currency to appreciate than the expectation that the rouble will depreciate. We use energy environment variant of the General Equilibrium model GTAP E for our analysis. Any sanction on gas production , exports and technological blockade brings negative vgdp growth of 2.50 percent growth in Russia but a larger fall in welfare reaching negative 44 billion US dollars. Technological blockade with tariff escalation in coal, oil and petroleum in Russia surprisingly brings positive welfare growth in Russia with negative vgdp growth not exceeding 2 percent in Russia. Trade diversion is surely happening with India and EU27 gaining with sanctions according to GTAP E model if the sanctions are imposed in all sectors, agriculture, industry and services, energy intensive industries, coal, oil, petroleum, petroleum, electricity, among others. The Russian economy welfare and vgdp growth would be negative. Vgdp loss would be nearly 5 percent with comprehensive sanctions. All embargo and trade policy instruments have beggar by thy impacts. Some economies grow at the cost of Russian economy. Inter fuel substitution happens with sanctions but agriculture, land and natural resource real returns gains with sanctions in Russia. EU 27 gains maybe because of migration of Ukrainian skilled and unskilled labour because of the War.The carbon emissions growth rates become negative due to sanctions.

Covid Impact using General Equilibrium Modelling

- How did covid and covid lockdowns impact the Indian economy since 2020. We use GTAP 10 general equilibrium model to study the economy wide impact of various shocks that occurred due to covid and grand lockdown policies adopted in India. Simulations include negative technological spillover on the shipping industry, negative impact of disruptions in global value chains on value added processes, decline in endowments of skilled and unskilled labour due to covid fatalities, reduction in outputs of manufacturing industries and negative impacts on public works and transportation with positive impact on business services and communications. The covid fatalities also had negative impact on the production processes in India..Tourism were also impacted negatively. We find from our comprehensive simulations massive 8.90 fall in vgdp in India with welfare loss of 138 billion us dollars. Public utilities, domestic investments, transportation, light and heavy manufacturing saw massive fall in outputs and value added.Real returns to Skilled and unskilled labour and capital were impacted negatively the most. Land real returns were impacted negatively but an amount less than the other factors of production. Returns to Natural resource were impacted positively. Carbon emissions went down with rise in energy inputs like natural gas and energy intensive products in India due to covid. Financial package equivalent to 15 percent of our 200 lakh crore GDP and Ukrainian Russian war may have had differential impacts on vgdp and welfare in India.

CPTPP vs RCEP using General Equilibrium Modelling

- Should India align with the 15 nation's RCEP with which it has relatively higher 185 billion trade or and with 11 nations CPTPP with which it has lesser 70, billion trade in agriculture, industrial products and petroleum ? It will depend on India's engagement with the mega blocks who agree on having deeper integration clauses along with adoption of atmanirbhar policies in india promoting innovation in manufacturing and transport and communications and member states promoting global value chains in the region . We construct three simulation scenarios . First, when India seperately has deeper integration relations with RCEP and CPTPP in the form of tariff and non tariff liberalization, freer movement of capital, skilled labour and endowment enhancement of natural capital, with global value chains enhancing technological progress and output oriented technological progress in manufacturing and transport and communications. This is the best scenario for india irrespective of whether India joins CPTPP or RCEP, in terms of welfare hovering 110, billion US dollars to 117 billion US dollars with vgdp growth beyond 5 percent in all scenarios . Other scenarios of deeper integration clauses mentioned above with adoption of common industrial policies of having output oriented technological progress in manufacturing in all member nations and having free trade with either RCEP and CPTPP , brings relatively lower welfare and vgdp growth in india. CPTPP 7, common members of RCEP and CPTPP, comprising of Australia, New Zealand, Vietnam, Brunei, Singapore , Japan and Malaysia are impacted more or less same whether they are part of RCEP or CPTPP by deeper integration policies. CPTPP4, the other nations in eleven member alliance, comprising of Canada, Mexico, Peru and Chile and RCEP8 are impacted negatively when India aligns with RCEP and CPTPP respectively. All factors gain in this deeper integration alignment except real returns to natural capital. We have the highest average tariff imposed on CPTPP7 tuning to level of 22 percent while for RCEP8 nation's product we impose on an average 20 percent tariff rates. We protect our grains crops and processed food sectors the most with tariffs reaching 70 percent for edible oil, palm oil and dairy products being imported from the two mega blocks.

Engagements with China

- It is said if one wishes to look east it is inevitable that one would need to align with China. Why is it then all GTAP simulations show that India China, Pak China, ASEAN china or RCEP deal has negative welfare for India, Pakistan and ASEAN 10 respectively.China gains in all the alignments. This is happening despite all South Asian and east Asian countries including Oceania major imports come from China. Of course South Asia exports reach more to the west, east Asian countries are more linked in their exports and imports and investments with China. GVCs in South Asia can be linked to textile production where in inputs are provided by China. Maybe if one looks at tariff structure we may have some answers. Bangladesh highest tariff rates 165 percent, India 44 percent, Pakistan 65 percent, SL 29 percent, China 7 percent, Japan 5 percent, Indonesia 36 percent but all other ASEAN nations with average 25 percent.Meaning with reduction in tariffs in home country having relatively higher tariffs, consumers gain, producers loose, loss of government revenue, loss in returns to factors intensive in production of good whose tariff had come down, loss in terms of terms of trade and possibly trade balance , investment and savings and marginal net effect on GDPs. On the other hand tariff reduction in home country provides trade to partners and substantial improvement in GDP via trade and higher investments and savings. I think we need to invest outside in terms of telecommunications, ports, build roads and have physical connectivity and village development with investment in 4IR technology to shift comparative advantage in our favour. Strategic industrial policy may be the answer keeping that protectionism needs to be kept at check.

SAARC

- A comprehensive SAARC agreement between India and other South Asian countries can bring welfare gain of more than 187 billion us dollars and vgdp growth of more than 4,90 percent for other South Asian countries except India. We use GTAP 10 model to evaluate a comprehensive economic partnership between India and other South Asian countries and among other South Asian countries including tariff and non tariff Liberalization between and among South Asian partners and freer flow of capital and skilled labour mvement from India flowing into other South Asian countries with promotion of common industrial policy by focusing on manufacturing sector in the other South Asian countries. India witnesses welfare gain of more than 300 billion us dollars with more than 1.90 percent vgdp growth. The SAARC where in intra trade is mere 5 percent of its world trade bring more dividends to other South Asian countries with all sectors uniformly growing due to comprehensive agreement with India where in India plays a major rule in promoting skills, export of manufacturing and provisioning outward capital. The vgdp growth of India reaches more than 6 percent if in addition to comprehensive agreement ,we invite skilled labour from abroad and provide output oriented TFP growth of manufacturing sector of India. Industrial policy adoption with skilled labour enhancement helps India grow at record faster rates with comprehensive alignment with other South Asian countries.Political climate and geopolitical realities with geoeconomics should drive India to align more with its neighbours. India protects mostly processed food and grains and crops while other South Asian countries protect their manufacturing sector in terms of tariffs .We impose on an average 6 percent tariffs on products coming from other South Asian countries with extraction and grain crops being taxed at 13 percent with lowest tariffs of merely 2 percent on manufacturing exports from other South Asian countries. The other South Asian countries average tariffs on Indian products are 8.57 percent with extraction being taxed at 12.29 percent and textiles at 9.36 percent. Light and heavy manufacturing are taxed on an average at 7 percent by other South Asian countries. The other South Asian countries average tariffs among themselves are merely 8 percent on an average with relatively higher tariffs for textiles at 13.41 percent, heavy manufacturing at 9.79 percent and grains and crops at 8.07 percent.

Quality of Inputs and Input Oriented Technological Progress

- If we improve upon the quality of inputs in India by bringing in input augementing technological progress in capital, energy inputs like coal, crude oil, petroleum, natural gas and electricity, augement unskilled labour, skilled labour, land and natural resource in that serial order of inputs then the welfare and vgdp also grows in that order except for energy inputs where in introduction of technology in energy inputs bring in maximum vgdp growth of 1.05 percent in india with second highest welfare increase of 15 billion US dollars after capital augementing technological progress bringing in maximum welfare of 18 billion US dollars with nearly one percent vgdp growth. Input augementing technological progress in our profession is best understood as in with lesser inputs if we can produce the same output or with same inputs we can produce more. Surely like 4IR technologies it has impact on unemployment in the economy. These are results from the general equilibrium models like GTAP 10 and GTAP E by assuming two percent technology upgrading input policy. Unskilled labour augementing technological progress or training of workers bring in 11 billion US dollars welfare gain in India, the third highest, but vgdp growth of nearly 0.50 percent vgdp growth. Skilled labour biased technological progress, land biased and natural resource biased technological progress bring in lesser welfare and vgdp changes in relative sense. The latter is a surprising result we get from the GTAP E model simulation results. If we add in structural issue of unemployment in the simulation all our results of positive welfare and vgdp changes turn into negative figures. We then do one set of simulation results where in we bring in technological progress in all inputs together, that is, augement capital, energy, unskilled labour,skilled labour, land and natural resource by 2 percent together , the resultant welfare increase is 54 billion US dollars with more than 3 percent vgdp growth in India. The interesting part is that the unemployment situation gets resolved by introduction of input augementing technological progress in all inputs to an extend that vgdp and welfare have marginal increment despite the structural presence of unemployment. The real returns to factors especially land and natural resource witnesses a spike due to the introduction of input augementing technological progress. It is capital, energy and unskilled labour augementing technological progress which brings in maximum welfare and vgdp growth in India followed by skilled labour, land and then natural resource. What about other nations like China, US and Japan. We again find capital augementing technological progress contributing relatively more to welfare with figures much higher in comparison to India. However, our energy augementing technological progress bring in relatively the highest vgdp growth rates in comparison to the US and China.

India Oceania Trade agreements

- Any India Oceania nation's trade agreement should contain deeper integration clauses to make it work in favour of India's interest in promoting welfare and vgdp growth in india. The GTAP simulations show that comprehensive agreement between India and Oceania need to go beyond tariff and non tariff liberalization and freer movement of endowments between member nations and introduce input and output oriented technological progress in mining and extraction and transport and communications and enhance value added processes to bring positive welfare and vgdp growth in india exceeding those in the Oceania nation's. The unemployment closure in India are part of the simulations allowing prices of factors like skilled and unskilled labour to be exogenous while endowment of labour to be endogenous variable in india. The welfare and vgdp growth in india reaches 162 billion US dollars with more than 7 percent vgdp growth in india after introducing deeper integration policies of output and input oriented technological progress in extraction and mining and transport and communications and enhancing value added in the model over and above tariff and non tariff liberalization with movement of capital and labour inflows in the nation. A base line scenario with no deeper integration clause always favour the Oceania nation's with India's welfare and vgdp growth becoming negative due to the alignment. Only deeper integration helps india while Australia welfare also reaches 77 billion US dollars with 6.1 percent vgdp growth. All our factors gain with deeper integration in respect of base line scenario of tariff and non tariff liberalization with movement of capital and labour flows. In the latter land and natural resource looses in India in terms of real returns to factors of production.

Unemployment Slacks

- How does unemployment closure get added in the general equilibrium models GTAP 10 and GTAP E. This is done by swapping the exogenous qo quantity output of skilled and unskilled labour for a region by making the same as endogenous and real returns to factors of production as exogenous allowing the latter to change exogenously. If one wants the endowments market to clear and yet want real returns to be exogenous then endowment slack needs to be introduced. The impact of india unemployment closure is reduction in welfare , vgdp and trade while an increase in trade deficit for India if India participates in a free trade area with the indo Pacific alliance nation's. The swapping code needs to be written below rest of endogenous statement in the closures of the rungtap window interface with gempack computer language.

Russian Far Eastern Alliance

- What are the benefits for India by aligning with the Russian led far eastern economic forum comprising of Russia, ASEAN 10 nations, Iran,Afghanistan, Eurasian nation's Belarus, Kazakhstan and Armenia, further including China, Mongolia, Japan, Korea,Oceania nation's Australia and New Zealand and other east Asian countries?. We use GTAP 10 general equilibrium model to simulate the impact of implementing the deeper integration policies among the member states on economy wide variables in india and collectively among the broader alliance nation's. The deeper integration policies include tariff and non tariff liberalization with endowment increases in natural resource and capital, natural resource input augementing technological progress in india and in the Russian led regional member countries , output oriented technological progress in extraction and mining and in sectors like grains and crops and adoption of new shipping technologies connecting shipping routes from Vladivostok ,Russia to Chennai in India. We have a welfare gain of 45 billion US dollars while the Russian led far eastern region gains 292 billion US dollars as welfare gain from adopting common deeper integration policies. Our vgdp growth is more than 3 percent while for the far eastern forum the vgdp growth reaches nearly 2 percent. This engagement of India in securing economic, political and security interests brings dividends to real returns to Indian capital, skilled labour and unskilled labour. Real Returns to natural capital, though surprisingly becomes negative in the entire region including india. India seems to gain from foreign engagements if it pursues common industrial policy further to augement trade policy actions and by specifically focussing on enhancing output oriented technological progress in manufacturing and transport and communication. The alignment with 45 indo Pacific nation's, 27 EU nation's, African 54 nation's economic union , or 11 nation CPTPP nation's and more importantly liberalizing multilaterally brings higher overall gains for India. Lot of investments and trade in extraction, light and heavy manufacturing get a boost due to the deeper alignment with the Russian led far eastern region.. The region which gets impacted negatively the most with far eastern union are the 27 nation's EU member countries.

India Shanghai Cooperation

- India Shanghai cooperation organization free trade area with only bilateral tariff and non tariff liberalization among 8 members, additional 4 observer countries and 6 dialogue partners and India brings relatively higher welfare and vgdp growth among SCO7 members with welfare reaching 137 billion US dollars in the region and nearly 1.50 percent vgdp growth. India's and SCO observer and dialogue partners welfare hovers nearly 27 billion US dollars with growth less than 1.50 percent vgdp growth.It seems that SCO8 is a military, political and economic alliance comprising of india, China, Pakistan, Russia, Uzbekistan, Tajikistan, Kazakhstan and Kyrgyzstan. Energy and Transport and communication and connectivity are sectors that are of immense interest to India. The four observer. Countries in the SCO are Afghanistan, Iran, Belarus and Mongolia. The 6 dialogue partners are Armenia, Azerbaijan, Sri Lanka, Nepal, Cambodia and Turkey. We build in our simulations of the GTAP 10 model besides tariff and non tariff liberalization, endowment increase of natural resource in all member nations due to possible deeper alignment of the agreement, natural resource enhancing technological progress as factor input augementing technological progress and adoption of common industrial policy of promoting output oriented technological progress in manufacturing and transport and communication in the entire Eurasian region including India. The vgdp growth of india reaches more than 5 percent , the highest among all other 7 SCO members and rest of dialogue members and observer countries. The welfare of India jumps to 67 billion US dollars but not the figure for SCO7 where in welfare reaches more than 400 billion US dollars with adoption of deeper integration and common industrial policies. The returns to all factors in the region including in India increases except for real returns to natural capital. The endowment increase of natural resource decreases real returns violating the Rybczynski theorem linking endowments with factor supplies in the long run with assumption of no impact on returns to factors. Trade in heavy manufacturing,textiles, transport and communications, other services and extraction and mining go up in the region. Domestic investments prop up growth rates due to adoption of deeper integration policies including pursuing common industrial policies across the member states including that in India. India tends to protect the following sectors by imposing relatively higher tariffs on SCO7 exports of grains and crops, meat and meat products and processed food to India. SCO7 imposes the highest tariff of 17 percent on Indian exports of meat and meat products. SCO7 tend to protect its textiles and heavy manufacturing while trading with its dialogue and observer partners. It is SCO7 welfare and vgdp growth rates who are maximum gainers of the indo sco trade agreement. India's route to central Asia can cater to its energy and natural resource needs and adapt to Neo geopolitical alignment with China and Pakistan also as important discussant member states along with the Eurasian region. Further gains are possible if Indian capital gets invested in the central Asian region. America's, MENA and other resource rich region SSA gets impacted negatively in terms of welfare and vgdp growth.

Carbon Emissions

- What if all countries mimics India's growth story and adopts common industrial policy by making concerted attempts to have 8 percent output oriented technical progress in services sector, 4 percent in industry and 2 percent output oriented growth of agriculture and allied sectors including meat and meat products and processed food?GTAP E General equilibrium model results show that Japan, followed by US, then EU 27, then china and finally India will have relatively high growth rates in that serial order. Carbon emissions also follow the same order with India and China having the least growth in carbon emissions not exceeding 2.5 percent . What is to be noted that services sector is the major carbon emitter followed by industry and then agriculture. Services include transport and communications, public utilities like electricity, gas, construction and other services including business and financial services. Trade liberalization and carbon taxation can partly take care of climate change . Therefore, it seems innovation, common long term industrial policies of promoting research and development and trade liberalization are inputs to sustainable development processes across nation's. Chinese and Indian carbon emissions growth rates do not exceed 2.5 percent, while for Japan, US and EU27 carbon emission growth rates exceed 6.5 percent when all adopt innovations mimicking tfp process of India. Carbon taxation rates can be 10 percent to have negative carbon emission growth rates across developed nations and for incentivising countries for substituting traditional energy resources into renewables and bio fuels. Scarcity of natural capital is the major constraint to the innovation and development processes all around with capital, skilled labour and unskilled labour gaining due to the adoption of self reliance policies with trade and fdi liberalization.

India EU 28

- India EU 28 comprehensive trade partnership would raise growth rates in India by nearly 3 percent and welfare levels by 50 billion US dollars. EU 28 growth rates would go up by 1.13 percent while welfare levels would go up by whopping number 230 billion US dollars by having one comprehensive deal with India. These are estimates of the general equilibrium GTAP 10 simulation model which also reads into the fact that returns to natural capital for EU would grow by nearly 8 percent by aligning with India. The latter seems to suggest that either scarcity is pulling up the rates in the EU, or the stolper Samuelson impact is playing its role where in by pushing one natural resource intensive sector leads to rise in real returns for natural capital, or India a natural resource scarce country is fulfilling the energy needs and requirements of the EU28 . The latter cannot happen. Therefore, all GTAP simulations show that if EU aligns with East Asia it would have more relative gains in terms of welfare and vgdp growth. However, the alignment with EU will help India to liberalize in terms of tariffs and non tariff barriers, invite foreign capital and address carbon emissions through carbon taxation and trade liberalization. India imposes on an average 75 percent duties on processed food imports from the EU. We have very high tariff duties on vegetable oils, dairy products, food products, beverages and tobacco products from the EU. We impose heavy tariffs on grains and crops from EU at the level of 17 percent from the EU. EU maximum tariff rates are for indian textiles but not exceeding 8 percent. The global value chain requirements of the EU are in motor vehicles, chemicals, machinery, food and processing, computer and electronic equipment, among others.EU helps other nations like Netherlands and Ireland in their countries exports of other business services. EU has maximum forward linkages in chemicals, wholesale trade, machinery and motor vehicles. The GVC requirements of the EU are met by the US, Germany, China, UK and Netherlands. Is India in a position to replace EU GVC partners? This is an open question. We need to bring our average tariffs of 16 percent on EU imports to lower levels, reduce non tariff barriers, invite foreign capital, address climate change, promote skill labour and human capital formation and promote our textiles& domestic investments and expand public utilities like electricity, water, gas and construction. We need to focus now on 5 Es. Electrical products, Engineering products, Electronic, Energy and Environment. After covid Health as well.The next set of results based on GTAP 10 would tell us that by having comprehensive treaties based on multilateralism gives us more benefit or rather by aligning regionally or bilaterally. MENA and SSA regions, ASEAN or other South Asian region gives us potential big markets to meet our energy needs and expand our exports of manufacturing and hence higher relative growth rates. If we have comprehensive agreement with other South Asian countries and build on improving the political climate all around , we can grow at more than 5 percent. However, such growth will be sourced through our energy needs , public utilities and manufacturing exports to our neighbours.South Asian partners would have lower growth rates and welfare, but their all sectors would grow uniformly. By aligning with ASEAN nations, we expect to grow by more than 4 percent. In all the simulations it is quiet clear our growth in real returns to natural capital becomes negative.Meaning, we have scarcity in coal, oil, petroleum, gas, extraction, mining among others. We can tide the latter by inviting capital and natural resource technologies from Oceania,MENA, South Asian partners and ASEAN nations.Alternatively, we can invest heavily in alternative energy resources .

India China African Union

- Who gains more, India or China or 54 nations African countries if we and Chinese have comprehensive bilateral Liberalization with the 54 nations African Comprehensive Free Trade Area? We use the General Equilibrium models GTAP 10 and an environment energy variant of the GTAP model GTAP E for our analysis. The Indians have the maximum relative gains in terms of welfare and vgdp growth by aligning with AFCFTA.The welfare gains are between 65 billion to 110 billion us dollars depending on comprehensive nature of alignment with vgdp growth exceeding 5 percent in India with possible comprehensive alignment in future. Also, their seems to be more gains in terms of welfare and vgdp growth of the African nations if they align with the Indians rather than the Chinese.. The downside for Africans nations are land and natural resource intensive products gets exported to India and China with supporting inflow of capital, skilled labour and technology of natural resource extraction coming from China and India. Chinese capital seems to bring their own labour having downside impact on manufacturing processes in Africa. Our capital is more salubrious. Therefore, AFCFTA as standalone can succeed if among 54 nations they can promote manufacturing and textiles production in their nation states. Our simulations take a comprehensive scenario where in we liberalize tariff and non tariff Liberalization with Freer flows of capital and skilled labour and having common industrial policy across countries with concerted attempts made to promote manufacturing sector in the 54 nations African region. All sectors in Africa grows if they align with India, while If they have comprehensive treaty with the Chinese, manufacturing sector in Africa gets impacted negatively or sees a tardy progress. Chinese alignment also brings 111 billion us dollars gain for China but skewed impact on African manufacturing sector with relatively lower vgdp growth in China in comparison with India. Carbon emissions go up but can be taken care by carbon taxation all around. Our average tariffs on AfCFtA are below 10 percent while AFCFTA tariffs on Indian products exceeds 13 percent. We impose higher tariffs on AFCFTA textiles and processed food of the level of 26 and 10 percent , while AfCFTA tariffs are around 18 percent for our textiles and processed food products. AfCFTA welfare and vgdp growth rates are relatively lower when they align with India and China but matches these countries if AFCFTA standalone can promote manufacturing sector in the 54 nations member states. Returns to natural capital and land though becomes negative in India and China with bilateral liberalization with the 54 nations AfCFTA.

India Nafta

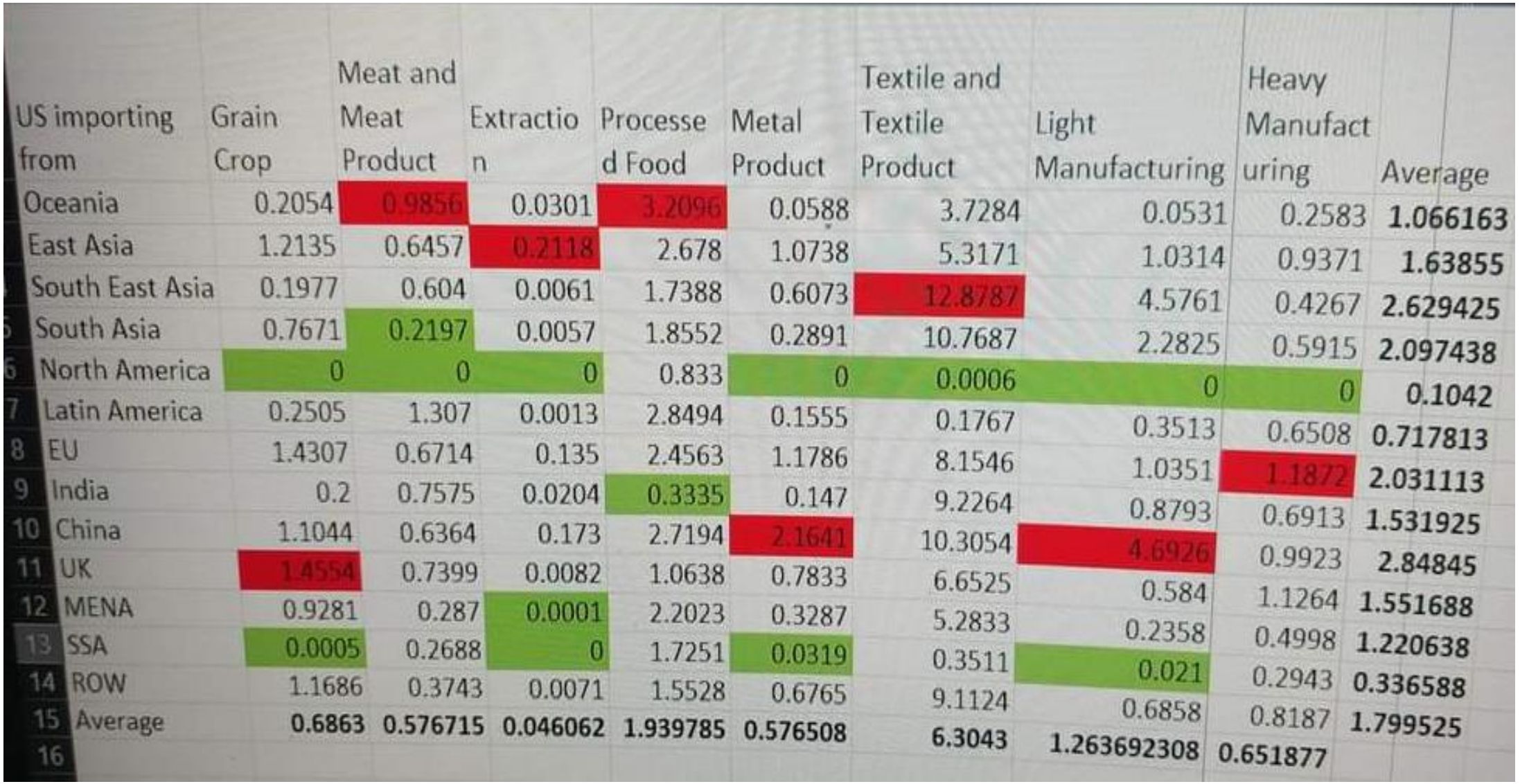
- We do comprehensive analysis of India North America Free trade area comprehensive pact using Purdue University GTAP 10 general equilibrium model and use of UNESCAP TINA and RiVA trade intelligence networks . The sectors which are likely to grow in India with the possible comprehensive agreement are services sector in India namely financial and other business services, probably replacing Ireland and Luxembourg in Europe as users of NAFTA other business and financial services. The other sectors which are likely to grow in India are metals, chemicals, motor vehicles, transport equipments, manufacturing, leather, wood products, printing and publishing among others. NAFTA global value chains are read by its forward and backward linkages in other business services, chemicals, wholesale trade, mining, financial services, motor vehicles, computers and computer equipments, machinery, other transport equipment, among others. These GVC relationships are presently catered by the Europeans,china and japan and NAFTA member states.The GTAP model shows that if we have tariff and non tariff Liberalization, freer flows of capital and skilled labour movements between NAFTA and India and have common industrial policy to promote light manufacturing and other business services in both regions, NAFTA would grow by nearly 1.91 percent with 238 billion welfare gains and India will have 2.91 growth with 58 billion welfare gain. The major source of welfare gain is the technological progress which will see a rise due to the possible agreement in the future.The above performances with respect to welfare changes maybe due to the fact that tariffs imposed by India on US products are on average 16 percent ,while US average tariffs on Indian products are merely 2 percent. We impose 32 percent duties on grains and crops coming from US with 50 percent tariffs on processed food from US. Maximum duties that US imposes on us is on textiles and garments of the level of 8 percent. We impose 10 percent, 8 percent, and 7 percent duties on US textiles, light manufacturing and heavy manufacturing respectively from the US. We export to US, diamonds, medicaments,fish,petroleum oil, jewellery, bed linen, kitchen and toilet linen, among others. We import from the US oils, petroleum oils, turbo jets, metals, petroleum gases and other gaseous hydrocarbons, nuts, almonds, media products, cotton, acyclic hydrocarbons, among others. We are hoping that we can be valuable partners in supply chain management of the US, Canadian and Mexicans economies in sectors like Motor vehicles, other transport equipment, chemicals,fuels, machinery, other business services, wholesale trade, computer and electronic equipments, among others. GTAP models shows that extraction sector and domestic investments will pull up growth in the NAFTA region with the pact. NAFTA however gains the most if it aligns with the East Asian economies like China, Japan, Korea , ASEAN nations ,among others because it majorily needs energy inputs and outputs and agricultural inputs from these nations. Returns to natural resource in both regions though becomes negative by the comprehensive agreement. Our Land,skilled labour, unskilled labour and capital gains by this agreement.Textile sector in India would see a major push due to the comprehensive agreement.

India UK

- India UK comprehensive trade treaty will favour UK more than India in terms of welfare and vgdp growth. We use GTAP 10 Energy Environment general equilibrium model ,a variant of the GTAP model to simulate and understand economy wide impact of UK India trade deal including impacts on carbon emissions in both nations. We include in our simulations tariff and non tariff Liberalization on all goods both ways with freer movement of capital and skilled labour flows across both nations with concerted attempts to promote trade in services in both nations including promotion of financial, education , health and business services trade happening between UK and India. India's welfare gain is more than 85 billion us dollars while UK gains more than 192 billion US dollars as welfare gain. VGDP growth for UK is more than 7 percent ,while for India vgdp growth is more than 3 percent due to comprehensive trade deal. All sectors in India grows with services and domestic investments pulling up growth in India. For UK domestic investments of more than 18 percent and services growth pulls up vgdp growth of more than 7 percent in the UK. In UK all sectors grow except industry and energy intensive products like pharmaceuticals, chemicals, minerals and metals. Energy intensive exporters gain from the comprehensive deal between India and UK, while US and EU are nations and region which witnesses a fall in welfare and growth. UKs Global value chains are met by European nations , US and China in products like business and financial services, chemicals, wholesale trade, mining, motor vehicles, machinery, other transport equipments, among others. UK exports to India includes metals, silver, turbo jets, petroleum, coke, ferrous waste and scrap, diamonds, aluminium waste and scrap, inorganic and organic compounds, paper and paper waste and scrap, whiskies, among others. India exports to the UK petroleum oil, medicaments, jewellery, t shirts, turbo jet parts, garments, footwear, aircraft and spacecraft parts, diamonds, among others. India imposes on an average 10 percent tariffs on UK exports of industrial products, 123 percent tariffs on UK exports of grains, vegetables and processed food to India, not more than 5 percent tariffs on UK exports of energy inputs and output exports to India. Correspondingly UK tariffs on Indian products are 4.25 percent on Indian industry exports, mere 5.2 percent on indian agricultural exports, and still lower tariffs on energy intensive exports from India. Carbon taxation of 3 percent and 5 percent in India and UK respectively can reduce carbon emissions in both India and UK respectively with little compromise on growth and welfare in UK and India. Skilled labour gains the most in India among other factors. In UK land gains the most while natural capital looses in the UK. For India, it is a win win situation with all sectors growing with vgdp growth and welfare gain but much lower than the UK economy. UK gains more by this comprehensive deal with skewed impact on industry and energy in the UK. Maybe UK then needs to build alliance with energy exporters from middle East and North Africa, Oceania, East asian and Latin American region.

India GCC

- GTAP10 simulations. What happens if India has free trade both ways with the GCC six Nations, UAE, Saudi, Qatar,Oman,Kuwait and Bahrain. India would have maximum gains among the trading group in relation with welfare changes of the level of 2250 million us dollars, followed by UAE and then Qatar. East Asian nations, Kuwait and EU, among others would loose in terms of negative welfare changes.UAE followed by Qatar and then India in that serial order would gain in terms of value GDP changes. India and UAE would though have negative trade balance with the rest of the world post free trade scenario. Saudi Arabia would have maximum positive trade balance with the rest of the world post FTA of GCC with India .In india sectors which would gain would be meat and meat products, processed food and light manufacturing. Textile would not gain much. Transport and Communication and utilities would also benefit in India. The fact though remains that maximum gains for India are when India liberalizes with all nations , followed by ASEAN 10, RCEP, Indo Pacific, CPTPP, MENA, EU 27 , SCO and then followed by individual nations like US, UK, among others. Where should GCC look for maximum gains, EU28, East asia, China or other MENA countries. It seems East Asia alignment would give them relatively maximum gains. Bahrain though has maximum gains in terms of GDP when GCC aligns with MENA nations. Saudi Arabia, Qatar, Kuwait gain more when aligning with EU and North American nations.



US importing from	Grain Crop	Meat and Meat Product	Extraction	Processed Food	Metal Product	Textile and Textile Product	Light Manufacturing	Heavy Manufacturing	Average
Oceania	0.2054	0.9856	0.0301	3.2096	0.0588	3.7284	0.0531	0.2583	**1.066163**
East Asia	1.2135	0.6457	0.2118	2.678	1.0738	5.3171	1.0314	0.9371	**1.63855**
South East Asia	0.1977	0.604	0.0061	1.7388	0.6073	12.8787	4.5761	0.4267	**2.629425**
South Asia	0.7671	0.2197	0.0057	1.8552	0.2891	10.7687	2.2825	0.5915	**2.097438**
North America	0	0	0	0.833	0	0.0006	0	0	**0.1042**
Latin America	0.2505	1.307	0.0013	2.8494	0.1555	0.1767	0.3513	0.6508	**0.717813**
EU	1.4307	0.6714	0.135	2.4563	1.1786	8.1546	1.0351	1.1872	**2.031113**
India	0.2	0.7575	0.0204	0.3335	0.147	9.2264	0.8793	0.6913	**1.531925**
China	1.1044	0.6364	0.173	2.7194	2.1641	10.3054	4.6926	0.9923	**2.84845**
UK	1.4554	0.7399	0.0082	1.0638	0.7833	6.6525	0.584	1.1264	**1.551688**
MENA	0.9281	0.287	0.0001	2.2023	0.3287	5.2833	0.2358	0.4998	**1.220638**
SSA	0.0005	0.2688	0	1.7251	0.0319	0.3511	0.021	0.2943	**0.336588**
ROW	1.1686	0.3743	0.0071	1.5528	0.6765	9.1124	0.6858	0.8187	**1.799525**
Average	**0.6863**	**0.576715**	**0.046062**	**1.939785**	**0.576508**	**6.3043**	**1.263692308**	**0.651877**	

The U.S.-China Trade War: A Brief Recap

US CHINA TRADE WAR

Analysis of US China Trade War and formation of possible Free trade area among themselves using GTAP 10 model gives some interesting results. The welfare and vgdp gains for China relatively become higher than US if at some point of time China and US form a free trade area. The Chinese welfare gains reaches more than 15000 million US dollars with vgdp growth of 0. 40 percent while US attains welfare gain of 8000 million US dollars with vgdp growth of 0. 17 percent.

The average tariffs that US imposes on all chinese products is 2 percent while the average tariffs that China imposes on all the US products is 6 percent. If due to trade war the average tariffs on each other's products reaches say 25 percent ,China and US welfare and vgdp are impacted drastically downward with China being relatively impacted more by the trade war strategy undertaken atleast by the US to curb it's heavy trade deficit with China. Trade war or bilateral imposition of higher tariffs though leads to improvement in trade balances of both the nations, US and China .

Countries and regions which gain in terms of welfare and vgdp due to trade war are Canada, Mexico, EU 28, Latin Americans, East Asian regions copiously while India marginally. I guess the realignment of exchange rates are better ways to handle the trade deficit rather than adopting beggar by thy tit for tat tariff policies.Without any trade war ,US imposes 1.10 percent tariffs on Chinese grains and crops, 0.68 percent tariffs on Chinese meat and meat products, 0.2730 percent tariffs on extraction industry, 2.719 on Chinese processed food, 10. 30 on Chinese textiles, 4.32 percent on Chinese light manufacturing and 1.02 on chinese heavy manufacturing.

Chinas tariffs are relatively higher. US grains and crops faces nearly 3 percent duty in China, for meat and meat products it is nearly 9 percent, extraction 0. 64, Processed food from US 8. 9 percent, Textiles ,7. 7 percent, US light manufacturing from US nearly 10 percent and US heavy manufacturing 3.76 percent. With trade war, in the US, the following sectors have negative impacts, grains and crops, public utilities and domestic investments.

In China heavy and light manufacturing, domestic investments, services and public utilities are impacted negatively. Further tomorrow in addition to tariff barriers, some non tariff barriers are imposed between China and the US , they would further depress welfare and vgdp growth both in China and US with China being impacted more negatively. The favourable impact would be felt among rest of the north american nations, EU, East Asians and Latin Americans as trade would get diverted to such regions. Also

US CHINA TRADE WAR

US China trade war in 2018.Gains and Losses and impact on India. GTAP 10 simulations.Three Simulation scenarios. Free trade scenario of zero tariffs imposed both ways, Tariff rates of 10 percent applied to trade in grains, extraction and meat and meat products both ways and 25 percent tariffs both ways on light and heavy manufacturing and third simulation of 25 percent tariffs imposed both ways on all products.

It seems that trade war improved trade balance with rest of the world for both countries,US and China. Welfare and GDP loss for both countries, US and China in case of 25 percent tariffs imposed by both countries with China suffering higher reduction in GDP, a decline of nearly 4 percent. The latter happens as production and trade of light and heavy manufacturing in China got adversely impacted.

EU, Canada, Mexico, East Asia,India among others impacted positively in terms of GDP positive changes. However in India one witnesses welfare loss and negative trade balance. The best scenario for India is under simulation two when US and China imposed tariffs on selected products.

Free trade brings dividend for both China and US but other countries impacted negatively in serial order, EU28,;Canada, Mexico, East Asia, among others. Trade war bought negative impact on grains and extraction business in US and negative growth in domestic investments in US and China and hence decline in GDP.

It may be noted that the US had marginal positive GDP changes and positive trade balance when tariffs were imposed on selected products two ways. Welfare changes were negative though.China impacted more by the US China trade war. The tariff war were quiet stringent on the consumers because of the price rise

TINA AND GTAP SIMULATIONS: INDIA CHINA RELATIONSHIP

Trade Intelligence network Tina estimates of Trade creation and Trade diversion between India and China. Trade creation for China 12 billion US dollars a figure 6 times the figure for trade creation of India. Around 5 percent of our exports reach China but around 14 percent of our imports come from China.

The corresponding figure for China with respect to India, the share is 3 percent with respect to exports and less than one percent with respect to imports. Importantly see what we import from India. Looks like fertilizers, electronic and engineering goods. Trade creation and trade diversion are based on the SMART model based on import substitution, export supply and import demand elasticities

TINA AND GTAP SIMULATIONS: INDIA CHINA RELATIONSHIP

What happens at some stage in future we think of having two way free trade between India and China. GTAP 10 simulations. We loose in terms of trade balance, welfare and vGDP having negative welfare, trade balance, and GDP. We loose in terms of trade in grains, trade in meat products and heavy manufacturing.

We have negative trade balance due to mainly negative trade balances in extraction and heavy manufacturing. Returns to unskilled labour, skilled labour, capital and much more than the former three,returns to natural capital would go up, namely those who are involved in forestry, fishing, coal and oil extraction and metals.

Chinese would have positive 0. 17 growth in vGDP and more than 4200 million us dollars welfare gain if it aligns with India. Gains would double for China and maybe some gains for India if services and investment Liberalization are included. As of today free trade with China brings negative welfare for India.

Idea is to shift comparative advantage in its own favour in India by investing in Electrical, Electronics, Engineering goods and 4IR technologies, promote village development, ports, telecommunications, among others to match the Chinese superiority. Pharma and medical products and GVCs can be further developed in India.

Indo Pacific Economic Framework 14 using General Equilibrium Modelling

- Which regions would gain the most under Indo pacific economic framework present areas of cooperation? We use the general equilibrium models to analyze and simulate the impact of present dispensation under the IPEF 14 focusing on four areas of cooperation namely connectivity including physical and digital connectivity, raising labour and environmental standards and following norms of fair trade, energy and climate security, and enhancing global value chains to stem supply chain disruptions. It seems that the US,Japan, Korea, Australia, New Zealand and Fiji would gain the most in terms of welfare and vgdp growth followed by India and then Asean 7 nation's in terms of vgdp growth. This serial order changes as and when IPEF 14 becomes a trade agreement where in their is free flow of goods, services and capital and skilled labour flows across nation's. ASEAN 7 jumps to the second position in terms of vgdp growth and welfare while India would be a laggard when IPEF would allow tariff liberalization along with free movement of factor flows across nation's. The welfare levels are any figure between 63 billion US dollars to 99 billion US dollars for India under two simulation scenarios of no trade agreement and one when IPEF 14 transforms into a trade agreement. Similarly ASEAN welfare levels reach 126 billion US dollars with ,nearly 5 percent growth under trade agreement scenario. It is the QUAD nation's, Korea and new Zealand which reap the maximum benefit under both scenarios, no and with trade agreement with welfare reaching beyond 1100 billion US dollars with nearly ,4.50 percent growth in the member states with trade agreement and free flow of labour and capital. A carbon taxation of 6 percent along with trade liberalization can take care of the carbon emissions and partly address the climate change in the US led IPEF 14 nation's. Fiji is the 14 th nation apart from asean 7 nation's along with the QUAD, new Zealand and Korea.

India ASEAN

- We use energy environment variant of the general equilibrium GTAP model named GTAP E to analyze standalone ASEAN 10 comprehensive liberalization at some future date among themselves and then bring in India's participation in the treaty. We assume tariff and non tariff liberalization with freer movement of skilled labour and capital with input and output oriented technological progress in sectors like industry and services ,agriculture and energy intensive industries. We find that standalone liberalization of ASEAN 10 brings welfare of 110 billion US dollars for the asean 10 nation's with vgdp growth of 4 percent and more . The same figure jumps to 132 billion US dollars with 6 percent growth rate if India becomes it's eleventh participating member. The growth rates seems to emanate from high domestic investments and high sectoral growth rates of industry,, services and agricultural sector. For India welfare levels reach 89 billion US dollars with 4.48 percent vgdp growth. The growth is again pushed up by domestic investments, industry and services, energy intensive industries, agriculture , electricity and petroleum. In fact carbon emissions growth of more than 3 percent and 1 percent in India and ASEAN 10 nation's due to this deeper integration policies can be taken care by imposition of 3 percent carbon taxation. In India all factors gain except real returns to natural capital while in ASEAN 10 except for land and natural resource ,skilled and unskilled labour and capital gains with adoption of deeper integration policies. The carbon tax rates are real carbon tax rates at 1997 US dollars per tonne.The trade balance for both India and ASEAN 10 with rest of the world becomes negative. Energy exporters gain with this alignment of India with ASEAN 10. Their are however deeper gains for India if we align deeper with Indo Pacific alliance countries, IPEF, CPTPP, EU 27 and last not the least we multilaterally liberalize under the aegis of the WTO.

Services Sector Contribution using General Equilibrium Modelling

- Services sector contribution in India can be also read by using the two general equilibrium models GTAP 10 and GTAP E . The simulations are worked out by ensuring that the sectors like transport and communication, public utilities and other services including business and financial services are given productivity shocks keeping the services sector as final demand and also by considering them as inputs to the production of all commodities. In addition we add simulations by including productivity shocks in skilled labour as inputs to the production processes. The welfare levels increases to more than 80000 million US dollars while vgdp growth is nearly 4 percent due to productivity shocks of the services sector. Public utilities and domestic investments are the major gainers because of services sector growth in terms of technology. Here comes the interesting part. Productivity shocks to light and heavy manufacturing and textiles both considering them as inputs and outputs, the welfare levels are more than 80000 million us dollars with vgdp growth of nearly 7 percent. Welfare and vgdp grows further if productivity of skilled labour and capital increases industry output all around. Agriculture productivity and allied activities brings relatively lower gains in terms of welfare and vgdp growth. The agriculture sector growth is important given that 48 percent of the workforce is still in the agriculture sector
- Services contributes more than 60 percent of the GDP involving 30 percent of the work force. Industry contributes 25 percent of the GDP while agriculture contributes around 15 percent of the GDP. All in all productivity shocks to outputs and inputs of the sector has welfare and growth dividends with manufacturing seems to be having greater relative impact on vgdp growth and employment. The quality of employment in the services sector is lagging behind especially in sectors like financial services and business services. Trade,Roads and Railways, public administration and defense, banks share in services sector contribution in terms of GVA are the highest. Air transport, communication, banks, non life insurance, computer related services among others are high productive services sectors.

Structural Transformation in India using General Equilibrium Modelling

- We use GTAP 10 simulations to understand the structural transformation of the Indian economy by assuming same and differential output oriented technological progress for manufacturing, services and agriculture. The theory of structural transformation were first given by Simon Kuznets who conjectured that share of agriculture in GDP and employment would first go up, then these shares would come down for agriculture and increase for manufacturing and industry and finally the shares of services in GDP and employment would go up. India seems to have leapfrogged the development process with services taking the lead role after agriculture lost its share in GDP but not employment to a great extend. The missing phase is the increase of share of manufacturing in GDP and employment of India Second, services sector employment share in India is around 30 percent of the total workforce of India, while agriculture employs 48 percent of the workforce. Using GTAP 10 model and the shock aoall we assume 2 percent output oriented technological progress in agriculture and manufacturing and 6 percent output oriented technological progress in services. We find that we can achieve more than 11 percent vgdp growth. All factors of production would gain except natural capital. Domestic investments would be the driver of the growth rates in India. The second set of simulations showed us that by seperating output oriented technological progress and assuming it to be same across agriculture and allied activities, manufacturing and services, we find maximum growth and employment due to technological progress in manufacturing sector with negative real returns to land and natural resource, but skilled labour and unskilled labour with capital gaining the most. Output oriented technological progress in Agriculture brings relatively the lowest vgdp growth as compared to other two sectors with positive real returns of all factors except land. Natural resource returns becomes positive if we see growth in agriculture. Worrying part is that Indian agriculture still employs 48 percent of our 492 million work force. Lower vgdp growth rates with 50 percent of the workforce still stationed in agriculture either requires massive education and training of the agricultural workforce or use of biotechnology to convert agricultural resources and waste into alternative energy resources. This may take care of the workforce in agriculture sector Subsidies tend to reduce world prices and bring in distortions in the economy. Services output oriented technological progress of 8 percent can push vgdp growth alone to more than 8 percent with real returns to all factors including land gaining except natural resource. Scarcity of Natural resources seems to be a thorn in India's progress. Domestic investments and public utilities like electricity, water, gas, construction have ability to push Indian growth rates. Renewables and alternative energy resources are future areas of investment for sustainable growth and achieving the millenium development goals.The new geopolitics and geoeconomics can become constraints unless and untill global governance, social harmony and democracy prevails with concerted attempts made to reduce authoritarianism all around.

Relative Gains in aligning with Regional Groups

- India's maximum relative gains in terms of vgdp growth of 6.95 percentage is by having one comprehensive trade, economic and industrial partnership with EU ,27 nations. These are simulation results from the GTAP 10 model . Followed by this is the India's vgdp growth of 6.82 percentage when India has one complete , full and comprehensive liberalization deal with 54 nations African Comprehensive free trade area. This is followed by having deeper integration with South Asia with India growing at 6.74 percentage. Then comes Oceania when India grows at 6.35 percentage. The next is MENA when India grows at 6.14 and finaly Latin American region when India grows at 5.35 percent..The laggard performance in terms of vgdp growth of India is when it comprehensively liberalizes with ASEAN, East Asia and North American regions. The difficulty is that welfare gains are more for India when it liberalizes with East Asian region including ASEAN nations. This may be due to possibly the average tariffs imposed by India on East Asian region products seems to be relatively higher as compared to other regions of the world. The comprehensive agreement includes tariff, non tariff and capital and skilled labour liberalization with adoption of common industrial policies in the entire region. India gains with our alignment with the EU 27 because of manufacturing growth in India along with services sector growth with pulling up of domestic investments in India due to comprehensive agreements with the EU 27 nations. Energy scarcity and negative returns to natural capital are constraints to India's progress.

Hands on Experience through analyzing trade data in stata and R using partial equilibrium models and simulations through General Equilibrium Modelling

EXPORT SUBSIDIES AND TARIFFS

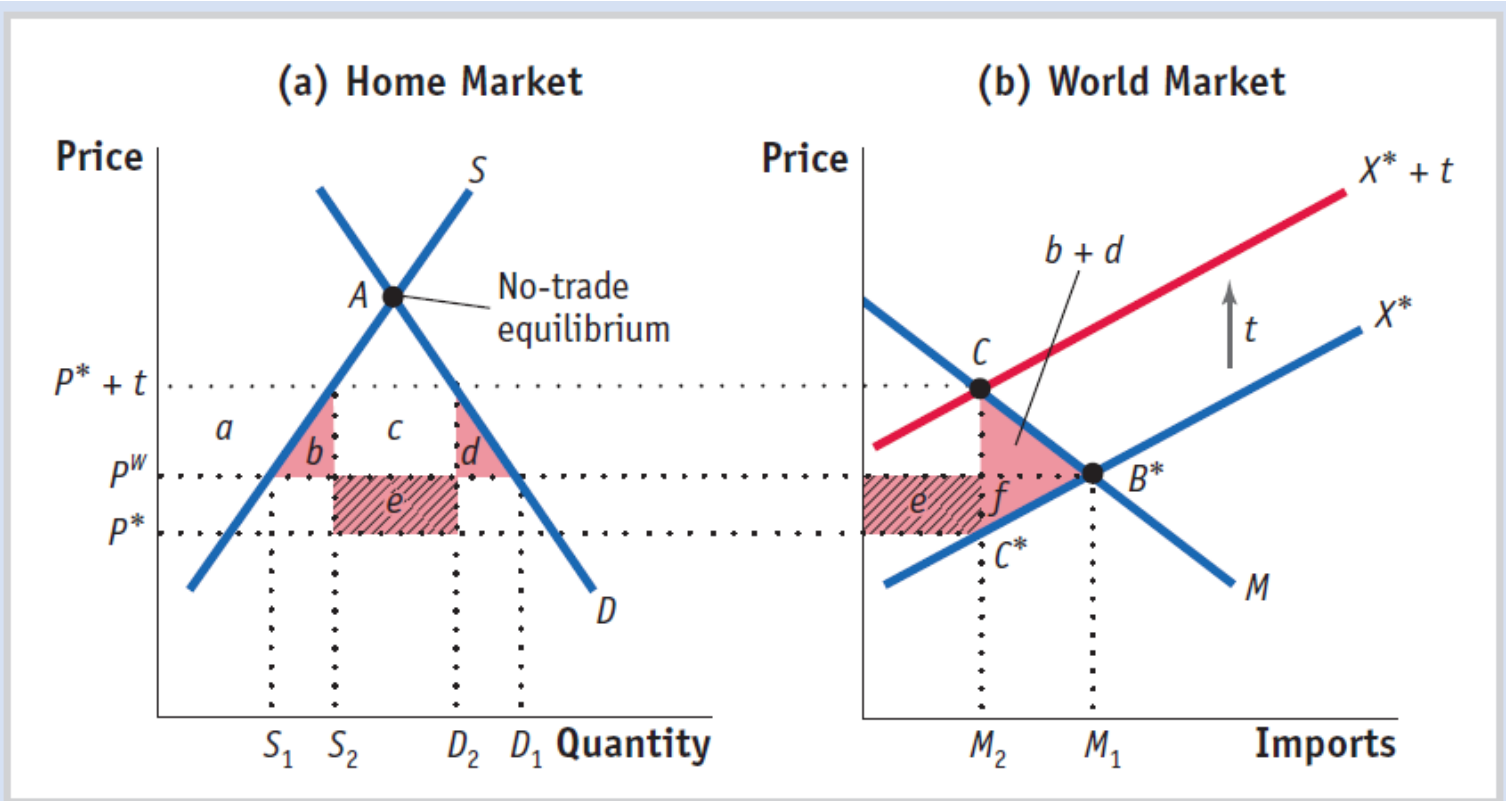
What is the partial and general equilibrium impact of giving exports subsidies and tariffs on home and foreign country and the world assuming home country is a large country.Exports subsidies imposed by large countries tends to increase price received by exporters incentivizing them to produce more. Consumers loose because of the increase in prices.

These two developments shifts the demand and supply curves leading to decrease in terms of trade or world prices. In addition production and consumption Distortions leads to decline in welfare for the home country. This is the partial equilibrium impact of imposing subsidies on home countries.

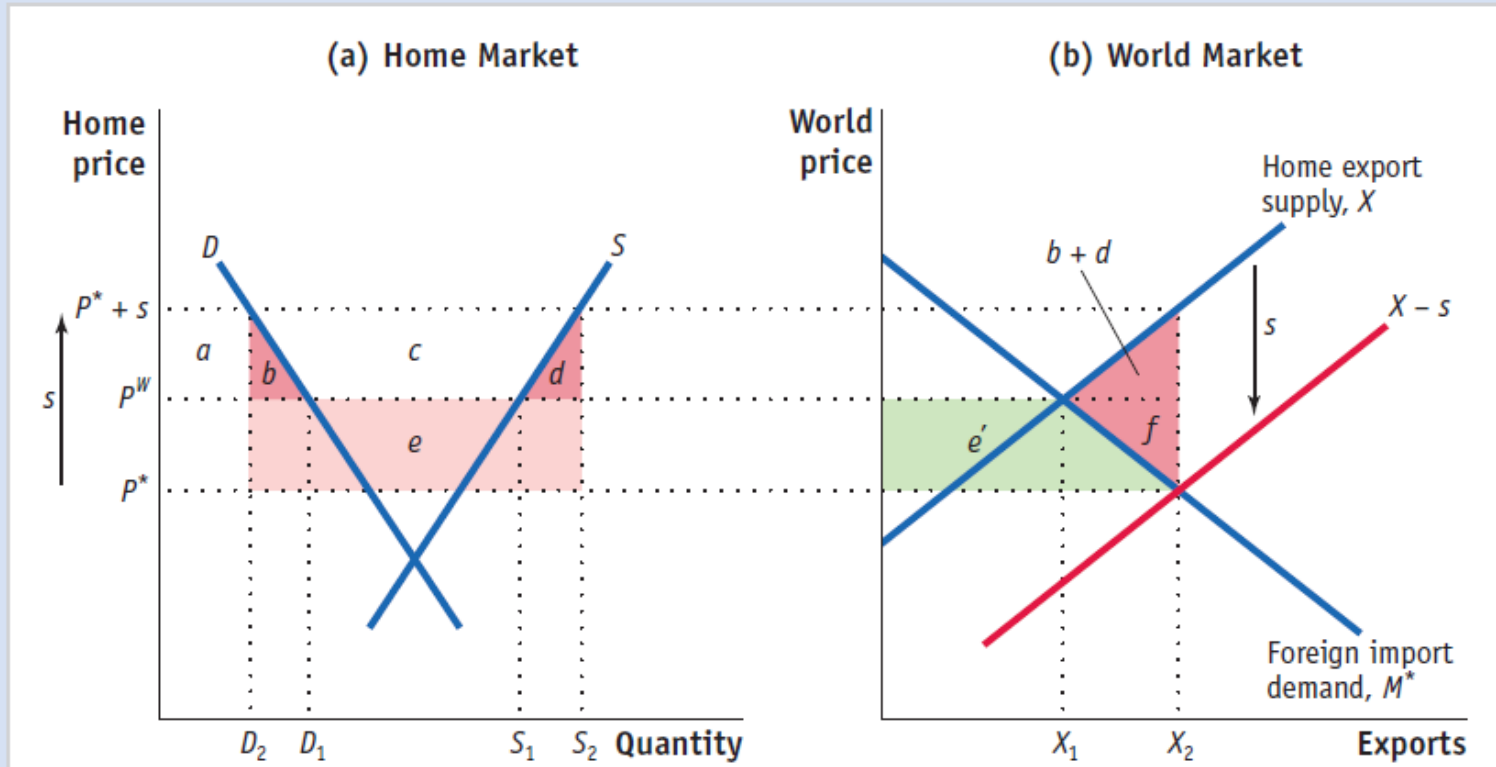
General equilibrium impact of export subsidies on employment, trade balance, allocative efficiency, investment savings among others also happens but difficult to gauge due to myriad and complex inter relationships among the variables.

What is the partial equilibrium impact of giving export subsidies on your trading partners. Your terms of trade Loss is terms of trade gain for the foreign country. However consumption Distortions reduces the welfare. Net effect is ambigous. World welfare is negative due to production and consumption Distortions across the world.

Export subsidies can be more pernicious than tariffs if general equilibrium impacts allso turns to be negative. Tariffs have ambigous impact on welfare of large country, decline in welfare of foreign country due to decline in terms of trade and production Distortions happening in foreign country. World welfare reduces due to distortions.



Tariff for a Large Country The tariff shifts up the export supply curve from X^* to $X^* + t$. As a result, the Home price increases from P^W to $P^* + t$, and the Foreign price falls from P^W to P^*. The deadweight loss at Home is the area of the triangle $(b + d)$, and Home also has a terms-of-trade gain of area e. Foreign loses the area $(e + f)$, so the net loss in world welfare is the triangle $(b + d + f)$.



Export Subsidy for a Large Country Panel (a) shows the effects of the subsidy at Home. The Home price increases from P^W to $P^* + s$, Home quantity demanded decreases from D_1 to D_2, and Home quantity supplied increases from S_1 to S_2. The deadweight loss for Home is the area of triangle $(b + d)$, but Home also has a terms-of-trade loss of area e. In the world market, the Home subsidy shifts out the export supply curve from X to $X - s$ in panel (b). As in the small-country case, the export supply curve shifts down by the amount of the subsidy, reflecting the lower marginal cost of exports. As a result, the world price falls from P^W to P^*. The Foreign country gains the consumer surplus area e', so the world deadweight loss due to the subsidy is the area $(b + d + f)$. The extra deadweight loss f arises because only a portion of the Home terms-of-trade loss is a Foreign gain.

PRODUCTION SUBSIDIES

When production subsidies are given it is equivalent to saying that price received by domestic producers goes up. Will producers increase their domestic prices. No. They did so when export subsidies were given. They will not do it because no will buy from them and would import the product at lower world prices.

However, when export subsidies are given domestic producers will increase their domestic prices. Why Reason being otherwise all will become exporters and no domestic producers and domestic market would exist .Domestic subsidies leads to production distortions but export subsidies leads to both production and consumption distortions.

Production subsidies are relatively less distortive and maybe that is the reason they continue to be mandated in the WTO. Export subsidies are also most of the times supported by import tariffs on the same goods in which export subsidies were given.

Ban on Wheat Exports

- What is the general equilibrium impact of ban on export of wheat by India to the rest of the world? It seems that India gains marginally in terms of welfare , trade balance and higher production of wheat due to further increase of wheat prices in the international market. Net importers of wheat like the Middle East and North African region and Sub Saharan African nations would loose the most in terms of welfare.We knew about the partial equilibrium impacts of export ban through the lerners theorem that export tax and import tax have equivalent but ambigous impacts on net welfare of the nation assuming export ban to be equivalent to export tax. Ambigous impact on net welfare due to export ban because terms of trade improvement will increase welfare in the nation while production and consumption distortions would reduce welfare due to export ban. Producers of wheat in home for example would get less incentivised to produce and sell after the ban creating scarcity and jacking up of world prices. Production distortions because net proceeds are less while consumers gain hopefully due to reduction in domestic prices.The net output producers like North American region and Oceania would gain the most due to India's export ban decision and rise in world prices.We use GTAP 10 general equilibrium model to work out the impacts of raising average tariffs on wheat in India to 20 percent and 40 percent respectively from present tax duties on wheat imports on an average being 11.23 percent for all regions imports of wheat into India. For other grains and crops on an average taxes in India are 24 percent for all regions imports of agriculture products. By creating scarcity through export ban the world prices would go up further. This may incentive major producers to produce more and export more. This includes the major producers and exporters of wheat like North American region, the EU, Oceania, Russia and Ukraine and India to some extend. MENA and SSA who are net importers of wheat would loose the maximum due to export ban followed by negative welfare for regions like EU and East Asia . North America, India and Oceania would be the net gainers in terms of welfare and output production. India's trade balance also improves marginally. Trade of wheat may also gets diverted to Oceania and North American region due to export ban in India, and whatever trade was suppose to get diverted to us due to Russian Ukraine War would be lost as well . Russia and Ukraine would be the impacted the most negatively due to the war and subsequent curtailment of production and export of wheat. We impose on average 24 percent duty on wheat imports from Russia and Ukraine, Oceanias wheat get taxed at 24.99 percent, East Asia 0 percent ,South East Asia 36.44 percent, South Asia 0 percent, North America 16.30 percent, Latin America 0 percent, EU 28 is charged 0 percent duty on wheat coming into india, MENA 2.71 percent and Rest of the world 20.9 percent. Domestically export prices and home prices may go down because the surplus gets diverted to domestic market provided middlemen do not distort the same. The entire trade policy literature is about how trade policy actions creating a division between export/ domestic prices and international prices. Protectionism is beggar by thy policy where in one country gains at the cost of the others while world welfare goes down .Their is limited impact on vgdp growth across regions except marginal impacts on MENA and SSA regions though.

Sugar Restraint

- We use GTAP 10 General equilibrium model to study and read the impact of recently announced sugar export restraint measures on the Indian economy and other major ten regions of the world. These are Oceania, East Asia, South East Asia, South Asia, North America, Latin America , EU 28, MENA, SSA and rest of the world. The average tariffs on all regions imports of sugar into India is 26.35 percent while all regions imports of Indian sugar is taxed at the rate of 10.46 percent. The export restrictions are like export taxes. Export taxes have equivalent impacts like that of import taxes on welfare. We assume in our simulations 50 percent target tariff rates , a raise of 24 percent from the present rate of 26 percent due to export restraint measures. Our welfare goes up by 201 million US dollars but we see a fall in trade balance with the rest of the world with marginal decline in vgdp growth of .12 percent due to negative thirteen percent growth in quantity value added of sugar. Export taxes tend to create scarcity and the world prices are likely to go up. This may hit net sugar importers like East Asian and SSA countries. Domestically the producers are likely to get lesser proceeds because they need to pay higher taxes. Consumers gain domestically because of lower prices. Trade policies always have beggar by thy impacts. We gain against the loss in welfare , output and exports of other region's . North America, Latin America, EU 28 and South East Asian exports of sugar would go up. However, the following regions have lot of potential to increase their sugar output and exports. These include our South Asian partners, MENA and SSA region. Latin American region welfare and exports go up due to one more protectionist measure adopted by India. We impose maximum duty on sugar imports on East Asian region with tariffs reaching 30.10 percentage , Oceania 25.06 percent, South East Asia 26.96 percentage, South Asia 1.45 percent, North America 26.35 percent, Latin American exports of sugar to India are taxed at 60 percent, EU 28 percent, MENA 24 percent, SSA 14.56 percent and ROW imports are taxed on an average of 29.45 percent. We tend to protect our processed food and grains and crops sector the most among all sectors. The sugar impacts are different from wheat ban exports. The GTAP results showed India gained in terms of welfare, vgdp and trade balance in case of ban of wheat exports . In case of sugar restraints returns to land and unskilled labour, transport and communications and public utilities are negative due to one more protectionist measure adopted by India. However all trade policies adopted by large countries have ambiguous impacts as some factors,sectors and stake holders gain and others loose. Trade always have unequal impacts on returns to factors of production. Hence complementary policies are needed to compensate the loosers. In this case agricultural exporters of sugar and wheat. We need liberalization of agricultural sector which seems to be the most protected sector ac

SAM MATRIX

		Activities		Factors		Taxes			Final Demands				
		1	2	K	L	T	TP	TC	H	G	I	X	Total
Activities	1	40	10						35	20	10	50	165
	2	10	40						135	20	10		215
Factors	K	80	20										100
	L	20	80										100
	T	0	5										5
Taxes	TP	10	10										20
	TC	5											5
	H			100	100					10			210
	G					5	20	5	20				50
Final Demands	I								20				20
	X		50										50
Total		165	215	100	100	5	20	5	210	50	20	50	

Yotov 2022 on gravity analysis being an estimating CGE Model

- See table in next slide

Nested Gravity: Trade and Growth

Structural Gravity Equation:
$$X_{ij,t} = \frac{E_{j,t}Y_{i,t}}{Y_t}\left(\frac{t_{ij,t}}{\Pi_{i,t}P_{j,t}}\right)^{1-\sigma},$$

Inward Multilateral Resistance:
$$P_{j,t}^{1-\sigma} = \sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t},$$

Outward Multilateral Resistance:
$$\Pi_{i,t}^{1-\sigma} = \sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{E_{j,t}}{Y_t},$$

Market Clearing Condition:
$$p_{j,t} = \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\beta_j \Pi_{j,t}},$$

Expenditure & Output:
$$E_{j,t} = \psi_j Y_{j,t} = \psi_j A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}{}^{\alpha} p_{j,t},$$

Capital Accumulation:
$$K_{j,t+1} = \Gamma_j \left[\frac{A_{j,t}L_{j,t}^{1-\alpha}}{P_{j,t}\Pi_{j,t}}\right]^{\delta}\left(\frac{Y_{j,t}}{Y_t}\right)^{\frac{\delta}{1-\sigma}} K_{j,t}^{\alpha\delta+1-\delta}.$$

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Thankyou for your patience