

SECTORAL PRODUCTIVITY IMPACTS OF TRADE
LIBERALIZATION, CAPITAL AND SKILLED LABOUR FLOW
LIBERALIZATION , HUMAN CAPITAL FORMATION AND
INDUSTRIAL POLICY WITH MACROECONOMIC DYNAMICS:
AN EXPOST PARTIAL AND EX ANTE GENERAL EQUILIBRIUM
ANALYSIS

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OBJECTIVES

We use general equilibrium models like GTAP and GTAP E models to run various simulations to understand the economy wide impacts of India aligning with other countries/regions of the world.

We assume tariff and non tariff liberalization along with assuming freer capital flows across regions in future to assess the general equilibrium impact on welfare(Equivalent Variation) and its decomposition into allocative efficiency, terms of trade, technology, endowment effects and investment savings impact of all liberalizing countries/regions and rest of the world.

In addition the impacts are read by looking at various variables defining the economy like sectoral productivity impacts, real returns to factors of production, vgdg growth, balance of trade with the rest of the world, carbon emissions, among others.

OBJECTIVES CONTD.

In addition we introduce changes made to industrial policies, inflow of skilled labour and spillover effects of industrial policy and factors of production on economy wide variables in both liberalizing and non liberalizing countries of the world. It seems from various simulations that trade policy and freer foreign capital inflows and outflows in conjunction with industrial policy and human capital formation can tide over the negative trade flows of the developing nations and shift comparative advantage in favor of high value-added goods and bring the desired changes in the real returns to the factors of production.

It seems from the simulations that liberalizing trade and capital flows with carbon taxation can address climate change. Vgdp growth and consumption gets impacted but marginally

GLOBAL TRADE ANALYSIS PROJECT

Economy wide impact of tariff liberalization. Businesses in source country goes up due to decline in tariffs or taxes along with businesses from other countries getting transferred to the source country whose sourced products to host country now faces lower tariffs. Lower tariffs means lower outputs due to supply impacts.

Further, Impacts returns of factors more which are impacted by decline in supply capacities due to tariff decline. Here comes the role of Stolper Samuelson theorem. A decline in prices of a commodity decreases the real returns of the factors used intensively but a rise in returns to factors of others. Also when due to tariff decline some factors move out of the production of this good to making of other goods. Also, now that imports are cheaper domestic production gets impacted. However, it is also important to know whether tariffs imposed are imposed on final or intermediate product. If later, then the cost of production comes down to raise profits to increase production and prices. The adjustment matters whether they are entirely happening in prices or production or both.

GTAP model allows all the Tariff liberalization and escalations to be analysed due to one integrated model of production, consumption, equilibrium markets and traded sector. Elasticities play an important role to gauge the economy wide changes due to shocks in the economy.

GTAP model are identified by model equations, data in input output format and parameters like the elasticities. The latter can also be changed. Non-linear simultaneous deterministic equations are solved to know the economy wide impact of exogenous variable changes on all endogenous variables. Closure allows you to fix or change the models endogenous and exogenous variables.

A huge effort to model general equilibrium impact of variable change in real sector on economy wide variables comprising of 141 regions and 65 sectors and 5 factors of production, namely, land, unskilled and skilled labour, capital and natural resource. Seminal work done in GTAP modelling in Monash University in Australia and the Purdue University in US with very early work done by Prof Whalley in Canada in late 1970s.

GTAP SIMULATIONS

After doing more than 500 simulations in GTAP10 it seems quiet clear that india has comparative advantage in unskilled and skilled labour and capital intensive goods in form of textiles and light manufacturing.

We have heavy disadvantage in terms of natural capital as a group including forestry, fishing, coal, oil extraction and construction. Returns to land sometimes comes positive sometimes negative when we align with ROW because of heavy subsidies provided by developed and developing countries alike.

We also gain in terms of meat and meat products, dairy products, rice and motor vehicle production. We also have advantages in transport and communication and other services. In South Asia we gain in terms of utilities also. Next set of reforms need to take care of regulatory burdens and promote competition as far as trade in services and investments are concerned.

SIMULATION SCENARIOS TO ASSESS AND EVALUATE REGIONAL TRADE AGREEMENTS

India ASEAN , India RCEP trade deal

India UAE trade deal

India China

India SSA

South Asian customs union

Brics

Brexit

US china trade war

Indo Pacific Alliance

India SSA

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	

UK importing from	Grain Crop	Meat and Meat Product	Extraction	Processed Food	Metal Product	Textile Product	Light Manufacturing	Heavy Manufacturing	Average
Oceania	6.9397	39.8046	0.0321	6.7908	0.3695	8.3636	1.693	1.2193	8.151575
East Asia	5.1287	1.2884	0.7374	7.0238	1.0053	4.2069	3.8137	1.5755	3.097463
South East Asia	3.4942	75.263	0.2514	10.6918	1.0277	4.8194	2.7836	1.0505	12.4227
South Asia	4.3802	0	1.7388	2.7517	0.0103	1.687	0.4256	0.1561	1.393713
North America	7.754	11.3437	0.1992	11.1368	0.0431	3.8815	0.8057	1.0309	4.524363
Latin America	3.0029	35.278	0.0051	4.6181	0.1964	1.4157	1.714	2.149	6.0474
EU	0	0	0	0	0	0	0	0	0
India	4.08	4.128	0.2546	6.7104	0.0886	8.6076	2.4938	1.1834	3.4433
China	7.2749	18.5863	1.364	10.0106	2.5346	10.5718	4.0013	1.897	7.030063
US	4.1108	5.1139	0.2024	8.088	0.9001	8.3827	1.0902	1.8934	3.722688
MENA	4.5273	1.5719	0.0004	2.2569	0.4648	0.2663	0.2757	0.8597	1.277875
SSA	1.3828	0.503	0.0014	1.327	0.0115	0.0127	0.0024	0.0063	0.405888
ROW	1.3157	2.2853	0.0401	2.1332	0.1254	1.219	0.1807	0.6463	0.993213
Average	4.107015	15.01278	0.3713	5.656854	0.521331	4.110323	1.483054	1.051338	

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.

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.

NTMS

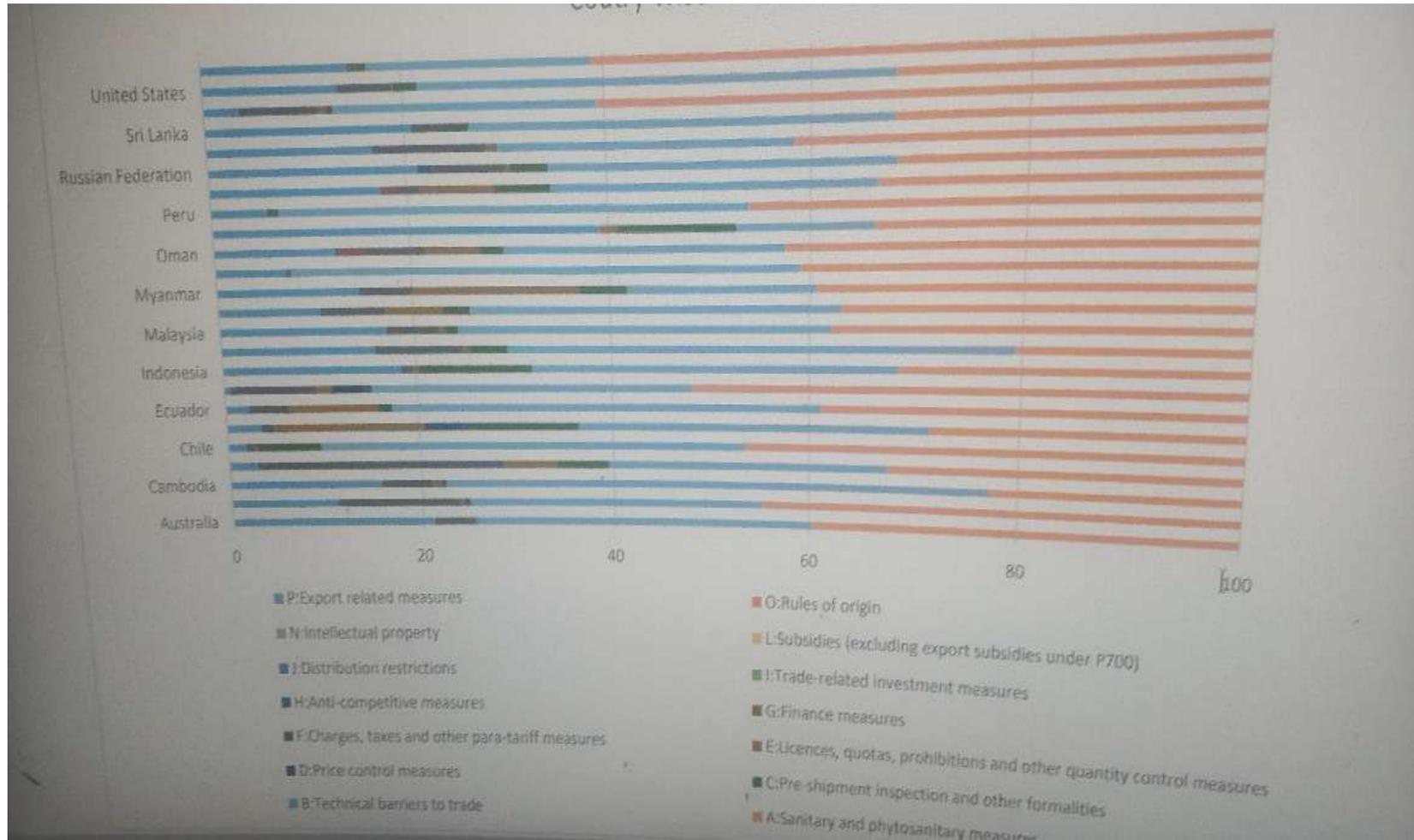


Table 1: Average Tariff Rates between India and Indo-Pacific Regions

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

Processed Food	12.84	26.65	14.57	14.82	27.45	19.26
Textiles	15.56	11.51	24.39	8.60	7.344	13.48
Light Manufacturing	14.63	10.20	8.47	24.48	1.23	11.80
Heavy Manufacturing	11.70	13.69	15.44	11.55	4.19	11.31
Average	10.69	10.01	11.65	11.93	8.23	

Tariffs on the other SAARC Nations exporting to Bangladesh Product wise						
	Sri-Lanka - Bangladesh	Nepal to Bangladesh	Pakistan – Bangladesh	India – Bangladesh	South Asia RE – Bangladesh	Average
Grain Crops	5.31	.0094	1.36	4.12	0.00	2.16
Meat	2.49	0.00	23.79	5.10	0.00	6.28
Extraction	4.97	3.61	4.93	14.58	0.00	5.62
Processed Food	7.46	3.82	7.92	7.49	0.00	5.34
Textiles	11.61	8.82	15.96	13.16	0.00	9.91
Light Manufacturing	7.78	0.00	4.82	14.70	0.00	5.46
Heavy Manufacturing	12.54	.5566	8.09	7.04	0.00	5.65
Average	7.45	2.40	9.45	9.55	0.00	

Tariffs on the other SAARC Nations exporting to Pakistan Product wise						
	Sri-Lanka - Pakistan	Nepal to Pakistan	Bangladesh – Pakistan	India – Pakistan	South Asia RE – Pakistan	Average
Grain Crops	0.00	5.67	1.51	1.79	9.32	3.66
Meat	0.00	0.00	4.37	3.32	1.15	1.77
Extraction	10.62	0.00	36.08	24.25	4.61	15.11
Processed Food	.80	2.97	5.66	7.29	5.61	4.47
Textiles	9.71	22.44	12.21	6.16	9.94	12.09
Light Manufacturing	.21	6.11	3.42	3.05	16.36	5.83
Heavy Manufacturing	1.49	6.47	6.15	6.54	2.22	4.57
Average	3.26	6.24	9.91	7.49	7.03	

Tariffs on the other SAARC Nations exporting to India Product wise						
	Sri-Lanka - India	Nepal to India	Bangladesh-India	Pakistan – India	South Asia RE – India	Average
Grain Crops	23.20	0.00	7.04	19.58	5.99	11.16
Meat	0.00	0.00	2.34	4.60	2.85	1.96
Extraction	0.00	0.00	.0028	5.02	23.08	5.62
Processed Food	2.88	.0022	13.26	23.79	38.52	15.69
Textiles	2.69	.0017	1.95	11.18	4.00	3.96
Light Manufacturing	.25	0.00	1.25	7.28	.28	1.81
Heavy Manufacturing	1.57	.0001	2.19	4.06	.1161	1.59
Average	4.37	0.0005	4.004	10.79	10.69	

Tariffs on the other SAARC Nations exporting to Rest of South Asia (Afghanistan, Bhutan and Maldives) Product wise						
	Sri-Lanka – South Asia RE	Nepal to South Asia RE	Bangladesh- South Asia RE	Pakistan – South Asia RE	India - South Asia RE	Average
Grain Crops	14.70	0.00	11.68	8.69	6.29	8.27
Meat	15.10	0.00	14.17	3.71	7.17	8.03
Extraction	18.56	0.00	14.08	12.23	12.23	11.42
Processed Food	16.61	9.98	18.40	5.23	7.12	11.47
Textiles	21.29	13.33	26.58	10.24	9.99	16.29
Light Manufacturing	23.32	7.58	22.97	5.31	5.44	12.92
Heavy Manufacturing	21.60	6.89	12.78	9.23	5.29	11.16
Average	18.74	5.39	17.24	7.80	7.64	

Tariffs on the other SAARC Nations exporting to Bangladesh Product wise						
	Sri-Lanka - Bangladesh	Nepal to Bangladesh	Pakistan Bangladesh	India Bangladesh	South Asia RE - Bangladesh	Average
Grain Crops	5.31	.0094	1.36	4.12	0.00	2.1
Meat	2.49	0.00	23.79	5.10	0.00	6.2
Extraction	4.97	3.61	4.93	14.58	0.00	5.6
Processed Food	7.46	3.82	7.92	7.49	0.00	5.3
Textiles	11.61	8.82	15.96	13.16	0.00	9.9
Light Manufacturing	7.78	0.00	4.82	14.70	0.00	5.4
Heavy Manufacturing	12.54	.5566	8.09	7.04	0.00	5.6
Average	7.45	2.40	9.45	9.55	0.00	

Tariffs on the other SAARC Nations exporting to Pakistan Product wise						
	Sri-Lanka - Pakistan	Nepal to Pakistan	Bangladesh - Pakistan	India Pakistan	South Asia RE - Pakistan	Average
Grain Crops	0.00	5.67	1.51	1.79	9.32	3.66
Meat	0.00	0.00	4.37	3.32	1.15	1.77
Extraction	10.62	0.00	36.08	24.25	4.61	15.11
Processed Food	.80	2.97	5.66	7.29	5.61	4.47
Textiles	9.71	22.44	12.21	6.16	9.94	12.09
Light Manufacturing	.21	6.11	3.42	3.05	16.36	5.83
Heavy Manufacturing	1.49	6.47	6.15	6.54	2.22	4.57
Average	3.26	6.24	9.91	7.49	7.03	

Tariffs on the other SAARC Nations exporting to India Product wise						
	Sri-Lanka - India	Nepal to India	Bangladesh- India	Pakistan India	South Asia RE India	Average
Grain Crops	23.20	0.00	7.04	19.58	5.99	11.16
Meat	0.00	0.00	2.34	4.60	2.85	1.96
Extraction	0.00	0.00	.0028	5.02	23.08	5.62
Processed Food	2.88	.0022	13.26	23.79	38.52	15.69

Tariffs on the other SAARC Nations exporting to Sri Lanka Product wise						
	Nepal to Sri Lanka	Bangladesh to Sri-Lanka	Pakistan Sri-Lanka	India – Sri Lanka	South Asia RE Sri Lanka	Average
Grain Crops	0.00	54.53	10.79	22.96	1.01	17.86
Meat	0.00	0.00	0.10	.4001	0.00	0.10
Extraction	0.00	4.45	3.94	11.88	4.02	4.86
Processed Food	0.00	12.19	2.89	13.14	2.0002	6.04
Textiles	0.00	3.11	.0021	.04	5.50	1.73
Light Manufacturing	9.67	12.37	3.98	2.31	2.69	6.20
Heavy Manufacturing	0.00	7.72	11.13	6.13	3.97	5.79
Average	1.381429	13.48143	4.6903	8.122871	2.741457	

Tariffs on the other SAARC Nations exporting to Nepal Product wise						
	Sri-Lanka to Nepal	Bangladesh-Nepal	Pakistan-Nepal	India – Nepal	South Asia RE Nepal	Average
Grain Crops	6.46	8.00	6.98	8.98	7.93	7.67
Meat	8.95	0.00	4.63	8.28	4.51	5.27
Extraction	4.70	0.00	7.07	6.82	4.99	4.75
Processed Food	12.84	26.65	14.57	14.82	27.45	19.26
Textiles	15.56	11.51	24.39	8.60	7.344	13.48
Light Manufacturing	14.63	10.20	8.47	24.48	1.23	11.80
Heavy Manufacturing	11.70	13.69	15.44	11.55	4.19	11.31
Average	10.69	10.01	11.65	11.93	8.23	

Tariffs on the other SAARC Nations exporting to Bangladesh Product wise						
	Sri-Lanka - Bangladesh	Nepal to Bangladesh	Pakistan Bangladesh	India Bangladesh	South Asia RE – Bangladesh	Average
Grain Crops	5.31	.0094	1.36	4.12	0.00	2.16
Meat	2.49	0.00	23.79	5.10	0.00	6.28
Extraction	4.97	3.61	4.93	14.58	0.00	5.62
Processed Food	7.46	3.82	7.92	7.49	0.00	5.34
Textiles	11.61	8.82	15.96	13.16	0.00	9.91

num Tariffs imposed by the SAARC Countries on Products Exported by Oceania

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	1.61	0.00	13.76	6.49	6.08	4.05

num Tariffs imposed by the SAARC Countries on Products Exported by North American Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	5.46	.29	6.62	2.76	5.74	3.99

num Tariffs imposed by the SAARC Countries on Products Exported by East Asian Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	.48	0.57	9.59	1.31	9.49	5.58

num Tariffs imposed by the SAARC Countries on Products Exported by South East Asian Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	6.54	0.12	8.42	3.12	7.98	5.51

num Tariffs imposed by the SAARC Countries on Products Exported by Latin American Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	1.25	0.03	4.20	6.83	1.60	3.72

num Tariffs imposed by the SAARC Countries on Products Exported by Middle East North African Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing

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	1.71	0.02	9.04	1.25	3.87	4.35
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num Tariffs imposed by the SAARC Countries on Products Exported by EU Region

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	7.43	0.01	11.44	1.60	6.17	4.18

num Tariffs imposed by the SAARC Countries on Products Exported by Sub Saharan Africa

n Crops	Meat Products	Extraction	Processed Food	Textiles	Light Manufacturing	Heavy Manufacturing
	2.32	0.10	6.96	6.11	7.39	6.25

TARIFF PROFILES IN SOUTH ASIA

Tariff profiles across broad products of SAARC nations with other SAARC nations and other regions of the world namely Oceania, East Asia, South East Asia, MENA, EU 27, SSA, North American region and SSA gives some insights of sectors protected by South Asian region.

Products cover Grains and Crops, Meat and Meat Products, Extraction, Processed food, Textiles, Light and Heavy Manufacturing. India imposes across regions and across other South Asian countries relatively higher tariffs for processed food and grains and crops. Pakistan protects extraction and Textiles. Others in South Asia protect more textiles and light and heavy manufacturing in their economies.

The average tariffs of India are relatively higher for EU and South East Nations crossing 20 percent across products and for Pakistan and Afghanistan, Bhutan and Maldives in South Asia crossing more than 10 percent across products. SAARC nations average tariffs are however lower among themselves than imposed on non member regions.

Pakistan and Bangladesh relatively have lower tariffs for non member regions. Non tariff barriers seems to have become more important than tariff barriers. SPS and TBT cover 80 percent of NTMs with some hidden costs.

TARIFF PROFILES IN SOUTH ASIA

Tariff profiles in South Asian region. Reference is the GTAP 10 general equilibrium model. Pakistan imposes relatively higher tariff for Indian extraction industry with tariffs reaching 24.25 percent, Indian grain crops face 1.79 tariff rate, meat and meat products 3.32 percent, processed food 7.29 percent, textiles 6.16 percent, light manufacturing 3.05 percent and heavy manufacturing from India in Pakistan faces 6.54 percent tariff rate.

Reciprocally Grains crops from Pakistan to India face 19.58 percent tariff rate, meat and meat products at 4.60 percent, extraction from Pakistan faces 5.02 percent, Processed food 23.79 percent in India, textiles from Pakistan 11.18 percent, light manufacturing 7.28 percent and heavy manufacturing from Pakistan faces 4.065 tariff rate.

It seems Processed food from Pakistan faces relatively higher tariffs in India in comparison with other products. Grains and crops tariff rates are also higher in India. Think of all nations in SAARC and the tariff profile. It seems for all nations except India they seem to protect textiles, light and heavy manufacturing. India seems to protect agriculture and processed food.

Pakistan seems to also protect extraction industry apart from textiles and manufacturing. India has free trade deal with Sri Lanka and Nepal. It seems that South Asian countries have relatively lower protection against its neighbours than the other regions of the world. Sri Lanka also seems to have relatively higher tariffs for Grains and Crops and processed food. Also it seems that Afghanistan, Bhutan and Maldives have relatively higher tariffs for South Asian imports. Pakistan and Bangladesh seem to have relatively lower tariffs for products imported from all regions of the world except South Asia.

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 ambiguous. World welfare is negative due to production and consumption Distortions across the world.

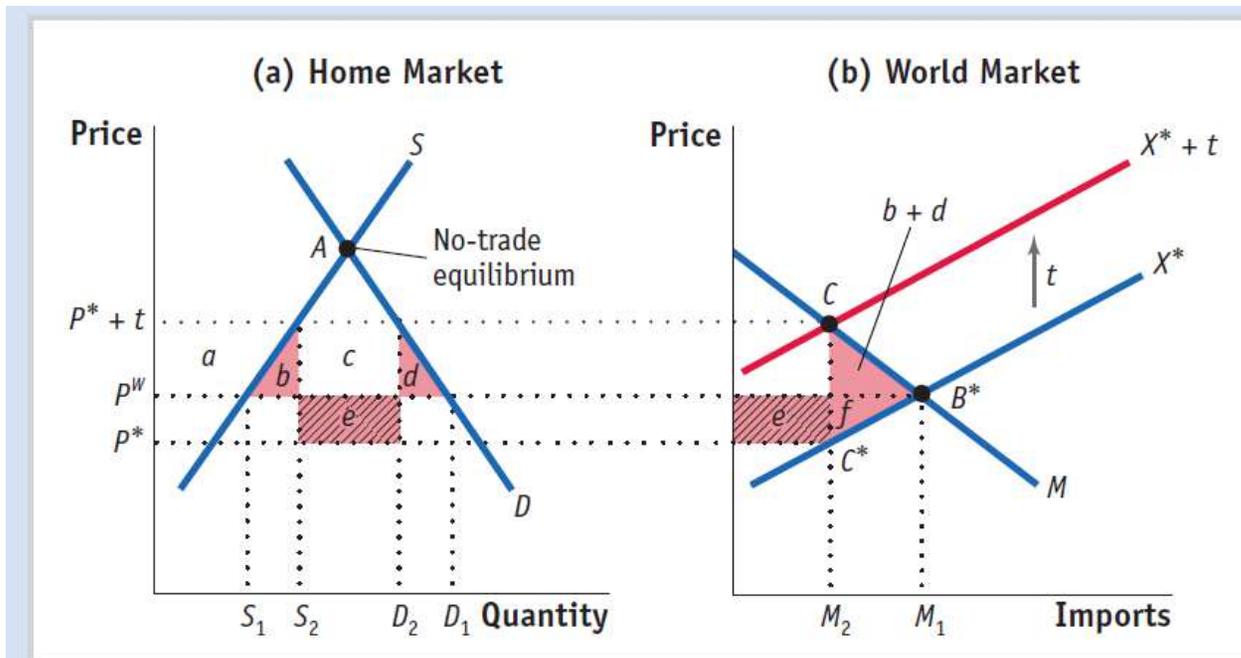
Export subsidies can be more pernicious than tariffs if general equilibrium impacts allso turns to be negative. Tariffs have ambiguous impact on welfare of large country, decline in welfare of foreign country due to decline in terms of trade and production Distortions happening in foreign country. World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

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 one will buy from them and would import the product at lower world prices.

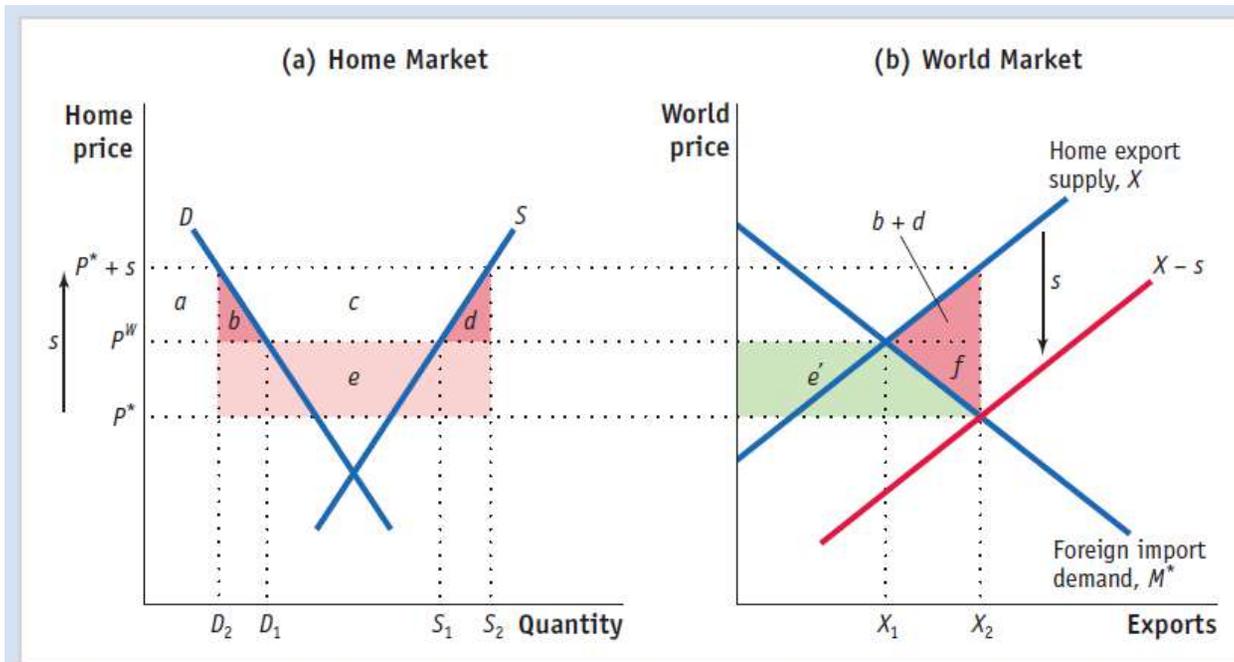
However, when export subsidies are given domestic producers will increase their domestic prices. Why? Reason being otherwise all will become exporters and no domestic producers and domestic market would exist. Domestic subsidies lead to production distortions but export subsidies lead to both production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



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.



Export Tariff for a Large Country The tariff shifts up the export supply curve from X to $X + t$, in panel (b). As a result, the world price increases from p^w to p^* . But this increase in the world price is less than the upward shift in export supply of t . It follows that the Home price decreases from p^w to

$p^* - t$, in panel (a). Home quantity demanded increases from D_1 to D_2 , and Home quantity supplied decreases from S_1 to S_2 . The deadweight loss for Home is the area of triangle $(b + d)$. Because world price rises from p^w to p^* , Home also has a terms-of-trade gain of area e .

STANDARD GTAP MODEL

Multi-region, multi-sector CGE model, perfect competition, constant returns to scale, bilateral trade via Armington assumption

Commodity and factor prices adjust to clear the markets

Domestic taxes, import tariffs and export subsidies provide wedges between domestic, import and export prices in any region

Explicit treatment of international trade and transport margins

- Wedge between the export price and import price of a commodity between the exporting and importing regions

Welfare changes in each country arising out of changes in trade or tax policies, in one or several countries, simultaneously

Single currency – all countries in US\$ millions

Flexibility to change closure rules for different markets

Fiscal side weakly characterized

STANDARD GTAP MODEL (CONTD.)

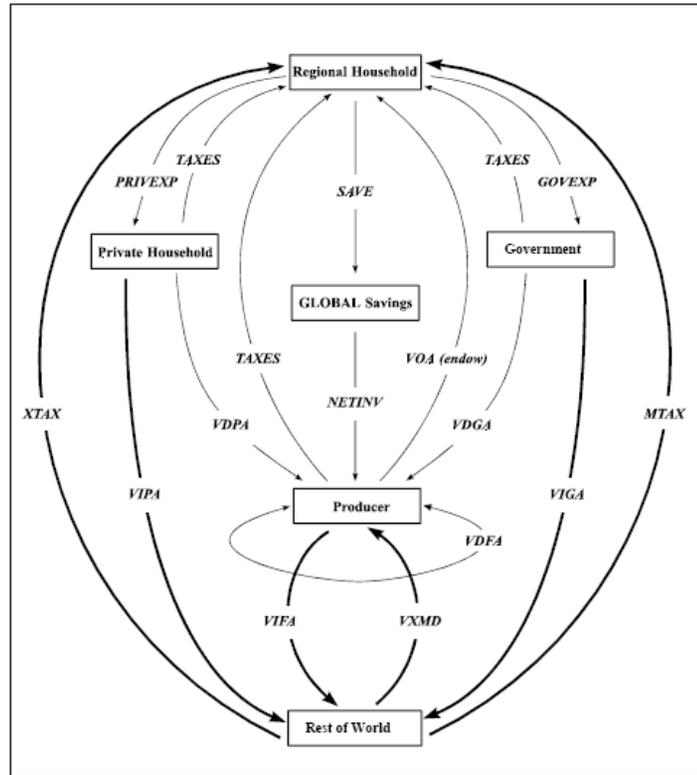
Each country represented by a regional household

- Regional household receives income from selling factor endowments to firms, and also from government revenue/subsidy
- Spends the income according to a Cobb-Douglas utility function specified over composite private consumption, government purchases and savings

Global economy consists of many (regional) economies

- Assumes same structure for all regions
- Economies are linked through international trade and investment flows

STANDARD GTAP MODEL (CONTD.)



STANDARD GTAP MODEL (CONTD.)

Each region is balanced

- Saving - Net Investment = $X - IM$ = Trade Balance

World is balanced

- Global Saving = Global Net Investment
- Total Exports = Total Imports

INTERNATIONAL TRADE

International trade links the economies

- Model tracks exports by commodity, source and destination
- Distinguishes between demand for domestic and imported goods
 - Imperfect substitutes (Argmington assumption)

FIRMS

Firms get revenue from domestic sales ($VDPA + VDGA$) & exports ($VXMD$)

Firms spend on primary factors (VOA), domestic inputs ($VDFA$), imported inputs ($VIFA$) and TAXES on imported inputs

Nested production function involving primary factors (that generate value added) and inputs

Armington assumption on inputs: Firms decide (a) the sourcing of imports, and (b) between domestic and imported (composite) inputs

FINAL DEMANDS

Cobb-Douglas function determines split between aggregate consumption and savings

- Aggregate consumption consists of PRIVEXP (household consumption) and GOVEXP (government consumption)

Household commodity-demands (composite good) based on Constant Difference in Elasticity functional form

Armington for both households and government:

- Households decide between demand for domestic goods (VDPA) and imports (VIPA)
- Government decide between demand for domestic goods (VDGA) and imports (VIGA)

Both pay taxes on both domestic and imported goods

SAVINGS – INVESTMENT

Savings and investment in each country determined globally (through the GLOBAL bank) based on a common price for savings, s.t., global savings equal global investment

- Implies free capital flows across borders
- Possible to fix capital flow in particular countries – alternate closures

ACCOUNTING RELATIONSHIPS IN THE MODEL

Market clearing equations

Supplies and demands of domestic goods, imports, endowments, investment goods and transport

Regional household – allocation of Income

Zero profits equation

Capital stocks

APPLICATIONS

Mostly used for trade policy analysis

Standard GTAP model has been extended to

- Energy-environment
- Imperfect competition
- Technological spillovers
- Land use
- Poverty and income distribution as well

Dynamic version exists

IMPLEMENTATION SOFTWARE

Model mathematically solved using GEMPACK

User interface RUNGTAP

Other tools

- AnalyseGE – to understand the results
- TABmate – Text editor to view
- ViewHAR – To View Header Array Files (data files)
- ViewSOL – To View the SOLution of several simulations

INTRODUCTION TO GTAP E

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 by

It was revised by McDougall and Golub 2007.

GTAP-E with 10th version of database has the data year as 2014 for simulation.

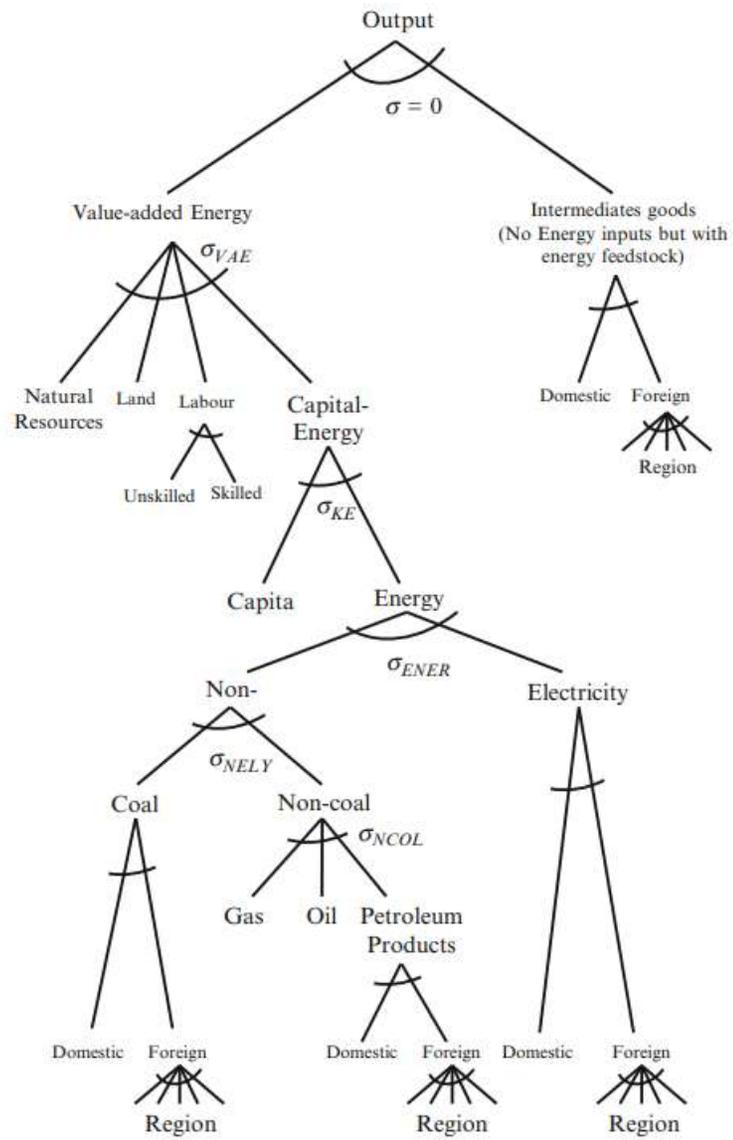
The main feature of GTAP-E model is to evaluate the impact of alternative climate change policies on economic and carbon emissions also.

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. complementarity is also explicitly considered.



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 enerav volume data. The formula to calculate CO₂ emissions is as follows:

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

$i \in EGY_COMM, s \in SRC, j \in ALLSEC, r \in REG.$

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:

$CO2_{isjr}$: CO₂ 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 = 10³ tonne)

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.

In 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_{NCOI}).
- 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

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.

CO2 EMISSIONS AND RELATED PARAMETERS

The GTAP-E model modifies the standard GTAP database to incorporate CO2 emissions from fossil fuel combustion which are incorporated by region, commodity and use in million tons of carbon.

Energy commodities include coal extraction (coa), crude oil (oil) extraction, natural gas extraction (gas), petroleum products (pc), electricity (ely) and gas manufacture and distribution (gdt). CO2 emissions for electricity are equal to zero, as well as for all other nonenergy commodities.

CO2 emission data are based on estimates from Lee (2008), properly adjusted to fit with the compatible GTAP format, which contain CO2 combustion-based emission values from intermediate use and government and private consumption playing a key role in describing the behaviour of energy consumers in facing higher energy prices.

As an example, taxes on CO2 emissions would require energy consumers to use less-polluting energy such as natural gas instead of coal. In addition, by using detailed and reliable emission data at regional level, analyses of potential carbon leakage effects can be performed.

THE GTAP-E REVISED VERSION

A recent revision of the energy-environmental extension of the GTAP-E by Burniaux and Truong (2002) can be found in McDougall and Golub (2007); this is adapted to a wider range of energy-environmental policy scenarios.

Improvements are related to different issues such as emission data, emission trading, carbon taxation, revenue from emission trading, production structure and welfare decomposition and will be summarised below.

First, new arrays are added to the data file, showing carbon dioxide emissions by region, commodity and use. This represents another way of using the information which in the standard GTAP-E is represented as energy volume data.

In particular, the database contains emissions from firms' usage of domestic and imported intermediate goods, emissions from households and government consumption of domestic and imported products.

An economic environment without emission constraints can be simulated by making the power of emission purchases endogenous and the real carbon tax rate exogenous.

In this case, there are two options for market and agents' prices: ad valorem tax and carbon tax. To distinguish them, a new computational level is added, including only non-carbon tax for each usage (referring to firms, private and government consumption of energy goods, domestic and imported).

The model also enables carbon tax and emission trading revenues to be computed by region from all sources.

Many more intermediate levels of nesting are added in the production system, combining capital with energy at the top level. To implement this system, a new set of subproducts is defined which includes value-added-energy composite, capital energy composite, energy composite, nonelectric energy commodities and non-coal energy commodities.

Such a production system enables technological change to be simulated at every level in the nest structure. Furthermore, the set of inputs and substitution elasticities are specified with a high level of detail. A similar approach is adopted for all the other nests in the production system whether the inputs are tradable, endowments, subproducts or any combination thereof.

SUMMARY OF IMPROVEMENT IN GTAP E

CO2 Emission Data Calibration

Updated Substitution Elasticities in the Capital-Energy Nest

Model Setting and Baseline

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
Final Demands	G					5	20	5	20				50
	I								20				20
	X		50										50
Total		165	215	100	100	5	20	5	210	50	20	50	



STOCHASTIC FRONTIER APPROACH TO EFFICIENCY AND PRODUCTIVITY

OBJECTIVES

We also use the parametric stochastic frontier analysis to analyze firm level data to work out efficiency of the Indian manufacturing sector and also assess the factors determining the inefficiencies existing in the manufacturing sector.

Benchmarking through stochastic frontier model helps us determine efficiency or inefficiency scores of the decision making units assuming imposition of econometric parametric function with a twist- includes composed error term . The parametric function generally is assumed to be Cobb Douglas or translog production function.

The model says that actual output is related additively or multiplicatively to maximal production and composed error term capturing noise and technical inefficiencies. The assumption is that one operates below maximal output due to statistical noise and technical inefficiency. The error term in the stochastic frontier model is a composed term comprising of statistical noise v and technical inefficiency term u . The noise error term v can take positive or negative value while u which measures the technical inefficiencies enters negatively with assumption that u is positive.

The exponential with negative u measures technical inefficiency in the multiplicative model. One uses MLE to estimate the stochastic frontier model parameters, intercept, slope, Sigma square, and lamda which is ratio of Sigma u by Sigma v . Further Battese and Coelli and Jondrow et al formulae help us to get technical efficiencies of the decision making units. The likelihood function of composed error term with use of transformation technique help in estimating or predicting technical efficiency scores.

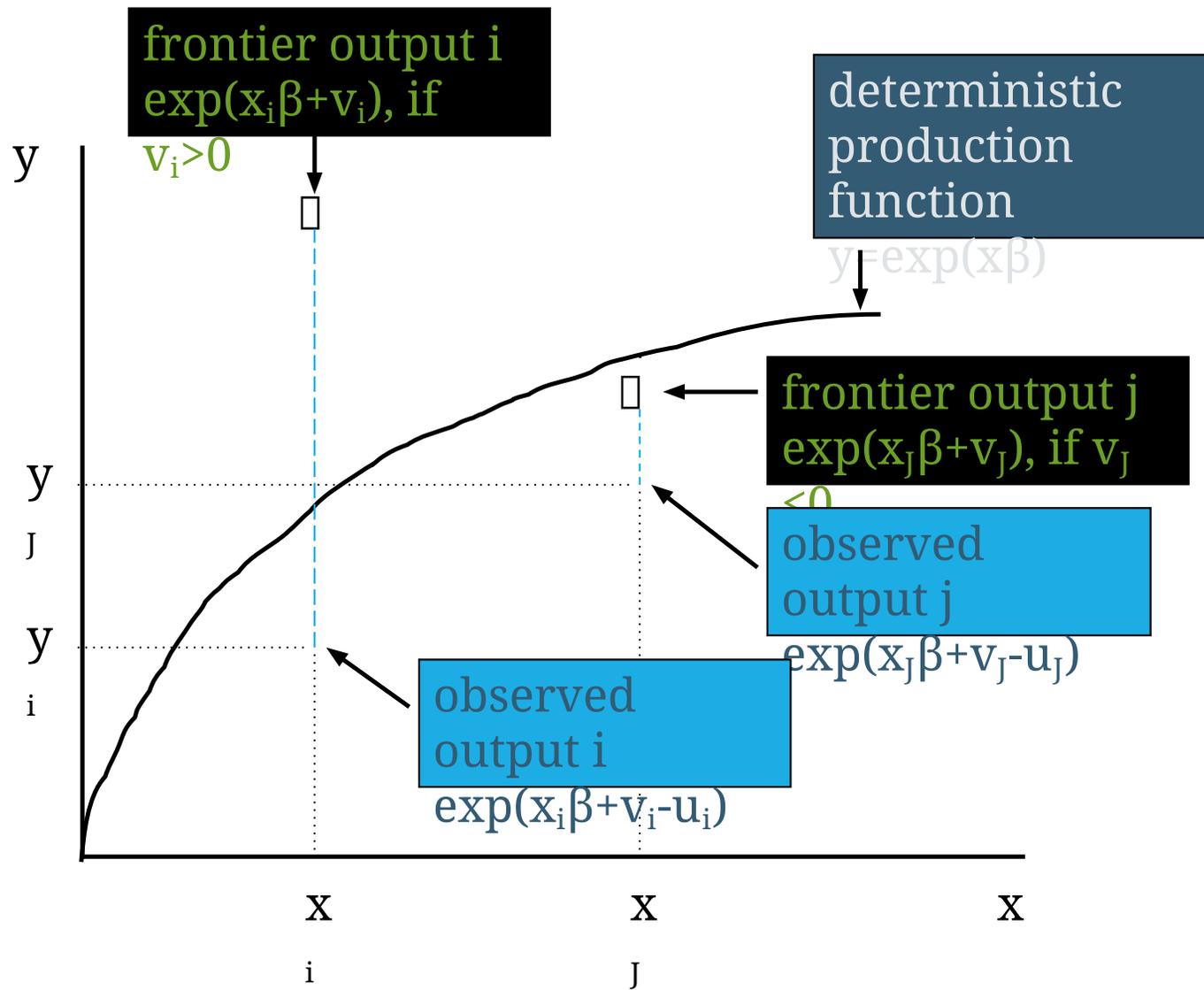
OBJECTIVES CONTD.

Think of analysing the Indian manufacturing firms and its technical efficiency. We need to model the above assuming that DMU can operate below its potential due to firm level statistical noise like COVID impacting the firm level performance either positively or negatively and due to internal processes not allowing the firm to operate at its potential.

Further factors affecting technical efficiency can be read in SFA using two step processes by including factors like import intensity, ICT and 4 IR technologies, R And D expenditures, value added by sales, among others explaining technical inefficiencies.

Panel data and Professor Greens methodology, namely True fixed effect model with output orientation and assumption of truncated normal of one side error term u help us to get efficiency scores based on SFA model in panel settings.

Time variant or time invariant technical efficiency model is estimated in panel setting with added parameters through setting up of different likelihood function using longitudinal data. `sfpnl` and `sfcross` are commands used in Stata for SFA model while SFA and DEA are estimated in R using packages `benchmarking`. Tim Coelli Frontier and `Deap` softwares with `nowmaxdea` also estimates technical efficiency and productivity using DEA and SFA model respectively.



STOCHASTIC FRONTIER

$$\ln y_i = x_i \beta + v_i - u_i$$

- v i.i.d. $N(0, \sigma_v^2)$
- $u \geq 0$
- v & u independent
- v accounts for
 - measurement error
 - random factors such as
 - weather
 - strikes
 - luck . . .

AIGNER & CHU

TE_i is

□ observed output / frontier output

$$= 0 < \exp(-u_i) \leq 1$$

□ magnitude of i-th firm's observed output relative to what could be produced by fully efficient firm using same x vector

TOTAL FACTOR PRODUCTIVITY:
LEVINSOHN AND PETRIN
(2003) APPROACH

ACCOUNTING

Cobb-Douglas production function

$$Y = AK^\alpha L^\beta$$

Assuming constant returns to scale, $1 - \alpha = \beta$, and taking the natural logarithm of both sides of first equation gives

$$\ln(Y) = \ln(A) + \alpha \ln(K) + (1 - \alpha) \ln(L)$$

Taking first differences of second equation and using a property of logarithms results in this approximation:

$$\frac{\Delta Y}{Y} \approx \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + (1 - \alpha) \frac{\Delta L}{L}$$

A key issue in the estimation of production functions is the correlation between unobservable productivity shocks and input levels.

- Profit-maximizing firms respond to positive productivity shocks by expanding output, which requires additional inputs.
- Negative shocks lead firms to pare back output, decreasing their input usage.
- When true, ordinary least squares (OLS) estimates of production functions are biased and, by implication, lead to biased estimates of productivity, often the relevant quantity for the estimation question.

Levinsohn and Petrin (2003a) (LP) point to the evidence from firm-level datasets that suggest investment is very lumpy (that is, that there are substantial adjustment costs). If this is true, the investment proxy may not smoothly respond to the productivity shock, violating the consistency condition.

Another nice feature of the intermediate input is that it provides a simple link between the estimation strategy and the economic theory, primarily because intermediate inputs are not typically state variables.

Levinsohn and Petrin (2003a) develop this link, showing the (mild) conditions that must hold if intermediate inputs are to be a valid proxy for the productivity shock.

They suggest three specification tests for evaluating any proxy's performance.

In addition, they derive the expected directions of bias on the OLS estimates relative to LP's intermediate input approach when simultaneity exists.

Calculating Total Factor Productivity

Our empirical strategy for the performance of the firm will follow Ahsan (2012) which is the extension of Levinsohn and Petrin (2003) to find out the total factor productivity. We will consider Cobb-Douglas production function in natural logarithmic form.

$$V_i = \beta_1 L_i + \beta_2 K_i + w_i + e_i$$

V_i is the natural logarithmic value-added for firm i which is equal to sales minus material cost of firm i at time t respectively.

w_i is the unobserved productivity which will have simultaneity biases because if capital intensive firms have high productivity, then the productivity shock will correlate with capital and it will give a downward biased coefficient for the variable capital and give an upward biased coefficient for labor.

Where standard fixed effect estimators will also ignore the time-varying productivity shock.

- To deal with this issue we use Levinsohn and Petrin (2003) methodology for opting for material or electricity as a proxy for unobserved productivity variable w_t . This will give consistent estimates for β_1 and β_2 . Therefore, total factor productivity will be calculated with the following formula

$$\ln(\text{TFPit}) = V_{it} - \beta_1 L_i + \beta_2 K_i$$

- The value of β_1 and β_2 will be estimated from the previous equation.

TRADE WITH ASEAN AND CHINA

We had trade surplus with Myanmar, Cambodia and Phillipines in 2019 while for all rest of the ASEAN nations we had negative trade balance. If we need to make this region more competitive we need to understand China's trade structure.

China's export to world and India includes computers, communication devices, electronic integrated circuits, machinery, parts, petroleum oils and electrical apparatus.

In sum China exports three Es, Electronic, Engineering and Electrical products . India also imports fertilizers, urea and cameras which surely we can produce competitively in India.

INDIA EAST ASIAN ALLIANCE AND 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 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.

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 vgdg 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 vgdg growth of 0.40 percent while US attains welfare gain of 8000 million US dollars with vgdg 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 vgdg 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 vgdg 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 vgdg 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 trade balance would become favourable in the US and China. Textiles in both the region's would gain from Trade war. All factors of production loose in both China and US except natural resource and land in China with trade war.

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 brought 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 quite stringent on the consumers because of the price rise

RCEP TRADE DEAL

Would India gain more by bilaterally aligning on one to one basis with 15 member RCEP trading block or become a full fledged member in future of the RCEP trading block ?. We study both the scenarios using the general equilibrium GTAP E model under the assumption that the region adopts whole gamut of policies ranging from trade and capital liberalization , makes concerted efforts in improving productivity of skilled labour in the region , imposes carbon taxation to address climate change and adopts industrial policy in promoting sectors like transport and communications.

It seems that bilateral Liberalization of India with adoption of comprehensive trade, industrial, carbon reductions and human capital formation policies brings more gains to India in terms of vgdg growth and welfare levels in India. Simulation results show that Indias vgdg growth is marginal or negative when it thinks of becoming part of RCEP nations at different stages of the 15 member trading blocks expansion towards achieving a comprehensive trade deal with expanding membership.

However, the gains of India, when in future it becomes part of RCEP, are two fold. One climate change is addressed partly because carbon emissions are reduced. Second, trade balance of India with the World becomes positive if India joins RCEP. These gains may be due to imposition of carbon taxation and regions policy to promote sectors like transport and communication and improve skilled labour productivity all around.

Hence trade, freer capital flows, human capital formation and industrial policy all adopted together have potential to tide over the negative trade pattern of the developing nations by shifting comparative advantage in favour of high value goods and negate the negative trade balance with rest of the world which one witnesses with trade patterns of SSA, Latin American and South Asian economies.

Agriculture, domestic investments and transport and communications gains the most in both the scenarios in India. All sectors grow except coal sector. Japan, Korea, China and Australia are the major gainers of the RCEP deal. ASEAN 10 nations are the laggards in the economic alignment processes.

RCEP TRADE DEAL

We evaluate the RCEP trade deal using GTAP E general equilibrium energy environment model to find that the trade Liberalization based only on tariff Liberalization among all 15 members bring the highest dividends in terms of welfare for Japan, Korea, China, Australia and New Zealand in that order.

ASEAN 10 countries have negative vgdg growth and negative welfare due to only trade Liberalization among 15 members trade block. It is only when non tariff barriers are addressed the welfare levels reaches 9000 million us dollars for ASEAN 10 nations. Freer capital flows along with tariff and non tariff Liberalization bring maximum benefit to the entire region spearheaded by Japanese, Koreans, Chinese, Australians and New Zealanders.

ASEAN 10 again are laggards but have positive vgdg growth and 16000 million us dollars as welfare gain due to comprehensive RCEP trade deal. New Zealand, Japan and Korea have maximum growth due to comprehensive agreement. Carbon emissions go up but can be taken care by carbon taxation with minimal negative impact on welfare and vgdg growth. If India joins RCEP free trade deal based on tariff and or tariff and non tariff Liberalization or comprehensive RCEP treaty the vgdg growth for India always turns out to be negative. This may be due to heavy negative trade balance that India has with most of the RCEP countries which gets aggravated by the trade deal.

Another interesting result is that if RCEP is confined to only tariff Liberalization, entry for India brings positive dividends for ASEAN 10. This may be due to the fact that ASEAN 10 have very low tariff barriers among themselves and with other RCEP members but has to deal with higher bilateral tariffs if trading with India. Act east and look east then need to be looked from larger geopolitical association where in our maritime interest are safeguarded and ASEAN centrality remains for geoeconomic gains due to transport and communication links, trade in services, inward foreign investment from Singapore and promotion of agricultural activities. Bilateral Liberalization with RCEP trading partners brings more gains for India than being part of free trade or comprehensive RCEP trade deal. We need Japan, Korea and Singapore for inward foreign direct investments.

RCEP TRADE DEAL: GTAP E SIMULATIONS

We use the general equilibrium GTAP energy environment model to perform simulations for understanding the consequences of India joining the RCEP 15 nations mega trade block maybe in future, given that we have at present not signed the deal. The RCEP mega trade block comprises of 10 ASEAN nation's, plus China, Australia, New Zealand, South Korea and Japan. GTAP E model divides the GTAP 141 regions, 65 sectors and 5 factors of production into regions like Energy Intensive Exporters, US, Japan, China, India, ROW, Annex I nations,EEFSU nations, among others. Interestingly, 65 GTAP sectors are divided into agriculture, industry and services, energy intensive industries like metals, Pharma , minerals, among others, coal, oil, gas, electricity, agriculture and refined oil sectors.

We simulate the scenario when India bilaterally liberalizes tariff and non tariff barriers for all goods along with freer capital flows with the RCEP trading block . It seems quite clear that our trade balance with RCEP nations and the world becomes negative . This negative trade balance may be due to misalignment of our exchange rate and can be corrected by depreciating of the Indian rupee . Carbon emissions also increases in India and in ASEAN 10 nations in specific though due to comprehensive economic treaty with RCEP trading block, where in India becomes it's 16 th member , probably in future .

However, all factors of production in India gain by the comprehensive economic treaty with land and natural resource gaining the most in India. Carbon emissions growth in India are more due to sectoral increase of coal and refined oil production. Sectorally, all sectors grow in India with the comprehensive treaty with RCEP region, except for the coal sector. Trade of agriculture and energy sectors grow with RCEP treaty. Their seems to be massive welfare gains for India nearing 19000 million us dollars for India with vgdg gains of 0.95 percent growth with the signing of the comprehensive treaty. ASEAN 10 and Japan have massive gains in terms of welfare of the level exceeding 25000 million us dollars.

GTAP 10 simulations have further shown that RCEP treaty in present form is good for Japan, Korea, Australia, New Zealand and China while ASEAN 10 lags behind in terms of welfare and vgdg growth. Also when RCEP increases the membership to all regions of the world except India , the ASEAN 10 nations again lag behind the richer member nations of the RCEP with China gaining the most by the new membership.It is only when India becomes part of RCEP, ASEAN 10 gains from having negative gains in the present RCEP deal or when RCEP increases membership excluding India. Maybe that is the reason that ASEAN 10 were keen to have India in RCEP. Their are more gains for East Asian nations in totality when India aligns with RCEP.

The carbon emissions can be addressed by imposing carbon taxation in the entire region including India leading to compromise on welfare and vgdg growth marginally across member nations . For example ,India's vgdg growth reduces from 0.95 to 0.90 once India becomes part of comprehensive economic treaty with RCEP nations adopting carbon taxation as an added policy reform to address the climate change . GTAP and GTAP E simulations show that RCEP without China and with India being a full member would always bring higher relative gains for India in terms of welfare and vgdg growth for India in comparison with scenario when china is part of the RCEP. Interestingly, comprehensive economic Liberalization with carbon taxation can partially address the climate change and in that process probably compromise growth and consumption all around . It may be added that trade Liberalization with Japan and US brings negative growth in carbon emissions in India while full trade Liberalization with China increases carbon emissions in both the countries apart from increasing India's trade deficit with its expansionist neighbouring nation.

INDIA UAE COMPREHENSIVE TRADE DEAL

We have signed one comprehensive trade deal with the UAE after ten long years. The simulations from GTAP and GTAP E general equilibrium models show that India and UAE are expected to grow more than 3 percent due to this alignment. India's 9 percent of its total exports to the world reaches the UAE and more than 6 percent of our total imports from the world are met by the UAE.

We export mainly jewellery, petroleum oils, telephones for cellular network, diamonds, metals, cereals, vehicles, T-shirts and chemicals to the UAE. We import mainly oil, chemicals, petroleum gases and copper from the UAE. Returns to land and natural resource especially energy intensive production are likely to go up in both nations due to one comprehensive deal. All sectors production would go up in India.

The downside would be negative trade balance with the rest of the world and increase in carbon emissions in both the nations. Therefore, a much greater agreement comprising of eliminating tariff and non tariff barriers further, freer capital flows, carbon taxation, human capital formation in the region and usage of industrial policies related to services trade and manufacturing have potential to tide over the negative trade balance and negate carbon emissions. India's welfare levels reach more than 34000 million us dollars when we align with the UAE. This figure is equivalent to the figure when India aligns with the other GCC countries. Therefore, we have chosen the right partner. However issues related to rules of origin, e-commerce, and government procurement needs to be settled for relatively more gains in future. Carbon taxation may hamper growth rates and consumption marginally though.

INDO PACIFIC ALLIANCE

Indo Pacific alliance of 46 trading partners of India encompassing regions like East Asia, South East Asia, Sub Saharan African nations, West Asian region, some nations in Europe, North America and Latin America brings relatively higher welfare and vgdg growth to India according to GTAP 10 simulations.

Non Tariff Liberalization enhances the gains. Welfare is achieved more in terms of allocative efficiency and terms of trade improvements. Sectors like textiles, light manufacturing, domestic investments and energy intensive industries electricity, water, gas, construction gain in India. East Asians centrality is manifested by its gain in terms of higher relative welfare and positive trade balances.

Sub Saharan African nations loose sectorally in terms of textiles and light Manufacturing. In India and other nations in South Asia returns to land and natural resource becomes negative due to trade Liberalization with 46 nations of the indo Pacific alliances. In case we induce higher inflow and outflow of capital in the Asia Pacific Region along with natural resource endowment induced efficiency, returns to all factors gain in sub saharan Africa. In India also we see all returns to factors gain including land except natural resource.

Africa is enriched by efficiency gains due to inflow of capital and natural resource. However, Vgdg growth is impacted differentially across 46 nations because of trade liberalization and endowment changes with positive gains for India, East Asian and South East Asian region, Oceania and some European nations . Shipping technology brings marginal gains. This analysis also means that covid 19 had deeper impacts on welfare and growth in the region due to its drastic impact on efficiencies and technology triggered by disruptions in provision of endowments of capital and natural resource . Indo Pacific alliance seems to be more geopolitical cum geo economic alliance.

INDIA SSA TRADE RELATIONS AND ITS IMPACT

GTAP10 simulations again. The motivation is the increasing presence of Chinese trade and investments in the 30 Sub Saharan African nations of western, southern and East African region. We also simulate parallelly the impact of India liberalizing its trade with SSA along with outflow of capital to SSA regions. The tariff and non-tariff Liberalization both ways and free flow of capital between SSA and Chinese one way would bring welfare gain for China of the tune of 70519 million us dollars with vgdP growth of one percent while 6620 million us dollars gain for SSA nations.

India will have negative welfare and vgdP growth due to the Chinese economic alignment with SSA nations and SSA outflow of capital to China. SSA would also witness negative growth rates due to negative sectoral impact on textile, light and heavy manufacturing which SSA protects the most by having tariffs peaking 22 percent for textile sector. Factors of production like Natural resource and land would gain the most by this alignment in both set of countries.

If Chinese have free flow of capital into the SSA one way along with trade liberalization their are welfare gains for SSA of the level of 15095 million us dollars, a figure slightly more than what Chinese would gain.. China would see negative trade balance while SSA would see positive trade balance of 1594 million us dollars. Natural resource and land would gain the most in SSA with Chinese trade and capital inflow.

Textiles and light manufacturing are negatively impacted in SSA. vgdP growth would be negative in SSA. All factors like skilled labour, capital and unskilled labour gains in China. If India liberalizes its trade both in terms of tariffs and non tariff barriers and puts capital in SSA, the SSA region gains more in terms of vgdP and has positive trade balance.

Natural resource and land gains the most in SSA region. Manufacturing and textiles gets a boost in both regions along with public utilities, transport and communications and other services in both regions. Therefore, geo economics tells us that it would be prudent on part of SSA to liberalize its trade with India and invite Indian capital for higher relative gains in terms of welfare, trade balance, vgdP and higher productivity growth in heavy manufacturing sector of the SSA.

SAARC

SAARC members can all gain by moving beyond tariff and non tariff liberalization and leapfrogging the process and achieving common market where in their is not only free movement of goods and services but also free movement of factors of production like capital and natural resource to be made available either from the south asian region or from the West. We use GTAP 10 to do three simulations.

The first simulation analyzed free trade across 8 SAARC countries. Second simulation does both tariff and non tariff Liberalization among 8 SAARC nations. Third simulation in addition assumes endowments increase of capital and natural resource. The third scenario is the best for India as all sectors grow in India with welfare levels reaching beyond 13000 million us dollars with growth reaching nearly one percent due to tariff and non tariff Liberalization with inflow of capital and natural resource endowments.

However, we see negative returns for capital and natural resource with corresponding increase in returns to land. Capital and natural resource endowments changes tend to increase returns to skilled and unskilled labour as well . Rybczynski theorem seems to not hold fully in India and Pakistan. In second and third simulations Pakistan, Nepal and Sri Lanka have relatively higher vgdg growth rates.

In summary, SAARC should move from free trade to have non tariff Liberalization and then achieve common market across 8 countries with no move to have customs union in between. In free trade scenario India achieves 1600 million us dollars welfare levels which jumps to 2100 million us dollars in case of tariff and non tariff Liberalization.

After doing more than 100 GTAP simulations it is clear India gains the most in terms of welfare and growth when it liberalizes with all regions, then comes Indo Pacific alliance , then ASEAN, then CPTPP, then EU, then African free trade area, then GCC, BRICS, then other individual nations like US, UK, Singapore among others.

SAARC CUSTOMS UNION

What if SAARC moves ahead from SAFTA to form one South Asian Customs union. This would mean we eight South Asian nations would have tariff and non tariff liberalization along with imposing one common external tariffs for all non member nations imports.

We use GTAP 10 for our analysis to do three simulations. One when eight SAARC nations form a free trade area. Second when they address both tariff and non tariff barriers. Third when in addition they impose minimum common external tariffs against non member regions. It seems from the GTAP results, the third simulation scenario of forming customs union with tariff and non tariff liberalization brings relatively lower welfare and vgdg gains for India than the simulations scenarios of tariff liberalization alone and tariffs and non tariff Liberalization together.

Nepal and Bangladesh would gain from tariff and non tariff liberalization in comparison with scenario of trade liberalization of goods among SAARC nations only. Bangladesh also gains from custom union but not other South Asian members. Pakistan gains in terms of relatively highest vgdg growth in the second simulation scenario of having a free trade area among SAARC nations with liberalization of non tariff barriers.

India's welfare and vgdg growth reaches more than 2100 million US dollars and vgdg growth of 0.77 percent with free trade area and liberalization of non tariff barriers. The welfare reduces to 1400 million us dollars with negative growth with the formation of customs union. What does it suggest. Maybe we South Asians leapfrog the alignment process and form one common market among SAARC member nations or have comprehensive treaty dealing with liberalization of trade in goods, services and investment.

INDIA AUSTRALIA ALLIANCE

India Australia free trade with tariff and non tariff Liberalization favours Australians more than India in terms of welfare and vgdg growth. GTAP 10 simulations further show that extraction and grain and crops gain in Australia while these sectors loose in India with negative growth because of the trade deal.

In India light and heavy manufacturing, transport and communications , domestic investments and business services gain. Welfare levels of India reaches 1300 million us dollars while Australia's welfare is 7 times of India with both tariff and non tariff Liberalization. Vgdg growth is beyond 0.50 percent in Australia while in India it reaches beyond 0.15 percent .

In case Australians provide capital and natural resource endowments to India , it's welfare jumps with higher growth rates. India sees positive returns of all factors except natural resource. Even extraction sector looses. Rybczynski theorem does not hold in India with respect to natural resource.

Rybczynski theorem states that an increase in supply of factor raises the output of the commodity which uses the expanding factor intensively with decline in output of the other commodity which uses non intensive factor intensively. The theorem is based on stringent assumption of wage rental ratios to be constant and hence factor intensities and marginal productivities to be constant.

GTAP SIMULATIONS: INDIA BANGLADESH COMPREHENSIVE TRADE DEAL

As we speak now and write about it, India Bangladesh are negotiating one comprehensive trade deal among themselves. Question is what constitutes comprehensive liberalization policies. We use general equilibrium GTAP and GTAP E models to run various simulations to understand the impact of tariff and non tariff liberalization between India and Bangladesh, along with having freer capital and skilled labour flows in the region, bringing in industrial policy changes by changing productivity of sectors like energy intensive sectors, transport and communication, industry and services, among others including raising of agricultural productivity .

We assume 2 percent improvement in endowment and productivity changes in the model. The welfare gains for India are 11 times more than Bangladesh. VGDP growth becomes positive for Bangladesh if trade and capital flow liberalization is combined with freer skilled labour flows in the region, adoption of industrial policy and agricultural policy by raising of agricultural productivity and productivity of sectors like industry and services along with that of transport and communications .

Bangladesh and India need to go beyond trade and capital flow liberalization to make it possible for Bangladesh to have positive vgdg growth. Designing the treaty would be important. VGDP growth for India is beyond 2 percent with the signing of very comprehensive treaty. The downside is negative trade balance of both the countries with the rest of the world and heavy carbon emissions. The latter can be taken care by imposition of carbon taxation in the region.

We export to Bangladesh cotton yarn, electrical energy, petroleum oils, motorcycles, metals among others. We import from Bangladesh trousers, shirts, vegetable fats and oils, jute products, trunks and suit cases among others. Bangladesh accounts for 2.55 percent of our world exports and .25 percent of our world imports. Domestic investments in India and Bangladesh gain the most followed by processed food sector. In India light manufacturing grows but the same sector is impacted negatively in Bangladesh.

Textile grows in both the countries. Public Utilities grow in both the countries as well. Services also gets the necessary boost due to comprehensive trade. Bangladesh imposes 4.12 percent tariffs on grains and crops from India, 5.10 percent tariffs on Indian Meat and Meat Products, 14.58 percent on extraction products from India, 7.49 percent tariffs on Indian processed food products, 13.16 percent on Indian textiles, 14.70 percent tariffs on Light manufacturing from India and 7.048 percent tariffs on heavy manufacturing from India. Bangladesh protects energy imports, textiles and light manufacturing from India. India's tariffs on an average are lower. India protects its agriculture and processed food sectors with tariffs not exceeding 13 percent.

GTAP E SIMULATIONS

We use GTAP E energy environment general equilibrium model to do four simulations related to India. First is India's bilateral trade liberalization of all goods with the US, EU 27, EEFSU, Annex one countries, net energy exporters, China and Japan. Second simulations adds to trade liberalization, non tariff barriers which are addressed by increasing efficiency and technology by two percentage points bilaterally in India and all its trading partners.

Third simulation adds carbon taxation imposed by all regions and countries of the world including India. Fourth simulations adds technological improvements in three sectors ICT, Financial services and Transport and Communications in India to study its impact on all goods in India. The impact of all simulations are read through its impact on economy wide variables, namely VGDP, welfare , sectoral changes and CO2 emissions, among others. All four simulations from one to ,4 show increasing trend of vgdg and welfare changes with former reaching vgdg growth of 2. 70 and welfare of more than 30000 million us dollars in the 4 th simulation. All simulations except third show positive CO2 emissions scenario for India.

The third simulations under the global policy adoption of carbon taxation of one percent by all regions including India brings negative CO2 emissions in India. The third simulation is the best scenario for India with negative carbon emissions and marginal drop in welfare and vgdg growth with welfare reaching more than 25000 million us dollars and vgdg growth of more than 2 percent. Sectorally gas is impacted negatively in all scenarios / simulations with positive changes in refined oil extraction industry. Domestic investments also grow manifold. It seems carbon taxation with trade liberalization and addressing non tariff barriers can tackle climate change maybe partly.

GTAP E SIMULATIONS

We use GTAPE to run three types of simulations to understand economy wide impact including impact on carbon emissions due to bilateral trade liberalization and imposition of carbon taxation policies on Indian economy, net energy exporting nations and ROW. The GTAP E output shows some interesting results. Net Energy exporters include Indonesia, Malaysia, Mexico, Argentina, Bolivia, Columbia, Ecuador, Venezuela, Iran, Kuwait, Qatar, Oman, Saudi Arabia, Egypt, UAE, Central Africa and Nigeria.

Full bilateral trade Liberalization of India with net energy exporting countries in agriculture, coal, oil, refined petroleum products, gas, electricity, energy intensive industries and rest of industrial products and all services bring welfare of the level of 10000 million us dollars for the net energy exporting countries' and 5000 million us dollars welfare gain for India. We see positive vgdg growth for India and net energy exporting countries. However, the CO2 emissions rate of change turn out to be positive in both the region's due to bilateral trade Liberalization.

The same trend reappears with less intensity with india bilaterally liberalizing it's trade with net energy exporters in energy intensive products only. Energy intensive products include chemicals, Basic pharmaceutical products, Rubber and Plastic products, Mineral products nec, Ferrous metals, Metals nec. Even trading by net exporters of energy in energy intensive products did not reduce rate of change in CO2 emissions in both India and net energy exporting countries.

It is only when carbon taxation of 1 percent all around are imposed and trade Liberalization is done for all products including energy intensive products that we witness reduction in the rate of change in CO2 emissions, that is we see negative rate of change of CO2 emissions in both India and net energy exporting nations. However, carbon taxation reduces welfare and vgdg growth rates all around.

INDIA US TRADE LIBERALIZATION: GTAP E SIMULATIONS

Using GTAP E to run simulations on liberalizing bilateral trade in energy intensive industries and other industry and services between US and India and understand the impact on economy wide variables including CO2 emissions. The above shows up interesting results.

One, energy intensive industries include chemical products, rubber and plastic products, mineral products, ferrous metals, metals nec while other industry and services includes all professional services and industries excluding crude oil and refined oil products, coal, agriculture and electricity. India imposes on an average 8 percent duty on US energy intensive products sold in India while US imposes 0.52 percent duty on Indian energy intensive products into the US.

India imposes 4.14 percent duty on industry and services products coming from the US while US correspondingly imposes meagre 1.934 percent duties on imports of Indian industry products into US. Importantly, the welfare gains of the US reaches nearly 2000 million US dollars with bilateral trade liberalization, leading further to vGDP growth of .05, while for India the vGDP growth is .10 percent growth while welfare is around 500 million US dollars.

More importantly, CO2 emissions for India show negative percent change while for US the percent change in CO2 emissions are positive .02 percent. For India the contributing sectors for negative growth in CO2 emissions are negative percent change in coal, oil and gas while it is positive change in coal in US and refined petroleum products for the US and India. Therefore, to tackle climate change and address CO2 emissions and pollution, we Indians need to liberalize trade with the US in energy intensive and industrial products and services. The same trend reappears if India and US liberalizes non tariff barriers with higher welfare and vGDP gains for the US and India while for latter one also witnesses negative growth in CO2 emissions

INDIA UK TRADE LIBERALIZATION: GTAP E SIMULATIONS

Does carbon emissions reduce with imposition of carbon taxation in the UK and India when both countries form a free trade area and address all non tariff barriers? We use GTAP E to address the above set of three questions through three simulations. The first simulation is of the formation of the free trade area. The second simulation adds accounting for non tariff barriers while the third adds imposition of carbon taxation in both nations.

UK gains more than India in all scenarios in respect of welfare and vgdg growth but has positive CO₂ emissions in all scenarios except when carbon taxation are imposed in both nations. India's welfare and vgdg growth is relatively highest in the second scenario when India forms a FTA with UK and addresses non tariff barriers. It also witnesses reasonable decline in CO₂ emissions in the second simulation.

In the third scenario when India forms a FTA, non tariff barriers are addressed and carbon taxation are imposed in both nations, India's welfare and vgdg relatively declines with salubrious impact on environment, that is CO₂ emissions falls further. India's welfare with FTA formation is meagre 75 million US dollars, which jumps to more than 700 million us dollars when non tariff barriers are also addressed in the UK and India.

Carbon taxation in both nations reduces welfare levels to 400 million us dollars in India. UK gains maximum welfare gain of more than 2400 milion us dollars when free trade area is formed and non tariff barriers are addressed in both nations. Carbon taxation in both nations reduces relatively vgdg growth and welfare marginally in the UK but also reduces CO₂ emissions.

GTAP E SIMULATIONS

We use GTAP E General equilibrium energy environment model to analyze Liberalization of agricultural and processed food markets of India. We study the economy wide impact along with agricultural Liberalization with all region impacts on emissions across regions including India.

Three sectors grow substantially in India. Meat and Meat Products, Oil seeds and Sugar stand out in terms of relatively higher production due to tariff Liberalization. Complete tariff and non tariff Liberalization and inflow and outflow of capital brings higher welfare and vgdg growth.

All factors except capital gains with comprehensive agricultural Liberalization. Of course gains are higher when we liberalize with all regions in all goods. All these Liberalization efforts, of agricultural or all goods with all regions ,brings positive growth in carbon emissions.

Hence, carbon taxation with comprehensive Liberalization brings higher vgdg growth and welfare with carbon taxation marginally compromising growth and welfare levels all around.

INDIA CHINA TRADE LIBERALIZATION: GTAP E SIMULATIONS

Using GTAP E to analyze bilateral trade Liberalization between India and China given that around 14 percent of our imports come from China. We do simulations by liberalizing both ways by imposing zero tariffs on trade in energy intensive industries and all industrial products and services.

We have negative welfare and vgdg growth but negative CO2 emissions. China has 5000 million us dollars welfare gains and positive vgdg growth but higher CO2 emissions.

The other gain besides reduction in co 2 emissions in India is surprisingly all factors gains, land, natural resource, skilled labour, unskilled labour and capital when India bilaterally liberalizes in selected energy intensive products and other industries with China.

Carbon taxation will further reduce vgdg growth and welfare and lead to further reductions in CO2 emissions in India. For china carbon taxation makes their welfare and vgdg growth lower but leads to negative percent change in CO2 emissions. At the end it seems that trade policy and carbon taxation can partly deal with climate change.

INDIA CHINA TRADE DEAL

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INDUSTRIAL POLICY

Can we promote transport and communications sector in India and Japan with adoption of free trade policies and make a case for favourable impact of FTA between India and Japan on the Indian economy?. We use GTAP E for our analysis. We do four simulations together. We impose zero tariffs on each other's goods.

Second, we improve technology of the level of 2 percent in transport and communications sector including air transport, water transport and transport nec to have forward impacts on outputs of all commodities in India and Japan .

Third, we improve technology in shipping keeping transport and communication sector in mind and lastly we augement factors used in transport and communication sector through adoption of new technologies in the transport and communication sector.

There is a massive rise in welfare in Japan of the level of more than 50000 million US dollars while in India welfare which was negative due to only FTA between India and Japan , welfare increases manifold to 20000 million us dollars. Vgdp growth in India though is still negative due to free trade policies and by brining in technology in the transport and communication sector.

Japans vgdg growth is positive but less than one due to comprehensive alignment between India and Japan. CO2 emissions in both India and Japan go up due to FTA Liberalization in goods and due to increase in technology in transport and communication sector. Maybe we need to impose carbon taxation to deal with carbon emissions with commensurate negative impact on vgdg and welfare atleast in India. All factors gain in India including Land and Natural resource.

INDIA INDONESIA COMPREHENSIVE TRADE DEAL

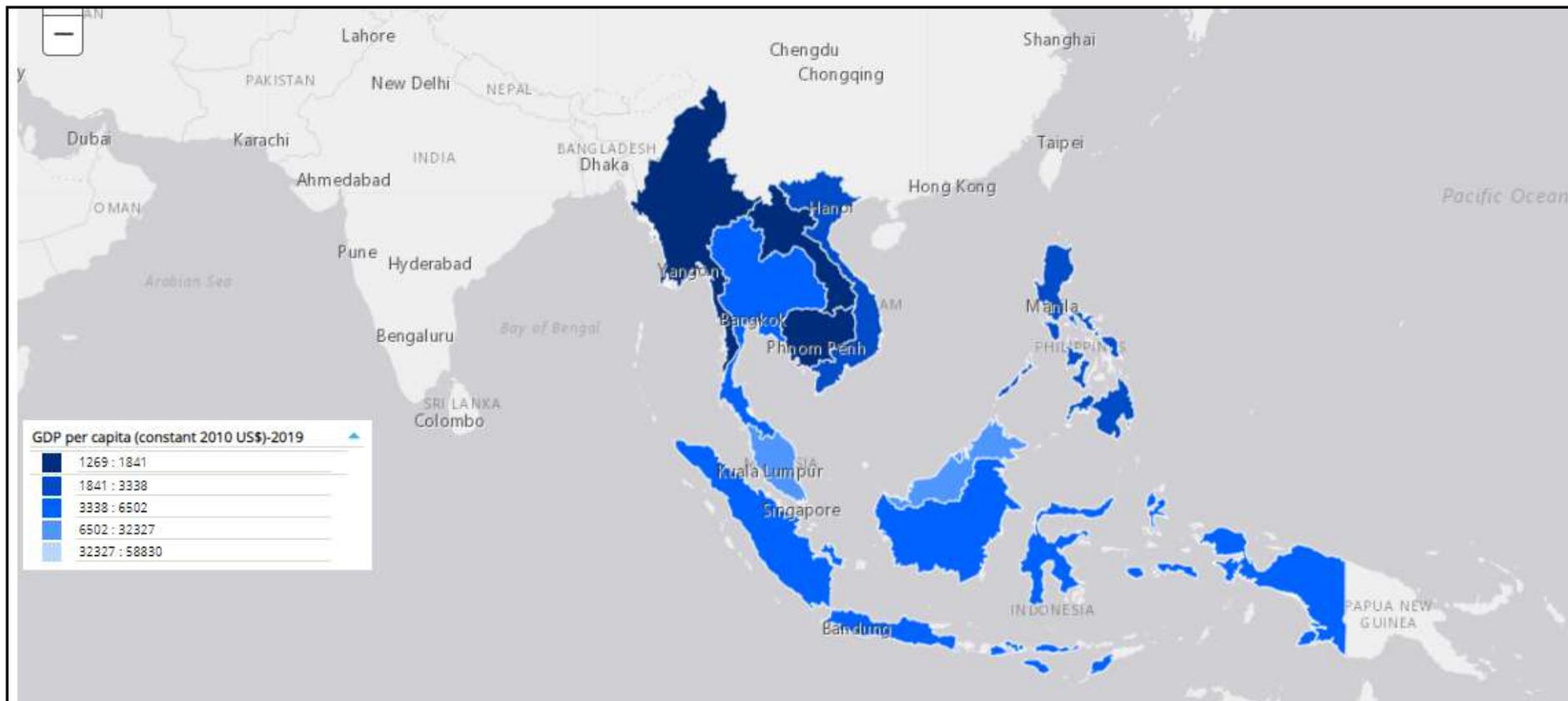
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Of course gains are higher when we liberalize with all regions in all goods. All these Liberalization efforts, of agricultural or all goods with all regions ,brings positive growth in carbon emissions. Hence, carbon taxation with comprehensive Liberalization brings higher vgdg growth and welfare with carbon taxation marginally compromising growth and welfare levels all around.

Country Name	Exports of goods and services (constant 2010 US\$)		GDP (constant 2010 US\$)		GDP per capita (constant 2010 US\$)		Gross fixed capital formation (% of GDP)		Imports of goods and services (% of GDP)	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Indonesia	251593056456	249396217628	1146853725883	1204479845862	4285	4451	32	32	22	19
Malaysia	268927801449	265511350021	382488813364	398946603156	12131	12487	24	23	62	58
Philippines	128046209261	131099618740	340302643541	360858880824	3191	3338	27	27	42	40
Singapore	687637023594	676914609270	333096256634	335538884575	59073	58830	23	23	149	146
Thailand	299329921741	291527950702	442260737640	452674624298	6370	6502	23	23	56	51
Brunei Darussalam	7556517128	8680991712	13485221856	14006979905	31437	32327	41	39	42	51
Vietnam	239708993157	255797764881	187686812137	200857611961	1964	2082	24	24	102	104
Myanmar	19444815028	..	84491238202	86931311984	1573	1608	30	..	30	..
Cambodia	13541517663	14597652341	19542411046	20920953618	1203	1269	23	23	63	62
Lao PDR	..	..	12608863058	13195413135	1786	1841	..	..	..	..

Country	Capital	Area (km ²)	Pop	GDP (nominal BILLION US DOLLARS IMF)	CURRENCY	Official languages
Brunei Darussalam	Bandar Seri Begawan	5,765	423,196	9.07	dollar	Malay
Myanmar	Naypyidaw	676,578	53,582,855	72.36	kyat	Burmese
Cambodia	Phnom Penh	181,035	15,762,370	20.95	riel	Khmer
Indonesia	Jakarta	1,904,569	261,115,456	1074	rupiah	Indonesian
Laos	Vientiane	236,800	6,758,353	18.337	kip	Lao
Malaysia	Kuala Lumpur	329,847	31,976,000	340	ringgit	Malay
Philippines	Manila	300,000	100,981,437 (2015)	310.31	peso	Filipino, English
Singapore	Singapore	707.1	5,612,300 (2017)	294.56	dollar	Malay, Mandarin (Huayu), English, Tamil
Thailand	Bangkok	513,115	68,863,514 (2016)	514.7	baht	Thai
Vietnam	Hanoi	331,690	94,569,072	240.779	đồng	Vietnamese
India	New Delhi	3,287,263	1,324,171,354 (2011)	2,848	rupee	Hindi, English



MAP OF ASEAN NATION'S GDP PERCAPITA (CONSTANT 2010 US\$)

HISTORICAL PERSPECTIVE

ASEAN was established on 8 August 1967 in Bangkok by the five original member countries: Indonesia, Malaysia, Philippines, Singapore, and Thailand. Brunei Darussalam joined on 8 January 1984, Vietnam on 28 July **1995**, Laos and Myanmar on 23 July 1997, and Cambodia on 30 April 1999.

Formed in 1967, **ASEAN** united Indonesia, Malaysia, the Philippines, Singapore, and Thailand, which sought to create a common front against the spread of communism and promote political, economic, and social stability amid rising tensions in the Asia-Pacific.

The ASEAN Community ascertains that the goal of ASEAN's founding fathers of improving the lives of its people is reflected on the region's economic and cultural development, social **progress**, regional peace and **security**, collaboration, mutual assistance in training and research, improvement of living standards

INDIA ASEAN RELATIONSHIP

India's relationship with ASEAN has emerged as a key cornerstone of our foreign policy. The relationship has evolved from the 'Look East Policy' enunciated in early 1990s which led India to become a Sectoral Partner of ASEAN in **1992**, a Dialogue Partner in **1996** and a Summit-level Partner in 2002.

INDIA ASEAN 10 FTA SIGNED IN 2003 BUT CAME INTO FORCE IN 2009 AND TILL DATE WE HAVE 100 BILLION US DOLLARS OF TOTAL TRADE WITH THE REGIONAL GROUPING. India's imports from ASEAN were valued at US\$47.13 billion while its exports to ASEAN stood at US\$34.2 billion IN 2018.

The signing of the ASEAN-India Trade in Goods Agreement paves the way for the creation of one of the world's largest FTAs – a market of almost 1.8 billion people with a combined GDP of US\$2.8 trillion. The ASEAN-India FTA will see tariff liberalisation of over 90 percent of products traded between the two dynamic regions, including the so-called “special products,” such as palm oil (crude and refined), coffee, black tea and pepper. Tariffs on over 4,000 product lines IS eliminated by 2016.

GTAP SIMULATION SCENARIOS: INDIA ALIGNING WITH EAST ASIA AND SOUTH-EAST ASIAN COUNTRIES

What happens if India aligns or have both ways free trade with East Asia comprising of China, Korea, Japan, Brunei, Taiwan, Mongolia, Hong Kong, among others and with South East Asia comprising of ASEAN 9 and other east Asian countries.

Wish to know how such alliance have impact on businesses of paddy rice, vegetable and fruits, wool, fishing, dairy products, motor vehicles and parts, computers and 10 broad product GTAP categories in India and ROW . GTAP 10 simulations.

Although trade balance becomes negative of India and we have marginal growth rate in vGDP, sectors like paddy rice, fishing, dairy products and motor vehicles gain. Heavy manufacturing, computers, extraction industry, processed food, vegetable and fruits, returns to natural capital and wool industry loses.

Textile, light manufacturing, transport and communication, meat and meat products, other services gain. We have welfare gain of more than 5800 million Us dollars. East Asian partners gain more in terms of welfare and growth rates as compared to India.

GTAP SIMULATION SCENARIOS: INDIA ALIGNING WITH SOUTH EAST ASIAN COUNTRIES(ASEAN 10)

How are sectors like paddy rice, vegetables and fruits, wool, fishing, dairy products, motor vehicles, computer industry among other 10 broad GTAP categories impacted if India aligns or have both ways free trade with South East Asia or ASEAN nations .

Our growth rates though lower than that of ASEAN nations as a group but we gain .14 percent in vGDP with more than 5600 million us dollars welfare gain. We do better than any other alliance of India in terms of welfare and vGDP. ASEAN nations or South East nations gain.33 percent in vGDP.

Sector wise wool, dairy products, motor vehicles, meat and meat products, textile, light manufacturing, utilities, domestic investments, gain. Heavy manufacturing, extraction industry, paddy rice, vegetable and fruits, fishing, computers, grain crops and processed food, have negative quantity of outputs. We also have negative trade balance with the World after alliance with South East Asian countries. GTAP 10 simulations.

Services and investment Liberalization may have mutual gains further for India and the ASEAN partners. Middle East and North African alliance of India brings maximum growth of 1. 01 vGDP changes but relatively lower welfare than when India aligns with East Asia and South East Asian partners.

GTAP 10 SIMULATIONS. EVALUATING INDIA ASEAN FTA SINCE 2009

GTAP10 simulations. Who among ASEAN 10 partners gains the most by having free trade both ways with India. Calibration based on country parameters, VGDP and welfare as defined by the GTAP model. It seems that Indonesia, followed by South East Asia comprising of Malaysia and Singapore, then D2 ASEAN 10 countries comprising of Vietnam and Thailand, followed by developing ASEAN 10 comprising of Laos, Cambodia, Phillipines and Myanmar have welfare gain in that order.

Brunei has marginal negative welfare when it has free trade with India both ways. India gains more than 5800 million us dollars welfare gain while Indonesia has more than 1400 million us dollars welfare gain, 1162 million us dollars welfare gain for Malaysia and Singapore, 875 million us dollars gain for Vietnam and Thailand, nearly 100 million us dollars gain for developing ASEAN 10. Indonesia sees 0.82 percent growth rate, Singapore and Malaysia together 0.34 per cent growth while India has nearly 0.08 percent growth due to free trade with ASEAN 10 nations. However, India's trade balance becomes negative basically due to negative fall on trade in grains and vegetables, processed food and extraction industry. All factors in India however gain except natural resource comprising of Shipping, forestry, coal and oil extraction, basic metals.

Light manufacturing, textiles, Meat and Meat Products, utilities, transport and communication and other services in India gets a boost due to the free trade deal of India with ASEAN 10 nations. Surprisingly, China which has historical and cultural ties with ASEAN 10 nations gains by having free trade with ASEAN 10 of the level of nearly 4500 million us dollars but ASEAN 10 as a group has negative welfare losses due to their free trade with China. China it seems alternatively has massive investments and trade in services with ASEAN 10 nations.

China may be imposing lower tariffs on ASEAN 10 exports leading to relatively lower welfare for ASEAN 10 nations. Agriculture, Processed food, Light and Heavy Manufacturing gain the most in ASEAN 10 nations due to free trade deal with India. Domestic investments in India gets a filip due to its free trade deal both ways with ASEAN 10 nations. What happens if ASEAN 10 also has free trade among themselves along with having free trade with India. In that case India's welfare gain are still higher while now Vietnam and Thailand's Welfare gains are relatively maximum followed by that of Singapore and Malaysia. Indonesia is third but still grows at the highest rate. Processed food trade from Singapore and Malaysia like vegetable oils and fats, sugar, dairy products, food products, among others bring gains to their economies.

EVALUATING RCEP TRADE DEAL: GTAP 10 SIMULATIONS

Evaluating 15 nations RCEP trade deal among ASEAN 10, China, Japan, Korea and Oceania comprising of Australia and New Zealand. Surprisingly, Japan followed by Korea, then China and followed by Oceania gain the most in terms of welfare gains. ASEAN 10 have negative 4000 million US dollars as welfare loss. Japan gains more than 22000 million US dollars followed by South Korea gain of more than 11000 million US dollars as welfare changes, China gains around 10000 million US dollars with more than 3300 million US dollars gain for Oceania countries.

Japan and Korea are gaining in terms of GDP growth and welfare despite massive losses to factors like land and natural resources. Korea gains because of higher trade and output of textile, light manufacturing, heavy manufacturing and public utilities. Japan sees growth in light manufacturing and utilities like electricity generation, gas, water and construction.

China gains more than any other RCEP partner if RCEP think of aligning with Latin America, MENA or CPTPP in future. If India joins RCEP, gains for India nearing 6000 million US dollars, with RCEP partners gaining more than China. It is one such unique deal and that may be the reason that RCEP 14 including ASEAN 10 and Japan were keen to have trade deal with India.

India however witnesses negligible changes in growth of GDP as trade balances of India become negative due to losses in extraction and grains and vegetable sector due to being part of RCEP. India ASEAN 10 free trade deal both ways with India seems to be mutually beneficial. Massive gains for Japan and Korea due to RCEP in its present form due to increase in domestic investments.

RCEP AND EXPANDING ALLIANCE

GTAP10 simulations. Where should 15 nations RCEP, an Asian and Pacific alliance look for maximum gains. It seems In any free trade deal both ways with EU28, or north american region or Latin American countries or middle East and North African region it is China which gains the most out of the free trade deal than RCEP 14 together except when RCEP 14 and China aligns with India. Maybe that is the reason that RCEP countries were keen on having trade deal with India. RCEP14 gains the most when it aligns with Latin American region , followed by MENA and followed by north american region. The welfare gain for RCEP14 is minimum when it aligns with EU28 along with maximum gain for China of more than 26000 million us dollars. India gains more when it aligns with RCEP14 without China. With China it brings lower dividends to India. Grains and meat products are adversely affected by its trade with north american Countries. . Textile in RCEP countries gain

GTAP 10 SIMULATIONS: WHO GAINS MORE IF INDIA AND CHINA HAVE FTA WITH ASEAN 10

GTAP 10 simulations. Surprised to find that when ASEAN 10 has free trade both ways with China, the entire ASEAN group as one entity has negative welfare and negative GDP growth while when India has free trade both ways with ASEAN 10, there are mutual welfare gains for both ASEAN 10 and India, ASEAN 10 gaining more than 3400 million us dollars while India has more than 5800 million us dollars gain with 0.10 change in Indian vGDP while ASEAN has .34 percent VGDP changes. Indian trade is 100 billion us dollars with ASEAN 10 but skewed towards the east asian partners, where in we have trade deficit with many of the ASEAN trading partners.

What gets impacted negatively with ASEAN 10 are trade in grains and vegetables, trade in processed food and extraction industry. With China, textile, Heavy and light manufacturing gets impacted negatively in the ASEAN nations and hence returns to skilled and unskilled labour and capital loses. For India, when it has free trade with ASEAN 10 all factors gain except returns to natural capital. China's welfare gains 4500 million us dollars, 1000 million us dollars lower than India, when it has free trade both ways with ASEAN 10.

In India, meat and meat products, light manufacturing, textiles, transport and communications, domestic investments and other services gain by having free trade with ASEAN 10. Strategically it is advisable to align with ASEAN 10. Culture and democratic traditions therefore should become the pillar of the economic and strategic partnership. Any discredit on democratic values lowers the value of the partnerships.

EVALUATING ASEAN 10

Evaluating ASEAN 10 FTA using GTAP10. It seems that developed ASEAN comprising of Brunei, Vietnam, Singapore, Indonesia, Malaysia and Thailand gains the most in terms of the level of welfare by having free trade among ASEAN 10, figuring 414 million us dollars while Laos, Cambodia and South East Asia loose in terms of welfare.

Phillipines also gain in terms of welfare of the level of 162 million US dollars. All developing ASEAN however loose in terms of vGDP by ASEAN FTA. The developed ASEAN gains in terms of trade in grains and vegetables while the developing part gains in terms of unskilled labour, skilled labour and capital by trading in textiles, light Manufacturing with their richer counterpart.

India's FTA with ASEAN 10 brings in around 5900 million us dollars welfare gain for India while more than 3500 million us dollars welfare gain for ASEAN 10. ASEAN 10 grows at vGDP of the level of 0.24 percent while India grows at .11 percent. If India joins RCEP, India's welfare may be more or matching the gains when India liberalizes and have free trade with ASEAN 10.

However, vGDP changes are negligible when India liberalizes with 15 nations RCEP having China as one of the member. In net, liberalizing with ASEAN 10 may be the best way to move forward economically and strategically.

GTAP 10 SIMULATIONS: INDIA ASEAN, INDIA EAST ASIA FUTURE PROSPECTS

Evaluating India ASEAN FTA signed since 2009, India Japan FTA and India Korea FTA using GTAP 10 simulations. ASEAN india total trade touching 100 billion us dollars but we have trade deficit with the group as such. Maximum welfare gains of India of the level of more than 5800 million us dollars while ASEAN gains more than 3800 million us dollars.

Grain trade, processed food, heavy manufacturing and extraction industry gets impacted while all factors gain except natural resource. Transport and Communication and other services gain relatively more by India ASEAN FTA.

Physical and IT connectivity, services and investment Liberalization, maritime security, and education and cultural ties would further strengthen India ASEAN FTA. We may also need ASEAN for China containment policies India Japan and India Korea brings nearly 1000 million and more than 1700 million us dollars gain for Japan and Korea respectively. India's welfare and VGDPT though goes down because heavy manufacturing gets impacted by the free trade deal.

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.

GTAP 10 SIMULATIONS: SAFTA

Revisiting South Asian Free Trade Area using GTAP10 simulations. India, Pakistan, Sri Lanka and Rest of South Asia have positive welfare of the levels of 1680 million us dollars, 307 million us dollars welfare gain for Pakistan, 17 million us dollars for Sri Lanka and 46.77 million us dollars welfare gain for rest of South Asia respectively.

Pakistan witnesses maximum growth among South Asian Countries in value GDP terms of the level of 0.62 percent followed by India of 0.34 percent while all other countries in South Asia have negative growth. Nepal is adversely impacted by SAFTA in terms of welfare. Bangladesh also has negative welfare and negative vGDP changes.

Utilities like electricity, water, construction , transport and communication, domestic investments and in some countries textile sector gains across South Asia by the safta free trade deal. Extraction is one sector which loses with SAFTA. Services and investment Liberalization with reenergizing focus on light and Heavy manufacturing can bring dividends to SAFTA process.

Otherwise, liberalize multilaterally after making efforts to shift comparative advantage in one's own favour by investing in 4 IR technologies, ports and communications , village development and converting agricultural resources into energy and power using biotechnology.

GTAP 10 SIMULATIONS: SAFTA

GTAP 10 simulations. What happens if India has free trade both ways with Pakistan, Sri Lanka, Nepal, Bangladesh and rest of South Asia. India is the only country which has positive welfare of 1680 million us dollars and change in value GDP of 0.35 percent while all other countries have negative welfare and negative value GDP changes. Rest of South Asia comprising of Bhutan, Maldives and Afghanistan though gain from India's free trade deal with the South Asian partners. Trade balance also becomes negative for India with the world.

East Asia gains the most in terms of trade balance. All factors of production except natural resource gains in India. What about other countries. Nepal is majorly negatively impacted. Textile, transport and communication, utilities and Services are few sectors which gain across South Asia. In India textile and light manufacturing gains. Domestic investments across South Asia gains.

It seems that for larger welfare and GDP gains, the South Asian countries need to ideally liberalize multilaterally or side with mega blocks like Indo Pacific, CPTPP, MENA, EU 27 among others. Extraction is one lagging industry which requires positive support across South Asia be it Forestry, Fishing, Oil and coal Extraction, metals among others.

INDIA SAFTA

Who gains the most in terms of welfare if India and Rest of South Asia have two way free trade. GTAP 10 simulations. Welfare gains for India around 2500 million us dollars. Half as it were with respect to ASEAN 10 but substantial gains in sectors like textiles, light and heavy manufacturing. This is happening as average tariffs on such products by other South Asian countries are higher as compared to Indian tariffs.

Other South Asian countries would gain in terms of textiles and wearing apparel. For extraction, grains and processed food one finds all across South Asia including India tariffs higher than world average. India also gains in terms of domestic investments. Transport and communication sector and services sector gains across countries.

GDP of India goes up but with one downside . A negative trade balance.. I want to add in the GTAP model the following assumptions. Unemployment and bring in non tariff barriers, services and investment Liberalization as exogenous variables.

INDIA BIMSTEC

GTAP10 simulations. What happens if India has free trade both ways with BIMSTEC countries. India gains the most in terms of welfare, 2200 million us dollars, followed by Thailand nearing 800 million us dollars.

GDP growth of 0.44 percent in India due to free trade with Bangladesh, Myanmar, Sri Lanka, Thailand, Nepal and Bhutan. Sectors which would grow are textiles, light and heavy manufacturing, meat and meat products, processed food, grains and vegetables, utilities like electricity, gas, construction, among others. Other South Asian nations would loose in terms of welfare.

China has maximum welfare loss due to India's alliance with BIMSTEC countries . All factors of production gain, Land, skilled and unskilled labour except natural resource as extraction industry in india is negatively impacted leading to negative trade balance with the rest of the world.

As Mekong countries and south east nations are added in the alliance welfare goes up for India but not higher than the scenario when India liberalizes with all followed by ASEAN 10 ,RCEP, Indo Pacific,CPTPP, MENA, EU 27, 54 nations African FTA,GCC, among others.Services and investment Liberalization would bring further dividends to India. Trade deficit with Thailand would go up though

GTAP 10 SIMULATIONS: UK AND EU BEYOND BREXIT

Where should UK look for trading partners after brexit. GTAP 10 simulations and analyzed based on vGDP, Equivalent variation or welfare, trade balance, and real returns to factors. Overall if one makes an assessment it seems that UK should align with East Asia and South East Asia to have over 7000 million us dollars welfare gain with .71 growth in VGDP.

All other alignments brings relatively lower welfare and VGDP growth. Such alignments includes UK aligning with the CPTPP, South Asia, North America, India, MENA, SSA, Latin America, Oceania, Russia, CIS republics among others.

INDIA BRICS

GTAP E simulations are done using the energy environment general equilibrium model for analyzing potential FTA among BRICS nations with trade and non tariff liberalization happening between all member nations. The three simulations done ranging for trade Liberalization alone, then with tariff and non tariff Liberalization and third trade and non tariff Liberalization with imposition of carbon taxation in all BRICS nations brings relatively lowest dividends in India across 5 nations in terms of welfare and vgdg growth. India also witnesses positive growth in carbon emissions .

China has the maximum gains in terms of welfare and vgdg growth followed by Brazil, then Russia and South Africa followed by India. Carbon emissions in all countries can be tackled by imposition of carbon taxation in all BRICS nations. It seems that Free trade and carbon taxation can tackle carbon emissions but at the cost of marginally reduced welfare and vgdg growth .

INDIA BRICS

GTAP 10 simulations show that lowest welfare and vGDP growth rate for India happens in a scenario when India has free trade both ways with Russia in comparison with Brazil and South Africa. Russia has negative welfare too. Returns to land and natural capital decline with free trade. 270 million us dollars welfare gain with Russia, 800 million us dollars welfare gain with Brazil and 400 million us dollars gain when we align with South Africa. vGDP growth of south africa is maximum , 0.24 percent, if India and South Africa form alliance within the BRICS alliance. Trade in grains and natural resources negatively impacted in India

INDIA BRICS

What if India has free trade both ways with other BRICS countries, namely Brazil, Russia, China and South Africa. Chinese gain the most in terms of welfare, more than 4200 million US dollars while South Africa vGDP grows at the highest rate at 0.23 percent. India would witness welfare levels of more than 800 million us dollars with growth of vGDP to be .01 percent.

Russia is the only country which loses from the free trade of India with the other BRICS countries. This trade would bring dividends to unskilled, skilled and capital as textile and light manufacturing is promoted in India. Grain trade and returns to land are adversely affected by the free trade deal. Public Utilities also gain by such trade. However, the welfare gains for India are much higher ,24000 million us dollars if India liberalizes multilaterally and touches nearly 5500 million us dollars if India liberalizes with East asia.GTAP10 simulations.

Trade balance of China and Russia are positive post alliance while for India they are negative. Why in all simulations India's trade balance becomes negative. Does it mean that our exchange rate needs further corrections or depreciation of Indian rupee.

INDIA ALIGNING WITH DEMOCRATIC 9 COUNTRIES

What happens if India has free trade both ways with D9, that is Democratic 9 countries, including G7 nations, Korea and Australia. G7 includes UK, US, Japan, Canada, France, Italy and Germany. Welfare gains for D9 more than 5000 million us dollars with India's welfare turning out to be more than around 4000 million us dollars. The latter figure are similar to when India liberalizes it's trade with the mega blocks CPTPP, EU 27, MENA and 54 nations African free trade area.

Returns to land and natural resource are expected to become negative, meaning extraction and grains and vegetable industry are negatively impacted by the new alignment with the developed nations including G7 plus Korea and Australia . Unskilled labour gains the most followed by skilled labour and capital. Textile industry prospers the most in India followed by light manufacturing.. It may be noted using GTAP 10 simulations ,Any grouping with East Asia and South East Asia without china gives India relatively higher welfare gains. Aligning with 9 democratic countries means transport and communication, utilities and services also gaining in terms of value addition. The free trade deal between India and other D9 countries using GTAP 10 assumes only tariff Liberalization. Additional gains due to services and investment Liberalization.

What is negatively impacted are trade balance of India and D9 countries with rest of the world. East Asian and MENA countries' gain in terms of trade balance but loses in terms of welfare. India sees a GDP growth of 0 .59 percent while D9 sees .03 percent growth rate in GDP . Extraction and Heavy Manufacturing gets negatively impacted by this free trade deal of India with the G7 nations plus Korea and Australia

INDIA LIBERALIZING STRATEGICALLY AND MULTILATERALLY

What happens if India joins RCEP with China in the grouping and when if at some stage China is not part of 15 nation East Asia Oceania grouping called RCEP. GTAP 10 simulations. It seems that our welfare goes down when China is part of RCEP from 5400 million us million when it is not part of it to 4735 million us dollars when China is in RCEP.

At present China is part of RCEP We have larger gains when China is not part of RCEP and we have free trade with 15 nations RCEP both ways. Also trying to asses and simulate India's free trade gain both ways with 54 nations African Free Trade area, 5 nations South African Customs Union, With BIMSTEC countries, having free trade with South Asian countries, having alliance with Ganga Mekong nations and having free trade with 6 nations latin American MERCOSUR countries. 4200 million us dollar welfare gain if we have two way free trade with African FTA nations.

Highest gain remain when India aligns with ASEAN 10 followed by RCEP and Indo Pacific alliance. Bimstec, South Asian alliance brings around 2000 million US dollars welfare gain for India. Half the amount if we align with Ganga Mekong nations. SACU alliance gives more relative welfare gain to India than aligning with MERCOSUR, but gains are not exceeding 1000 million us dollars.. East asia gains more if we look east.

INDIA LIBERALIZING IF STRATEGICALLY AND MULTILATERALLY

GTAP10 simulations when India liberalizes with all countries and regions of the world with zero tariffs imposed both ways. India's gain worth more than 23000 million us dollars in terms of welfare.

India's GDP gains are much higher than the rest of the world. ASEAN 10, north american region and rest of the world gain with India's multilateral Liberalization effort in terms of Welfare gain.

The sector which gains the most are textile and ready made garments, followed by meat and meat products and transport and communications. Multilateral liberalization promotes light manufacturing and domestic investments in India.

GTAP 10 SIMULATIONS: ASEAN 10 OR RCEP OR INDO PACIFIC ALLIANCE

GTAP 10 simulations for today. Where do we have maximum welfare gains as defined in GTAP model? Aligning with ASEAN 10, RCEP or EAS or Indo Pacific region.

It seems surprisingly the maximum welfare gains of more than 5500 million us dollars are with ASEAN 10 nations with which we already have a free trade area. RCEP and Indo Pacific welfare gains are relatively lower for India but greater than aligning with CPTPP, MENA, EU 28, Latin American regions, among others.

Sectoral outputs and trade balances improve for Meat and meat Products and Light Manufacturing if we align with ASEAN 10. Utilities and transport and communication gain for all. This happens when we have tariff Liberalization both ways with trading blocks. In addition if we have services and investment Liberalization, there would be additional benefits.

Economically and strategically we need to strengthen our relations with the East Asian partners. Downside negative trade balance with all three trading blocks and processed food, heavy manufacturing and extraction industry are negatively impacted the most. If we compare with our possible alignment with Comprehensive Progressive Trans Pacific Partnership, CPTPP, the eleven member mega trading block, EU 27, Middle East and North Africa and Latin American regions, the welfare gains are maximum if we align with ASEAN 10.

Of course, if we align with all welfare gains would be maximum, that is multilateral Liberalization is the best unilateral strategy. Were we then right by aligning with ASEAN 10 only and not RCEP. Should we look west wards or in all directions

INDIA MIDDLE EAST FTA

What happens if India has free trade both ways with middle East nations ranging from Iran, Israel, Saudi Arabia, Oman, Qatar, Kuwait, Bahrain, Turkey among other west asian nations. India gains the most with welfare gain of 3700 million us dollars. All factors gain including land except natural resource .

Why in all such simulations India's trade balance with rest of world decline. 0.85 percent growth in value GDP in India because of its alliance with West Asia. 0.12 percent growth for middle East nation's. Maximum gains for India when it liberalized with all nations both ways of the level of 23000 million us dollars.

INDIA AUSTRALIA FTA

GTAP10 simulations. If Australia asks us to have free trade both ways in areas where they have a comparative advantage. Processed food, grains and vegetables, Meat and Meat Products and Extraction. Australia would surely gain more in terms of welfare change and change in value GDP .

Reason being our tariffs for processed food coming from Australia are on average 45 percent, for grains and crops 23 percent, for meat and meat products they are 5 percent while for extraction they are 3 percent.

Australian tariffs are relatively lower for the above agri , extraction and allied products coming from India. India would gain by trading in textiles, light and heavy manufacturing. Services, utilities and transport and communication and investment Liberalization are added advantages for serving Indian interests

INDIA AUSTRALIA FTA

India Australia Free Trade deal simulations using GTAP10 model. It seems Australia would gain more in terms of changes in welfare and value GDP compared to India. Australia would see change of 0.23 percent change in value GDP while India would witness .05 percent improvement in GDP due to tariff reduction both ways with target rate of 0.

Welfare change would be around 750 million us dollars for Australia while it would be 450 million us dollars for India. In Australia sectors which would gain would be heavy manufacturing, grains and crops and extraction in terms of value added and industry output.. In India Light manufacturing, textiles and transport and communications and utilities would grow with the potential free trade between India and Australia. Business in East Asia and North America would be impacted by this free trade deal.

In India trade balance with world would become negative with extraction sector witnessing maximum negative trade balance. Deal would be good in promoting employment in India as sectors related to manufacturing would grow. However, fact remains India would see much larger gains if it liberalized multilaterally or with regional or mega trade blocks.

NAFTA, INDIA AND EAST ASIAN COUNTRIES ALLIANCE

Including NAFTA countries US, Mexico and Canada in GTAP 10 simulations show that when they have free trade alliance with East Asian region and South East Asian region, NAFTA gains the most in terms of welfare rather than aligning with EU28, Latin America, South Asia, Oceania among others. Grains and vegetables and land gains the most when NAFTA allies with East Asia.

Welfare gains of NAFTA of the level of 12000 million US dollars and East Asia and South East Asia welfare gains are of the level of 18000 million US dollars. Surprisingly, When NAFTA aligns with South Asia we gain more than NAFTA nations, US, Canada and Mexico all together. NAFTA aligning with MENA and Latin America brings negative welfare for these two regions but substantial gains for NAFTA nations but not the one that US, Canada and Mexico get and gain when they align with East Asia. Imagine if RCEP and NAFTA align or when mega trade blocks CPTPP and RCEP aligns Won't then it be better that we have multilateral Liberalization under the aegis of the WTO.

WHAT AFTER BREXIT? A GENERAL EQUILIBRIUM IMPACT ON THE EU AND UK ECONOMIES

What happens after Brexit to economies of the UK and the EU? We use GTAP 10 model to do three simulations. We analyze economy wide impact by assuming tariffs schedule in two regions to be minimum tariffs existing for each product across regions with non tariff Liberalization and inflow and outflow of capital happening across two regions, second by assuming tariffs to be averages across regions for each product with non tariff liberalization and free flow of capital and third simulation with assumption of maximum tariffs across regions for each product with non tariff Liberalization and free flow of capital between EU and UK.

It is pretty clear that first simulation with minimum tariffs along with non tariff Liberalization and free flow of capital among the EU and the UK brings relatively higher dividends for both EU27 and the UK than the other scenarios. Brexit seems to be regressive step with tariff escalation hurting the UK more than EU economies. However, land gains in the UK while natural resource factor gains in EU 27 with only tariff escalation. Non tariff Liberalization and free flow of capital across two regions can tide the negative impact of Brexit and tariff escalation, and bring positive welfare and vgdg growth in both countries.

Therefore, UK and EU should consider imposing the existing minimum tariffs for each product across regions on each other's products and open up its capital markets and address non tariff barriers for maximum gains in terms of welfare and vgdg growth. We base our research on the basis of GTAP data base consisting of US and UK tariff schedule with all regions of the world like Oceania, East Asia, South East Asia, South Asia, North America, Latin America, India, China, MENA, SSA, ROW for each of the broad products namely Grains and Grain crops, Meat and Meat Products, Extraction, Processed food, Metal Products, Textile and Textile products, Light Manufacturing and Heavy Manufacturing.

US has relatively higher average tariffs of 6.30 percent for textile and textile products across all products while its average tariffs across regions are highest with respect to China with tariff reaching meagre 2.84 percent before tariff war. UK has highest average tariffs across products for meat and meat products with tariffs reaching 15.012 percent and highest average tariffs across regions for South East Asian region with tariffs reaching 12.27 percent. EU also imposes higher average tariffs for meat and meat products across products and has highest tariffs across regions

HARD OR SOFT BREXIT

Hard Brexit or soft Brexit and what does it entail for India. We gain in terms of welfare when we have hard Brexit, that is when tariff and non tariff barriers are imposed with no export subsidies. Chinese gain the most among the rest of the world with MFN tariff barriers and with business as usual with other non tariff barriers and no export subsidies, that is with hard Brexit.

Welfare level goes down more for UK than EU27 when hard Brexit happens as compared to situation with soft Brexit, that is when only MFN tariffs are imposed. However, UK loses more in terms of GDP with soft Brexit than hard Brexit and it is opposite for EU27.

Hard or soft Brexit, it is good for grains, meat and processed food, light and heavy manufacturing in UK, while have downside impact on domestic investments and businesses of utilities like gas, water and electricity. For EU minimal gains with respect to extraction and other services with Brexit. GTAP 10 simulations

INDIA CANADA FTA

Using GTAP 10 to analyze India Canada FTA. The two common sectors which would gain in Canada and loose in India are grains and crops and extraction. Welfare levels reaches around 600 million us dollars in both countries while Canada's vgdg growth is beyond 0.10 percent while India is below 0. 10 percent growth. US and EU are impacted negatively by the alliance.

Textile sector in India grows the most followed by light manufacturing and then domestic investments. If India joins NAFTA US and Mexico's vgdg growth and welfare improves substantially in comparison with situation of only NAFTA alliance between US, Canada and Mexico. In NAFTA alliances Canada seems to be the main gainer while other two nations loose out. The fact remains NAFTA gains the most if it aligns with the East Asian nations. Grains and vegetables in Canada and meat businesses are two sectors which gain due to NAFTA alliance or NAFTAs alliance with other nations and regional groups.

Technological improvements in health sector in India brings more dividends to all sectors in India all around. We Indians seem to protect grains and crops and processed food coming from NAFTA region with Mexicans facing relative lower tariff than products coming from the US and Canada. US seems to have relatively the lowest tariffs for the Indian products.

AGRICULTURAL TRADE LIBERALIZATION

We tend to protect our agricultural and processed food markets more than any other set of goods in terms of imposing higher relative tariffs on imports of grains and vegetables including wheat, rice, oil seeds, vegetable oil and others along with processed food including dairy products coming from rest of the world.

Our natural resource and land returns to factors also become negative in all our Liberalization with rest of the world with maybe exceptions when we liberalize with China and Japan. We use GTAP 10 to do three different type of simulations for India. We liberalize our agriculture and processed food sector with all regions of the world by bilaterally imposing zero tariffs with all regions of the world.

Second simulations are done by liberalizing all goods with all regions of the world. Third simulations we assume Oceania, East Asia and we Indians, three in all, increase endowments of natural resource in India, along with having bilateral liberalization of all goods with East Asian region and Oceania countries. The first set of simulations of agricultural Liberalization brings more sectoral changes in wheat, oil seeds and dairy production. Vegetable oil and fat sector loses. Welfare levels reaches nearly 2000 million US dollars in India.

The welfare levels reaches 20000 million us dollars with tariff and non tariff Liberalization of the agricultural markets. The welfare levels are however higher when India liberalizes with all regions in all products with welfare reaching more than 26000 million us dollars. When natural resource endowments go up in all scenarios with Japanese and Australians helping us, among others, returns to natural resource becomes negative.

It seems Rybczynski theorem does not apply in India and there is presence of factor sensitivity due to changes in endowments levels of natural resource. Maximum growth and welfare levels in India happens when we liberalize with all regions with vgdg growth of 4.64 percent. Agriculture and processed food tariff liberalization brings 0.62 percent growth in India. Tariff and non tariff Liberalization of agriculture and processed food markets brings 0.76 vgdg percent growth in India.

EXPOST SIMULATIONS DONE BY SMART MODEL: INDIA US TRADE ALLIANCE

Single market partial equilibrium analysis model is applied to analyze India US Free trade Area where in one way trade liberalization happens when India reduces its tariffs to zero on products coming from the US. The products covered are 97 industrial and agricultural goods as defined in the SMART model. SMART model gives trade creation and Trade diversion values, welfare, exports before and after liberalization and revenue loss for total trade and product wise values.

The welfare impact in India is working out to be 732 million us dollars while trade creation for India with US is 6372 million us dollars. With trade diversion US has added business of more than 2000 million us dollars. Trade gets diverted from Rest of North American region of Canada, Brazil and Chile in Latin America, Ghana, Israel and Kuwait in MENA, France, Italy, Germany, Belgium in the EU, China, Hong Kong, Indonesia, Japan and Korea in the East Asia. East Asian region is impacted the most with China getting impacted the most. The revenue loss for India is 2000 million us dollars but the figure is less than total trade effect because of the free trade deal one way.

SMART model is based on three elasticities, import demand elasticity, import substitution elasticity and export supply elasticity. Generally small country assumption is made while analyzing free trade deals.

FDI FLOWS AND INDIA

Mauritius, Cyprus and Singapore seems to be the trading partners with which India needs to have FDI agreements where in their are free bilateral inflow and outflow of capital from India.

All sectors would gain in India including all factors of production except capital. Welfare jumps to 10000 million us dollars from below 100 million us dollars if we go beyond free trade to have one trade in investment treaty with such countries including Mauritius, Cyprus and Singapore.

Singapore we can understand, a great destination for forward linkages of GVCs in trade in services. The ICT sector may get a boost due to capital inflow and outflow of capital from Singapore. But Mauritius and Cyprus. Any reasons. Good for us anyway. GTAP 10 simulations.

GTAP SIMULATIONS AND THE ROADMAP TO ALIGNING WITH THE OTHER COUNTRIES/REGIONS

India is contemplating early harvest or possibly comprehensive economic treaties with the US, UK, UAE, Brazil and EU 27. We use GTAP 10 to study and simulate economy wide impact of tariff and non tariff liberalization on 141 regions of the world including in India and its major trading partners like US, UK, EU27, UAE, Brazil , among others transcending 65 GTAP defined products aggregated into ten broad products and across five factors of production, skilled and unskilled labour, capital, land and natural resource.

On the basis of welfare as defined in GTAP and vgdg growth, India's maximum benefit in terms of serial order lies with the EU27, then US, then UAE, then UK and finally Brazil. Aligning with western democracies like the EU, US and the UK would promote sectorally in India textiles the most followed by domestic investments, public utilities or energy sector and finally transport and communications.

If India aligns with Brazil and UAE, relatively welfare and vgdg gains would be lower but sectorally apart from above sectors mentioned, the light and heavy manufacturing and processed food in India would also grow. It seems that in India skilled labour, unskilled labour, capital would grow but definitely natural resource factor would loose by bilateral Liberalization. Land would also loose depending on which regions of the world are providing heavy subsidies leading to depressed world prices of agricultural commodities and further impacting Land with negative returns. Welfare and vgdg gains in second simulation, comprising of tariff and non tariff liberalization always brings larger gains to all regions including India than only tariff liberalization. However, liberalization with one region always brings welfare losses and negative vgdg growth in others regions.

India seems to have relatively higher growth when it bilaterally liberalizes with the US, UK and the EU 27. What happens if India simultaneously decide to have tariff and non tariff Liberalization with all regions US, UK, UAE, EU27 and Brazil at the same time? India has maximum welfare benefit of more than 11000 million US dollars followed that of the EU 27, then the US, then UK and the UAE and finally the least gainer is Brazil. In all the simulations India's bilateral Liberalization brings negative trade balance for India suggesting that our exchange rate may be overvalued.

RTA PRINCIPLES



Regional blocks powerful tool in international affairs

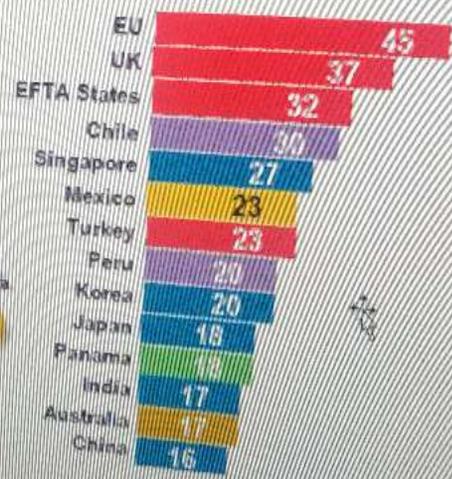
As of 15 October 2021, 350 RTAs were in force. These correspond to 568 notifications from WTO members, counting goods, services and accessions separately.

Number of RTAs notified to WTO



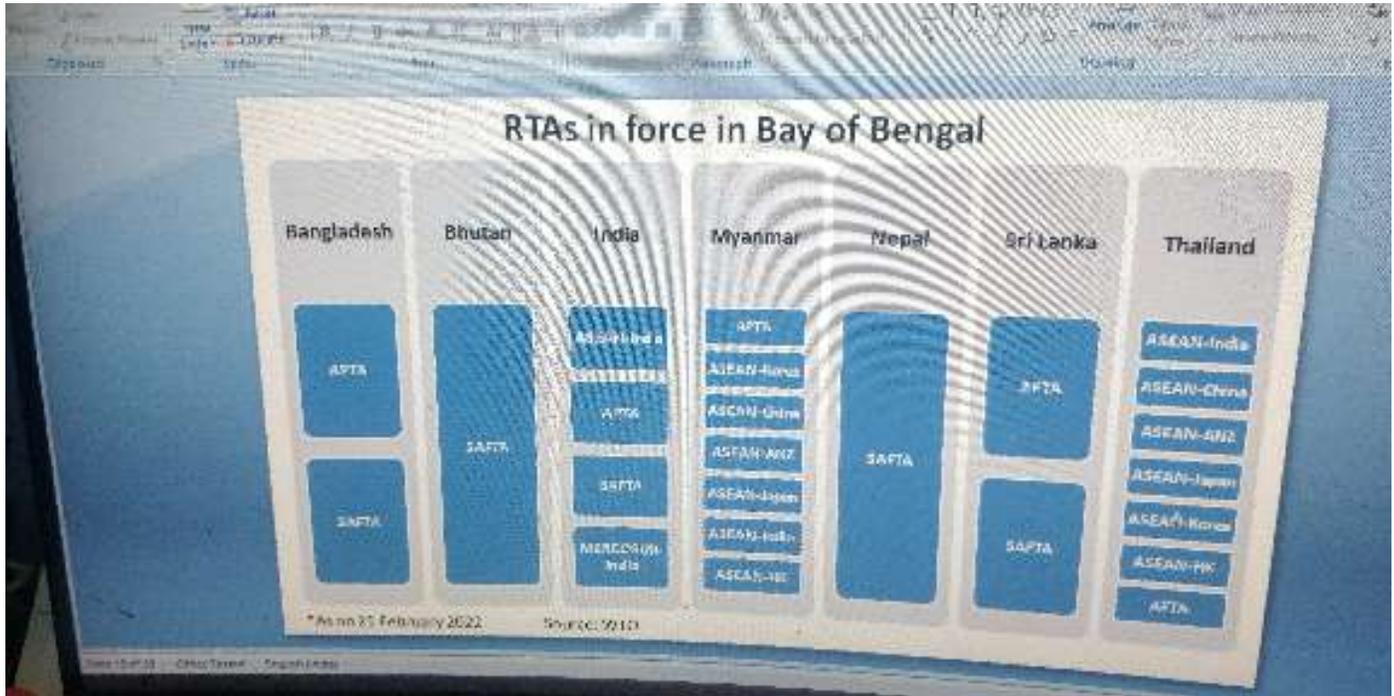
Source: WTO

The biggest "users" of RTAs



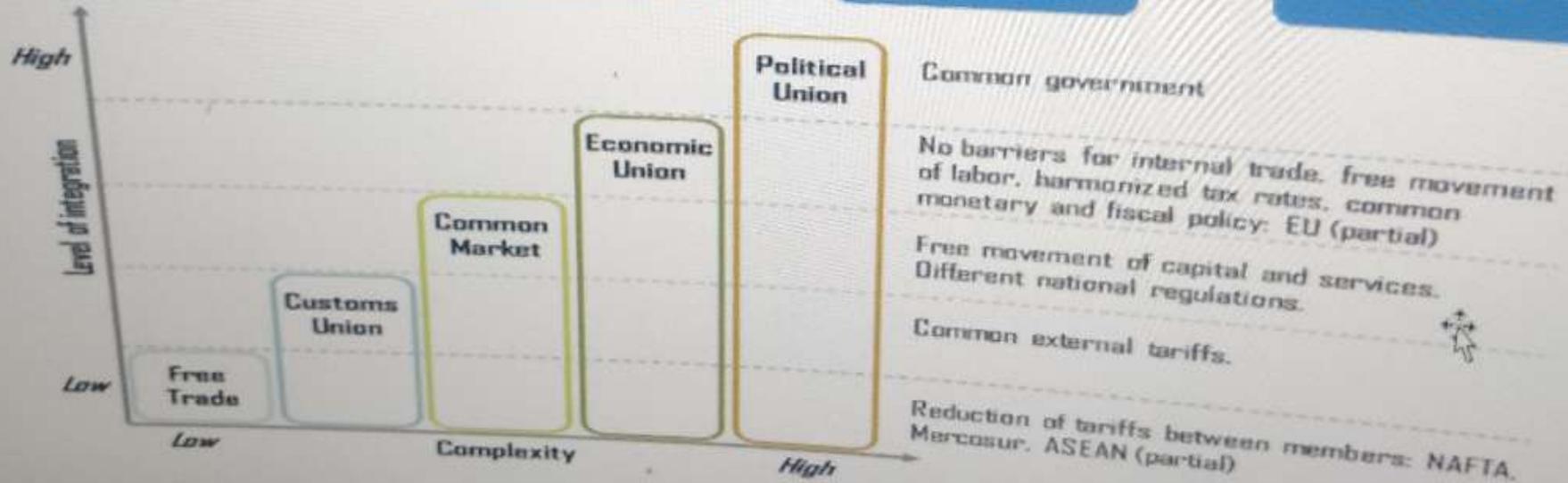
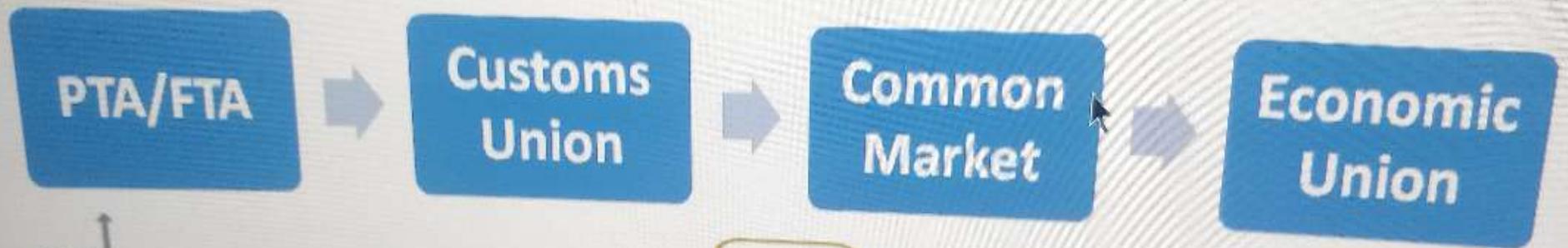
How did past FTAs affect trade?

Authors	Increase in Intra-trade	Dataset	Special features
World Bank <i>GEP 2005</i> (2005)	120%	17 research studies	Meta-analysis, mostly naïve models
<u>Cippolina & Salvatici</u> <i>REStat</i> (2010)	84%	1460 estimates	Meta-analysis, cross-section and individual FTA studies
Head & Mayer <i>Handbook</i> (2014)	43% - 80%	108 - 257 estimates	Meta-analysis, naïve and structural models
Baier et al. <i>CESifo WP</i> (2016)	70%	1965-2010, every 5 years	Panel, general equilibrium, endogenous FTA, two margins
Egger et al. <i>Am Ec J</i> (2016)	215% - 255%	CEPII 2005	General equilibrium, endogenous FTA
Limão <i>Handbook</i> (2016)	82%	5-year panel 1965-2010	General equilibrium, dynamic, endogenous FTA



Types of economic integration and level of complexity

Bella Balassa, *Towards A Theory of Economic Integration*, 1961



Typology of integration schemes

		PTA	FTA	CU	CM	EcU	EMU	FEI	PU
Freedom of movement within the community	Goods (tariff)	none	partial	full	full	full	full	full	full
	Goods (non-tariff)	none	partial	full	full	full	full	full	full
	Services	none	partial	full	full	full	full	full	full
	Capital	none	partial	full	full	full	full	full	full
	Labour force	none	partial	full	full	full	full	full	full
Common external barriers	Goods (tariff)	none	partial	full	full	full	full	full	full
	Goods (non-tariff)	none	partial	full	full	full	full	full	full
	Services	none	partial	full	full	full	full	full	full
	Capital	none	partial	full	full	full	full	full	full
	Labour force	none	partial	full	full	full	full	full	full
Common policies	Customs tariff	none	partial	full	full	full	full	full	full
	Monetary policy	none	partial	full	full	full	full	full	full
	Economic policies	none	partial	full	full	full	full	full	full
	Sovereign policies	none	partial	full	full	full	full	full	full

Preferential trade agreement (PTA), Free Trade Area (FTA), Customs Union (CU), Common Market (CM), Economic union (EcU), Economic and monetary union (EMU), full economic integration (FEI)

Source: Author

CONCLUSIONS

GTAP and GTAPE Simulations show

Trade always have unequal impact on returns to factors of production. We need to undertake a holistic view and understand economy wide impact of external liberalization

Besides economic concerns , safeguarding security interests are primary factors if we need to look east and act east.

Trade policy need to be aligned with industrial policy and human capital formation for maximum gains.

India seems to be rich in skilled labour, capital and unskilled labour with scarcity of land atleast reflected in relatively higher prices in urban areas and negative real returns once liberalization takes place. Also, we see shortages of natural capital. Freer capital flows can spur positive returns to natural resource and land.

India gains the most in terms of welfare when we align with the mega blocks in terms of welfare. We need to go beyond our discussion of getting constrained by trade deficits with the countries and study economy wide impact of liberalization measures. Maybe trade deficits have to be reflected in changes in our exchange rates

The best strategy remains. Liberalize Multilaterally

SFA , LP and DEA are parametric and non parametric approaches for working out efficiency and productivity of the DMUs. Inefficiencies can be due to noise and inability to convert judiciously inputs into output. In India inefficiency in manufacturing can be curtailed by import of raw material, increasing R and D, adoption of ICT and 4IR technologies, financial services, agglomeration and neighborhood effects.

20:19

The screenshot shows the RStudio IDE interface. The main editor window contains R code for data analysis. The code includes several `describe()` calls for variables like `avgthroughput`, `berthnumber10`, `berthLength10`, `depth10`, `terminalarea10`, `yardgranyno10`, and `shipshore.orquay.granty10`. It also includes `class(data)`, `str(data)`, and `matrix()` operations. A `with()` function is used to create a matrix `y` from selected variables. The code then defines a `play` function and calculates efficiency using `1-eff(play)*x`. A comment indicates that a variable returns to scale. The code ends with a `dea()` function call.

The right-hand pane shows the 'Environment' tab with a 'Data' section containing a data object with 38 observations and 14 variables. Below this is the 'User Library' section, which lists installed packages:

Name	Description	Version
abind	Combine Multidimensional Arrays	1.4-5
acepack	ACE and AVAS for Selecting Multiple Regression Transformations	1.4.1
arm	Data Analysis Using Regression and Multilevel/Hierarchical Models	1.10-1
askpass	Safe Password Entry	1.1

The Windows taskbar is visible at the bottom of the screen. It includes the Start button, a search icon, and several application icons. The system tray on the right shows the date and time as 1:23 AM on 12/27/2019, along with network and volume icons.



20:20



Go to file/function Addins

```

23 y <- read.csv("data.csv", as.is=TRUE)
24
25 #calculating efficiency
26 #####
27 #variable returns to scale
28 #dea(x,y, RTS="vrs", ORIENTATION = "in")
29 bcc<-dea(x,y, RTS="vrs", ORIENTATION = "in")
30 bcc
31 shapiro.test(bcc$eff) #to check normality
32
33 eff(bcc)
34 data.frame(bcc$eff)
35 summary(bcc)
36 s1<-slack(x,y,bcc)
37 data.frame(eff(bcc),eff(s1),s1$slack,s1$xs,s1$sy,lambda(s1))
38
39 dea.plot(x,y, RTS="vrs", ORIENTATION = "in-out")
40 dea.plot.frontier(x,y, txt=1:dim(x[1]))
41
42
35:73 (Untitled) R Script

```

```

Console Terminal Jobs
-/
3 0.9226645
4 0.7117317
5 0.8386808
6 0.8382512
7 0.8575082
8 0.8713889
9 1.0000000
10 1.0000000
11 1.0000000

```

Environment History Connections

Global Environment

Data

bcc	List of 12
data	38 obs. of 14 variabl...
s1	List of 10
x	num [1:38, 1:6] 7 6 7...
y	num [1:38, 1] 3159568...

Files Plots Packages Help Viewer

Install Update

Name	Description	Ver...
<input type="checkbox"/> abind	Combine Multidimensional Arrays	1.4-5
<input type="checkbox"/> acepack	ACE and AVAS for Selecting Multiple Regression Transformations	1.4.1
<input type="checkbox"/> arm	Data Analysis Using Regression and Multilevel/Hierarchical Models	1.10-1
<input type="checkbox"/> askpass	Safe Password Entry	1.1

Review

Filter commands here

Command .rc

1 clear

2 xtset id year

3 gen logy=log(outp

4 gen logL=log(emp...

5 gen logK=log(capi...

* (7 variables, 1316 observations passed into data editor)

```
xtset id year
  panel variable: id (strongly balanced)
  time variable: year, 1970 to 2016
  delta: 1 unit
```

```
. gen logy=log(output)
```

```
. gen logL=log(employment)
```

```
. gen logK=log(capital_stock)
```

Command

```
sfpanel logy logL logK year, model(tfe) dist(tn) e(mean(importa_share) ort(o))
```

Variables

Filter variables here

Name	Label
industry	INDUSTRY
year	YEAR
id	ID
output	OUTPUT
capital_stock	CAPITAL_STOCK
employment	EMPLOYMENT
imports_share	IMPORTS_SHARE
logy	
logL	
logK	

Properties

Variables

Name	imports_share
Label	IMPORTS_SHARE
Type	float
Format	%8.0g
Value label	
Notes	

Data

Filename	
Label	
Notes	
Variables	10
Observations	1,316
Size	87.39K

22:57

Document1 - Word

File Home Insert Design Layout References Mailings Review View Tell me what you want to do

Calibri (Body) 11 A Aa

Clipboard Font Paragraph Styles Editing

Stochastic Frontier Analysis (Aigner, et al., 1977)

This video demonstrates the application of a stochastic frontier model in STATA.

$$\ln \text{Output}_{it} = \ln f(\text{Labour}_{it}, \text{Capital}_{it}, T, \beta) + (v_{it} - u_{it})$$

```
sfpnl logy logk year, model(tfe) dist(tn) emean(imports_share) ort(o)
```

TPE

$$u_{it} = f(z)$$

Input oriented technical efficiency

Page 1 of 3 10 of 117 words English (South Africa) 100%



Review

Filter commands here

Command .rc

1 drop bc

. drop bc

Command

```
stforce inoutput inlabour incapital, model(bc) dist(tn) ort(o) emean(
```

I

Variables

Filter variables here

Name	Label
obs	OBS
experience	MARKET_DISTANCE
lnoutput	LNOUTPUT
lnlabour	LNLABOUR
lncapital	LNCAPITAL

Properties

Variables

Name	Label
incapital	LNCAPITAL
Type	float
Format	%8.0g
Value label	
Notes	

Data

Filename	Label
Notes	
Variables	5
Observations	1,238
Size	23.90K

Review

Filter commands here

- # Command
- 1 drop bc
- 2 sfcross lncapital ln...
- 3 predict bc, jlrts
- 4 sum bc

Log likelihood = -152.4550

	lnoutput	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Frontier						
lnlabour	.3657634	.0175864	20.80	0.000	.3312947	.400232
lncapital	.532876	.0110193	48.36	0.000	.5112785	.5544734
_cons	.6627592	.0647775	10.23	0.000	.5307976	.7897208
Ma						
experience	-.2778153	.0376515	-7.38	0.000	-.3516108	-.2040197
_cons	-2.66274	.317589	-8.39	0.000	-3.285145	-2.040336
Voigma						
_cons	-.2199666	.1024295	-2.15	0.032	-.4207247	-.0192085
Voigma						
_cons	-3.563741	.0528502	-67.43	0.000	-3.667325	-3.460156
sigma_u						
sigma_u	.8958491	.0658907	13.53	0.000	.8102906	.9904417
sigma_v	.148323	.004448	33.34	0.000	.1398271	.1572205
lambda	5.322202	.0474047	112.27	0.000	5.229291	5.415114

. predict bc, jlrts

. sum bc

Variable	Obs	Mean	Std. Dev.	Min	Max
bc	1,288	.8943858	.0650637	.6122939	.9785641

Command

Variables

Filter variables here

Name	Label
obs	Obs
experience	MARKET_DISTANCE
lnoutput	LNOUTPUT
lnlabour	LNLABOUR
lncapital	LNCAPITAL
bc	Technical efficien...

Properties

Variables

Name	experience
Label	MARKET_DISTANCE
Type	float
Format	%8.0g
Value label	
Notes	

Data

Filename	
Label	
Notes	
Variables	6
Observations	1,288
Size	28.93K

Stata/MP 13.0 - D:\salman\asi data paper\EE PAPER\main file\stata dta - Copy.dta - [Results]

File Edit Data Graphics Statistics User Window Help

Statistics/Data Analysis

MP - Parallel Edition

Copyright 1980-2013 StataCorp.
4905 Lakeway College Station, Texas 77845
800-STATA-PC 979-696-4600
979-696-4601

3-user 8-core Stata network perpetual license:
Serial number: 501306208483
Licensed to: IDRE-UCLA
IDRE-UCLA

Notes:

1. (/v# option or -set maxvar-) 5000 maximum variables

. use "D:\salman\asi data paper\EE PAPER\main file\stata dta - Copy.dta"

. do "C:\Users\Khalid\AppData\Local\Temp\STD000000\stata.dta"

. xtset cc year, yearly
panel variable: cc (strongly balanced)
time variable: year, 2004 to 2013
delta: 1 year

end of do-file

Command

D:\salman\asi data paper\EE PAPER\main file

Do-file Editor - coman stata

File Edit View Project Tools

coman stata Untitled.do

```
1 #cob-douglas production function
2 xtset cc year, yearly
3 ###Battese and Coelli (1995) Inefficiency effect Model (
4 sfpanel ene cap mat lab vgo, model(bc95) emean(sop labpro capint)
5
6 ###Pitt and Lee (1981) half normal distribution##
7 sfpanel ene cap mat lab vgo, model(pl81)
8
9 ###Schmidt and Sickles (1984) Fixed effect model
10 sfpanel ene cap mat lab vgo, model(fe)
11
12 ###Kumbhakar (1990) TV Truncated Normal Distribution
13 sfpanel ene cap mat lab vgo, model(kumb90) |
14 panel: efficiency, 1.15
```

Ready Line: 13, Col: 43 CAP NUM OVR

Notes

Data

Filename stata dta - C

Label

Notes

Variables 10

subtracted from the bootstrapped sample's moments when minimizing the objective function for that bootstrapped sample. This restores the consistency of the bootstrap approach in the construction of standard errors.

3 Stata implementation

3.1 Syntax

```
levpet devar [if exp] [in range, first(varname) proxy(varname)  
  capital(varname) [valueadded|revenue] justid grid 1(varname)  
  t(varname) reps(#) level(#)]
```

⁹See Horowitz (2001) for an overview of the bootstrap and a discussion of the necessity of recentering.

15:09

The screenshot shows a mobile application interface for editing Stata do-files. The main window is titled "Do-file Editor - command tfp*" and contains a Stata script with the following content:

```
1 xtset cc year
2
3
4 levpct vgo, free(labour energy) proxy(material) capital(capital) valueadded
5 predict TFP, omega
6
7 //omega requests the predicted levels of productivity
8 //Predict assumes that the production function inputs are in log levels
9
end of do-file
.do "C:\Users\Khalid\AppData\Local\Temp\1\Stata_12\stata_12.do"
.predict TFP, omega
end of do-file
```

Below the script, a regression results table is displayed:

	Coef.
vgo	
labour	.04029
energy	1.1729
capital	.57148

At the bottom of the screen, a command window shows the execution of the do-file: `do "C:\Users\Khalid\AppData\Local\Temp\1\Stata_12\stata_12.do"`. The status bar indicates "Ready" and "Line: 5, Col: 18".