TERM PAPER

Stochastic Frontier Analysis of India's Trade with Gulf Cooperation Council (GCC): Assessing Trade, Economic Integration and Export Potential

TEAM: Stochastic

Submitted to :

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ABSTRACT

- This paper seeks to closely analyze India’s trade relations with the GCC. It also explores India’s export potential to the GCC with which a Free Trade Agreement (FTA) was signed on 25th August 2004.
- Considering the uniqueness and the importance of India's relation with the GCC, we’ll add a few modifications to the stochastic frontier gravity model (SFGM) discussed by Ebaidalla M. Ebaidalla & Mohammed Elhaj Mustafa Ali (2023) to account for the finer and unique details in India-GCC trading relations, making our model more robust.
- The modifications would take the form of a few dummy variables accounting for important factors like diaspora, trade affinity, common languages, etc. The “augmented” stochastic frontier gravity model would then be used to analyze India’s trade relation with GCC, look at the export flows, etc.
- The coefficients thus obtained will be used to carry out an impact analysis of the FTA which partially came into effect in 2008-09.

OBJECTIVE

- The objective of this research proposal is to evaluate the potential for trade integration between the GCC nations and India, and identify the factors affecting trade flows between them using the stochastic frontier gravity model (albeit with a few modifications) along with the technical efficiency.
- We will also analyse the impact of India-GCC FTA on India's trade with GCC countries. At last, to cap off our analysis, we'll calculate the export potential of India to the various GCC members, based on the derived model by estimating the coefficients.

INTRODUCTION

- For India, the GCC as a whole has enormous geographic and economic significance. The Gulf nations make up India's "immediate" neighbourhood, with the Arabian Sea serving as the only physical barrier. The GCC has historically had strong trading ties with India, but those ties have recently been seeing new heights as the GCC has emerged as a major trading partner for India. It also has humongous potential to be India's investment partner in the near future
- Another aspect of this relationship is that India's energy needs are greatly dependent on the GCC's large oil and gas reserves
- Labour migration is also a crucial link between these two sides, with the Gulf countries being host to a very large Indian diaspora, approximately 8.5 million in number in 2021. As a result, the Indian expatriate community in the Gulf region is the source of huge amounts of remittances for India, leading to an inflow of large amounts of foreign exchange into India

LITERATURE REVIEW

- The gravity model of trade has widely been used to analyse the determinants of bilateral trade flows. It was first proposed by Jan Tinbergen.
- Anderson and van Wincoop (2003) introduced the idea of adding the exchange rate to the gravity model, showing that it can significantly improve the model's explanatory power.
- They further developed the gravity model by introducing a variable called the "multilateral resistance," which measures the overall trade barriers faced by a country.
- Baier and Bergstrand (2007, 2009) made significant contributions to the analysis of the impact of FTAs on trade flows. They used the gravity model with the multilateral resistance term to analyse the impact of FTAs on trade flows between countries.
- Samir Pradhan (2009) explored India’s export potential to the six-member countries of Gulf Cooperation Council (GCC) using a simple augmented gravity model, and used OLS with panel data (1994-2004) to estimate the model.
- Then, Imran Alam and Shahid Ahmed (2018) made some improvements to the gravity model being used for analysing the trade between India and GCC, by introducing a few more relevant dummy variables like “diaspora”, etc.

RESEARCH GAP

- We use the stochastic frontier gravity model (SFGM) developed by Ebaidalla M. Ebaidalla & Mohammed Elhaj Mustafa Ali (2023), albeit with a few modifications (in the form of a few dummy variables, some of which have previously been used by researchers but only with traditional gravity models) to analyze India-GCC trade, and to evaluate trade determinants and trade potentials.
- The estimates from our model would then be used for assessing the export potential of India, and also analyzing the effects of FTA on India's trade with GCC and its other major trading partners (USA, China, Russia).
- Overall it aims to be more robust (accounting for important variables like MTR terms, etc.) and use the recently developed modelling techniques (SFGM) for the gravity model, along with innovations like "diaspora" dummy variables of the past researchers, and also try to predict more things. We also take technical efficiency into account.

METHODOLOGY

- Our paper would be based on an “augmented” (modified) stochastic frontier gravity model of trade. The model will be estimated using a panel data framework that includes data on bilateral trade flows, economic size, distance, language similarity, shared borders, and trade agreements between the GCC countries and India.
- The stochastic frontier gravity model also considers inefficiencies in the trade process, such as trade barriers etc.
- To model the trade creation effect, we can estimate the change in India’s trade flows with GCC countries after the implementation of FTA, holding other factors constant
- To address the inherent bias of the standard gravity model of trade and to estimate potential trade flows, this study uses the stochastic production frontier approach presented by Kalirajan (1999) to overcome the limitations of the conventional gravity model.

METHODOLOGY

- The stochastic frontier gravity model incorporates the gravity model, the stochastic frontier technique, and a non-negative error factor. In particular, the non-negative error term refers to inefficiencies “behind the border” in the exporting nation that hinder it from reaching its trading frontier. On the other hand, the random word encompasses all other disturbances, including “beyond the border.” We can use the gamma coefficient to understand the variation in total trade due to ‘behind the border’ effects.

$$\gamma = \left[\frac{\sum_t \sigma_{ut}^2}{\sum_t \sigma_{ut}^2 + \sigma_{vt}^2} \right]$$

- **square(σ{ut})** is the variance of the one-sided error term at time t, whereas square(σ{vt}) is the variance of the two-sided error term at time t.

METHODOLOGY

- After estimating the parameters, the point estimates of technical efficiency can then be measured using Battese and Coelli's (1988) formula:

$$TE[-\mu_{ijt}|\epsilon_{ijt}] = \left[\frac{1-(\sigma_* - \mu *_{ijt}/\sigma_*)}{1-(-\mu *_{ijt}/\sigma_*)}\right] exp(-\mu *_{ijt} + \sigma_*^2/2$$

- where square(μ * {ijt}) = ε{ijt} − square(σ{v})/σ{μ} and (.) is the standard normal density function. Estimates of technical efficiency for each country-pair range from zero to one.
- The conventional gravity model can be converted to an SFGM variant as follows:
- **Trade{ijt} = f(GDP{it};GDP{jt}; POP{it}; POP{jt}; DIS{ij}; Z{ij}; X{ijt})exp(V{ijt}−u{ij})**
- Here, **V{ijt}−u{ij}** is the error term. There are two components to the error term: the two-sided (V{ijt}) and one-sided error terms (u{ijt}). The two-sided error element (V{ijt}) represents the influence on trade flows of other variables, such as measurement mistakes and the implicit beyond-the-border constraints that are beyond the control of the exporting country and are randomly distributed throughout the sample data. Whereas the one-sided error term (u{ijt}) reveals the cumulative effects of "behind the border" restraints on trade and identifies the degree to which actual trade volumes depart from the maximum possible level.

TECHNICAL EFFICIENCY

- Battese and Coelli (1988) proposed a formula for calculating technical efficiency (TE) in a stochastic frontier gravity model. The formula is: **TE(i) = exp(-u(i))**
- Here i refers to the i-th firm in the sample and u(i) is the inefficiency term for the firm. The inefficiency term is assumed to be a random variable that captures the deviation of firm i's observed output from its optimal output level given its inputs.
- The inefficiency term u(i) is decomposed into two parts: a stochastic component v(i) and a deterministic component x(i)β, where x(i) is a vector of firm i's input values and β is a vector of unknown parameters. The formula is written as: **u(i) = x(i)β + v(i)**
- The stochastic component v(i) is assumed to follow a half-normal distribution with zero mean and variance σ(v^2), while the deterministic component x(i)β is non-negative.
- Using this formula, TE(i) is estimated by taking the ratio of the observed output y(i) to the estimated optimal output level y(i)*. The estimated optimal output level is calculated as y(i)* = exp(x(i)β), and is obtained by maximizing the likelihood function of the model given the data.
- Therefore, the Battese and Coelli (1988) formula for TE(i) can be written as:
- **TE(i) = y(i) / exp(x(i)β + v(i)**
- This formula measures the extent to which firm i is operating at its optimal output level given its inputs, with a TE value of 1 indicating that the firm is fully efficient and values less than 1 indicating inefficiency.
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MODEL

- The full gravity model to investigate the determinants of India's trade performance can be stated as follows, based on the available literature and the preceding discussion, and also adding a few relevant dummy variables . We will utilise both time and country fixed effects to add the MTR term. (i refers country i, j refers country j and t refers time period (year))

- **lnTrade{ijt} = α{ij} + β1lnGDP{it}+β2lnGDP{jt} + β3lnDIST{ij} + β4lnPOP{it} + β5lnPOP{jt} + β6lnREX{it} + β7lnREX{jt} + β8lnMTR{it} + β9Diaspora{ij} +β10TradeAffinity{ij} + β11lnINFR{it} + β12lnINFR{jt} + β14lnINS{it} + β16lnINS{jt} + β18TA_FTA{ij} +β20COMCOL{ij} + v{ij} − μ**
- Here, MR{ij} is the multilateral trade resistance term defined as follows -

$$MR_{ij} = \sum_{k} \left(\frac{Y_k}{Y}\right)^{\theta} \left(1 + D_{ik}^{\gamma}\right)^{-\alpha} \left(1 + D_{jk}^{\gamma}\right)^{-\beta}$$

MODEL PARAMETERS

- TA{ij}, which reflects the vector of time-invariant explanatory factors, is added to the gravity model. TA{ij} is a dummy variable that indicates membership in a trade integration. It is basically used to model India-GCC FTA practically.
- TradeAffinity (Trading Affinity) – If a country has on average more than one per cent share in India's global trade from 2004 to 2023, then dummy value will be one otherwise it will be zero. Expected sign of trading affinity is positive.
- Diaspora - If average numbers of country i Diaspora population in country j is more than one per cent of total population of country j for the period of 2004 to 2023, dummy value will be one otherwise it will be zero. Expected sign of Diaspora is positive.
- COMCOL - If both countries have had a common colonizer, hence some similarities, giving synergy in trade. It is a dummy variable.

MODEL PARAMETERS

- Apart from this, the other variables are -
- GDPit/jt : Gross Domestic Product of country i/j
- POPitj/t : Population of country i/j
- DISij : Distance between countries i & j
- REXit/jt : Real Exchange Rate of country i/j
- INFRit/jt : Infrastructure level in the country
- INSit/jt : Quality of institutions in the country
- Vijt - u : Error term

PARAMETER ESTIMATION

- We will be estimating the above model using the following estimators:

1. Random effects
2. Fixed effects

- We will be using Stata for the estimation.

- The gravity model's capacity to forecast future trade flows between two sides is another helpful feature. Using the coefficient value from the augmented gravity model, the trade potential between India and the GCC has been determined. The entire trade potentials for the most recent time, 2023, have been estimated by the study. India's potential for trade with the GCC is determined by the ratio of the computed trade value from the augmented model (P) to the actual trade value between India and the GCC countries (A).

FIXED AND RANDOM EFFECTS

- Now we move onto one of the methods of estimation; the fixed effects model. We know that the fixed effects models are useful because they control for unobserved heterogeneity between individuals or entities that is constant over time, which OLS cannot do. We will run the code for the fixed effects model and see if the results are mostly of sobriety and matching the expectations.
- To check and account for unobserved heterogeneity, we also try the random effects model using the respective code for it and check its results too. We will also store the results data of both the codes for comparing the two effects.

DATA SNAPSHOT

ır	Countries	trade_ijt	gdp_it	gdp_jt	pop_it	pop_jt	dis_ij	rex_it	rex_jt	infr_it (1 to 5	infr_jt (1 to 5	ins_it (scalec	ins_it	ins_jt (scaled	ins_jt	cb_ij	ta_ij (FTA	mtr_ij	COMLANG	COMCOL	TradeAffinity	Dia
2004	India-Kuwait	421.44	7,09,00,00,00,000.00	59,40,00,00,000.00	1,14,00,00,000.00	21,53,481.00	3,305.00	45.32	0.29	2.82	2.49	0.41	-0.45	0.65	0.77	0.00	1.00	5.97	0.00	1.00	0.00	
2005	India-Kuwait	513.73	8,20,00,00,00,000.00	80,80,00,00,000.00	1,15,00,00,000.00	22,35,403.00	3,305.00	44.10	0.29	2.83	2.56	0.43	-0.36	0.60	0.50	0.00	1.00	5.07	0.00	1.00	0.00	
2006	India-Kuwait	614.81	9,40,00,00,00,000.00	################	1,17,00,00,000.00	23,63,409.00	3,305.00	45.31	0.29	2.86	2.59	0.45	-0.27	0.59	0.43	0.00	1.00	4.61	0.00	1.00	0.00	
2007	India-Kuwait	681.54	12,20,00,00,00,000.00	################	1,19,00,00,000.00	25,06,769.00	3,305.00	41.35	0.28	2.90	2.64	0.42	-0.40	0.57	0.36	0.00	1.00	5.30	0.00	1.00	0.00	
2008	India-Kuwait	797.50	12,00,00,00,00,000.00	################	1,21,00,00,000.00	26,50,930.00	3,305.00	43.51	0.27	2.90	2.67	0.43	-0.34	0.58	0.41	0.00	1.00	4.08	0.00	1.00	0.00	
2009	India-Kuwait	782.45	13,40,00,00,00,000.00	################	1,22,00,00,000.00	27,95,550.00	3,305.00	48.41	0.29	2.95	2.69	0.41	-0.45	0.56	0.30	0.00	1.00	6.32	0.00	1.00	0.00	
2010	India-Kuwait	1,856.01	16,80,00,00,00,000.00	################	1,24,00,00,000.00	29,43,356.00	3,305.00	45.73	0.29	2.91	3.45	0.41	-0.46	0.56	0.30	0.00	1.00	7.30	0.00	1.00	0.00	
2011	India-Kuwait	1,181.41	18,20,00,00,00,000.00	################	1,26,00,00,000.00	31,43,825.00	3,305.00	46.67	0.28	2.89	3.22	0.39	-0.54	0.52	0.08	0.00	1.00	5.91	0.00	1.00	0.00	
2012	India-Kuwait	1,061.08	18,30,00,00,00,000.00	################	1,27,00,00,000.00	33,94,663.00	3,305.00	53.44	0.28	2.88	3.23	0.40	-0.51	0.46	-0.20	0.00	1.00	5.26	0.00	1.00	0.00	
2013	India-Kuwait	1,061.14	18,60,00,00,00,000.00	################	1,29,00,00,000.00	36,46,518.00	3,305.00	58.60	0.28	2.99	3.34	0.40	-0.52	0.46	-0.20	0.00	1.00	5.34	0.00	1.00	0.00	
2014	India-Kuwait	1,198.89	20,40,00,00,00,000.00	################	1,31,00,00,000.00	37,61,584.00	3,305.00	61.03	0.28	2.88	3.34	0.41	-0.46	0.45	-0.25	0.00	1.00	6.26	0.00	1.00	0.00	
2015	India-Kuwait	1,247.51	21,00,00,00,00,000.00	################	1,32,00,00,000.00	39,08,743.00	3,305.00	64.15	0.30	3.01	3.41	0.42	-0.41	0.45	-0.25	0.00	1.00	9.13	0.00	1.00	0.00	
2016	India-Kuwait	1,497.99	22,90,00,00,00,000.00	################	1,34,00,00,000.00	40,48,085.00	3,305.00	67.20	0.30	3.34	3.47	0.43	-0.34	0.44	-0.30	0.00	1.00	10.50	0.00	1.00	0.00	
2017	India-Kuwait	1,365.66	26,50,00,00,00,000.00	################	1,35,00,00,000.00	41,24,904.00	3,305.00	65.12	0.30	3.21	3.48	0.44	-0.29	0.43	-0.36	0.00	1.00	10.95	0.00	1.00	0.00	
2018	India-Kuwait	1,333.92	27,00,00,00,00,000.00	################	1,37,00,00,000.00	43,17,185.00	3,305.00	68.39	0.30	2.91	3.39	0.45	-0.23	0.44	-0.32	0.00	1.00	9.78	0.00	1.00	0.00	
2019	India-Kuwait	1,286.56	28,40,00,00,00,000.00	################	1,38,00,00,000.00	44,41,100.00	3,305.00	70.42	0.30	3.01	3.48	0.44	-0.30	0.47	-0.16	0.00	1.00	10.44	0.00	1.00	0.00	
2020	India-Kuwait	1,054.20	26,70,00,00,00,000.00	################	1,40,00,00,000.00	43,60,444.00	3,305.00	74.10	0.31	3.02	3.48	0.44	-0.29	0.48	-0.09	0.00	1.00	12.59	0.00	1.00	0.00	
2021	India-Kuwait	1,241.93	31,50,00,00,00,000.00	################	1,41,00,00,000.00	42,50,114.00	3,305.00	73.92	0.30	3.11	3.56	0.44	-0.32	0.49	-0.06	0.00	1.00	11.50	0.00	1.00	0.00	
2022	India-Kuwait	1,560.45	34,20,00,00,00,000.00	################	1,42,00,00,000.00	42,68,873.00	3,305.00	78.60	0.31	3.25	3.59	0.44	-0.32	0.53	0.13	0.00	1.00	9.77	0.00	1.00	0.00	
2004	India-Bahrain	156.46	7,09,00,00,00,000.00	13,20,00,00,000.00	1,14,00,00,000.00	8,33,451.00	2,955.00	45.32	0.38	2.82	3.20	0.41	-0.45	0.59	0.44	0.00	1.00	26.86	0.00	1.00	0.00	
2005	India-Bahrain	192.25	8,20,00,00,00,000.00	16,00,00,00,000.00	1,15,00,00,000.00	9,01,921.00	2,955.00	44.10	0.38	2.83	3.21	0.43	-0.36	0.58	0.38	0.00	1.00	25.63	0.00	1.00	0.00	
2006	India-Bahrain	184.52	9,40,00,00,00,000.00	18,50,00,00,000.00	1,17,00,00,000.00	9,70,981.00	2,955.00	45.31	0.38	2.86	3.24	0.45	-0.27	0.54	0.19	0.00	1.00	25.41	0.00	1.00	0.00	
2007	India-Bahrain	252.47	12,20,00,00,00,000.00	21,70,00,00,000.00	1,19,00,00,000.00	10,40,532.00	2,955.00	41.35	0.38	2.90	3.41	0.42	-0.40	0.54	0.18	0.00	1.00	28.11	0.00	1.00	0.00	
2008	India-Bahrain	286.52	12,00,00,00,00,000.00	25,70,00,00,000.00	1,21,00,00,000.00	11,10,343.00	2,955.00	43.51	0.38	2.90	3.44	0.43	-0.34	0.54	0.18	0.00	1.00	23.35	0.00	1.00	0.00	
2009	India-Bahrain	250.21	13,40,00,00,00,000.00	22,90,00,00,000.00	1,22,00,00,000.00	11,79,453.00	2,955.00	48.41	0.38	2.95	3.36	0.41	-0.45	0.54	0.18	0.00	1.00	29.26	0.00	1.00	0.00	
2010	India-Bahrain	651.83	16,80,00,00,00,000.00	25,70,00,00,000.00	1,24,00,00,000.00	12,13,645.00	2,955.00	45.73	0.38	2.91	3.36	0.41	-0.46	0.54	0.18	0.00	1.00	32.68	0.00	1.00	0.00	
2011	India-Bahrain	439.99	18,20,00,00,00,000.00	28,80,00,00,000.00	1,26,00,00,000.00	12,12,077.00	2,955.00	46.67	0.38	2.89	3.00	0.39	-0.54	0.54	0.21	0.00	1.00	31.60	0.00	1.00	0.00	
2012	India-Bahrain	603.47	18,30,00,00,00,000.00	30,70,00,00,000.00	1,27,00,00,000.00	12,24,939.00	2,955.00	53.44	0.38	2.88	3.08	0.40	-0.51	0.57	0.37	0.00	1.00	29.80	0.00	1.00	0.00	
2013	India-Bahrain	639.36	18,60,00,00,00,000.00	32,50,00,00,000.00	1,29,00,00,000.00	12,61,673.00	2,955.00	58.60	0.38	2.99	3.24	0.40	-0.52	0.59	0.43	0.00	1.00	28.62	0.00	1.00	0.00	
2014	India-Bahrain	472.98	20,40,00,00,00,000.00	33,40,00,00,000.00	1,31,00,00,000.00	13,11,134.00	2,955.00	61.03	0.38	2.88	3.04	0.41	-0.46	0.55	0.27	0.00	1.00	30.54	0.00	1.00	0.00	
2015	India-Bahrain	654.14	21,00,00,00,00,000.00	31,10,00,00,000.00	1,32,00,00,000.00	13,62,142.00	2,955.00	64.15	0.38	3.01	3.28	0.42	-0.41	0.52	0.11	0.00	1.00	33.76	0.00	1.00	0.00	
2016	India-Bahrain	471.71	22,90,00,00,00,000.00	32,20,00,00,000.00	1,34,00,00,000.00	14,09,661.00	2,955.00	67.20	0.38	3.34	3.10	0.43	-0.34	0.49	-0.05	0.00	1.00	35.56	0.00	1.00	0.00	

Link to data file :- http://surl.li/sqmnf

DATA SOURCES

World Bank's World Development Indicators (for data on Real GDP, population, diaspora and infrastructure): World

- Development Indicators | DataBank (worldbank.org)
- Ministry of Commerce and Industry, Govt. of India (for export import data): Export Import Data Bank (Monthly) - Mcommerce
- Centre D' Etudes Prospectives et D' Informations Internationales (CEPII) (COMLANG and COMCOL data): CEPII - Gravity
- Geographical distances were procured using Google Maps satellite data: Google Maps
- World Bank's World Integrated Trade Solution (WITS): World Integrated Trade Solution (WITS) | Data on Export, Import, Tariff,
- NTM (worldbank.org)
- International Monetary Fund's Direction of Trade Statistics (for data on trade volume): Direction of Trade Statistics (DOTS) -
- dataset by imf | data.world
- UNCTAD database (for data on both the tariffs and trade): UNCTADstat
- For Institutional quality we have used the control of corruption variable as a proxy Worldwide Governance Indicators from worldbank.org
-

CODE

```
* first normalise the variables *

gen logY = log(trade_ijt/1000)
gen logX1 = log(gdp_it/100000000000)
gen logX2 = log(gdp_jt/100000000000)
gen logX3 = log(dis_ij/1000)
gen logX4 = log(pop_it/1000000000)
gen logX5 = log(pop_jt/1000000000)
gen logX6 = log(rex_it/100)
gen logX7 = log(rex_jt/100)
gen logX8 = log(mtr_ij)
gen X9 = Diaspora
gen X10 = TradeAffinity
gen X11 = log(infr_it1to5)
gen X12 = log(infr_jt1to5)
gen X14 = log(ins_itscaled)
gen X16 = log(ins_jtscaled)
gen X18 = ta_ijFTA
gen X20 = COMCOL



* define panel data *

xtset id Year

* run panel sfa *

sfpanel logY logX1 logX2 logX3 logX4 logX5 logX6 logX7 logX8 X9 X10 X11 X12 X14 X16  X18  X20 Year,
model(tfe) distribution(tn) efficiency(eta_ij)
```

HYPOTHESIS

- When the FTA dummy is set to one, we anticipate a significant increase in export potential.
- Countries exhibiting higher technical efficiency in production and exportation are likely to experience increased bilateral trade with their partners.
- Positive influences on bilateral trade are expected from population and GDP factors for both reporting and trading partners.
- Anticipated positive effects include those from real exchange rate coefficients, diaspora impact, and sub-regional integration. Additionally, common language is projected to enhance trade negotiations and reduce transaction costs.

RESULTS

True fixed-effects model (truncated-normal) — Number of obs = 114
Group variable: **id** — Number of groups = 6
Time variable: **Year** — Obs per group: min = 19, avg = 19.0, max = 19
Prob > chi2 = 0.0000
Log likelihood = 10.6672 — Wald chi2(15) = 622.79

logY	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Frontier						
logX1	.0947607	.5483247	0.17	0.863	-.9799359	1.169457
logX2	.6086709	.2660964	2.29	0.022	.0871316	1.13021
logX3	-.2419998	123.0267	-0.00	0.998	-241.37	240.886
logX4	.6445064	6.641343	0.10	0.923	-12.37229	13.6613
logX5	.0641234	.2585405	0.25	0.804	-.4426066	.5708535
logX6	.1022291	.6263802	0.16	0.870	-1.125453	1.329912
logX7	.0460733	1.800039	0.03	0.980	-3.481938	3.574084
logX8	-.1937004	.2172358	-0.89	0.373	-.6194749	.232074
X9	.2537039	.1416092	1.79	0.073	-.0238449	.5312528
X10	.3007104	.1572222	1.91	0.056	-.0074395	.6088604
X11	.0308992	.7115091	0.04	0.965	1.425431	1.363633
X12	.3670527	.3897349	0.94	0.346	-.3968137	1.130919
X14	.0044278	.7837612	0.01	0.995	-1.531716	1.540572
X16	.4600722	.3242184	1.42	0.156	1.095529	.1753843
X18	0	(omitted)				
X20	.0837597	.	.	.	.	.
Year	.0001553	.0736659	0.00	0.998	-.1442272	.1445377
Mu						
_cons	-2.980144	7.946468	-0.38	0.708	-18.55493	12.59465
Usigma						
_cons	-1.648198	2.923832	-0.56	0.573	-7.378804	4.082409
Vsigma						
_cons	-3.074647	.2923984	-10.52	0.000	-3.647737	-2.501556
sigma_u	.4386301	.6412404	0.68	0.494	.0249869	7.699876
sigma_v	.2149557	.0314263	6.84	0.000	.1614002	.2862819
lambda	2.040561	.6556019	3.11	0.002	.7556045	3.325517

True Fixed Effect

RESULTS

Random-effects GLS regression — Number of obs = 114
Group variable: id — Number of groups = 6

R-sq:
within = 0.8247
between = 0.9995
overall = 0.9727

Obs per group:
min = 19
avg = 19.0
max = 19

Wald chi2(15) = 3486.07
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

logY	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
logX1	.8707557	.5874571	1.48	0.138	-.280639	2.02215
logX2	.0547162	.2632483	0.21	0.835	-.461241	.5706734
logX3	-6.064565	.38128	-15.91	0.000	-6.81186	-5.31727
logX4	4.158651	5.119696	0.81	0.417	-14.19307	5.875769
logX5	1.054302	.1378174	7.65	0.000	.784185	1.324419
logX6	.1719895	.6675622	0.26	0.797	-1.136408	1.480387
logX7	-.1286734	.0449439	-2.86	0.004	-.2167619	-.040585
logX8	-.2934638	.2400911	-1.22	0.222	-.7640336	.177106
X9	.0411595	.1547966	0.27	0.790	-.3445553	.2622362
X10	.8321559	.1287204	6.46	0.000	.5798686	1.084443
X11	.0976656	.8044049	0.12	0.903	-1.67427	1.478939
X12	.2624903	.3989972	0.66	0.511	-.5195299	1.044511
X14	.8332194	.8411046	0.99	0.322	-2.481754	.8153153
X16	.4929033	.3626136	1.36	0.174	-1.203613	.2178063
X18	0	(omitted)				
X20	1.394566	.1456252	9.58	0.000	1.109146	1.679986
_cons	9.207773	1.603777	5.74	0.000	6.064428	12.35112

sigma_u	0	
sigma_e	.23885373	
rho	0	(fraction of variance due to u_i)

Random Effect

TECHNICAL EFFICIENCY

- The coefficient for Technical Inefficiency comes out to be negative. Thus, we can say that entering into Trade Agreements has a positive impact on the Technical Efficiency .
- Checking the proportion of variation in trade accounted for by technical inefficiency:
- **γ** = σ^2u / (σ^2u + σ^2v) = 0.8003
- Thus, almost 80% of the variation in exports from India to members of GCC arises due to Technical Inefficiency.

TECHNICAL EFFICIENCY

```
. list id Year eff effi te in 1/10
```

	id	Year	eff	effi	te
1.	1	2010	.0348214	.2595987	.2595987
2.	5	2013	.0358773	2.49545	2.49545
3.	5	2014	.0384515	2.496979	2.496979
4.	2	2010	.0405552	-.949262	-.949262
5.	5	2012	.0413189	2.45526	2.45526
6.	6	2010	.0417411	1.536267	1.536267
7.	4	2021	.0420773	.8106366	.8106366
8.	3	2016	.0430962	.1730329	.1730329
9.	6	2011	.0439841	1.658005	1.658005
10.	3	2021	.0446317	.3564975	.3564975

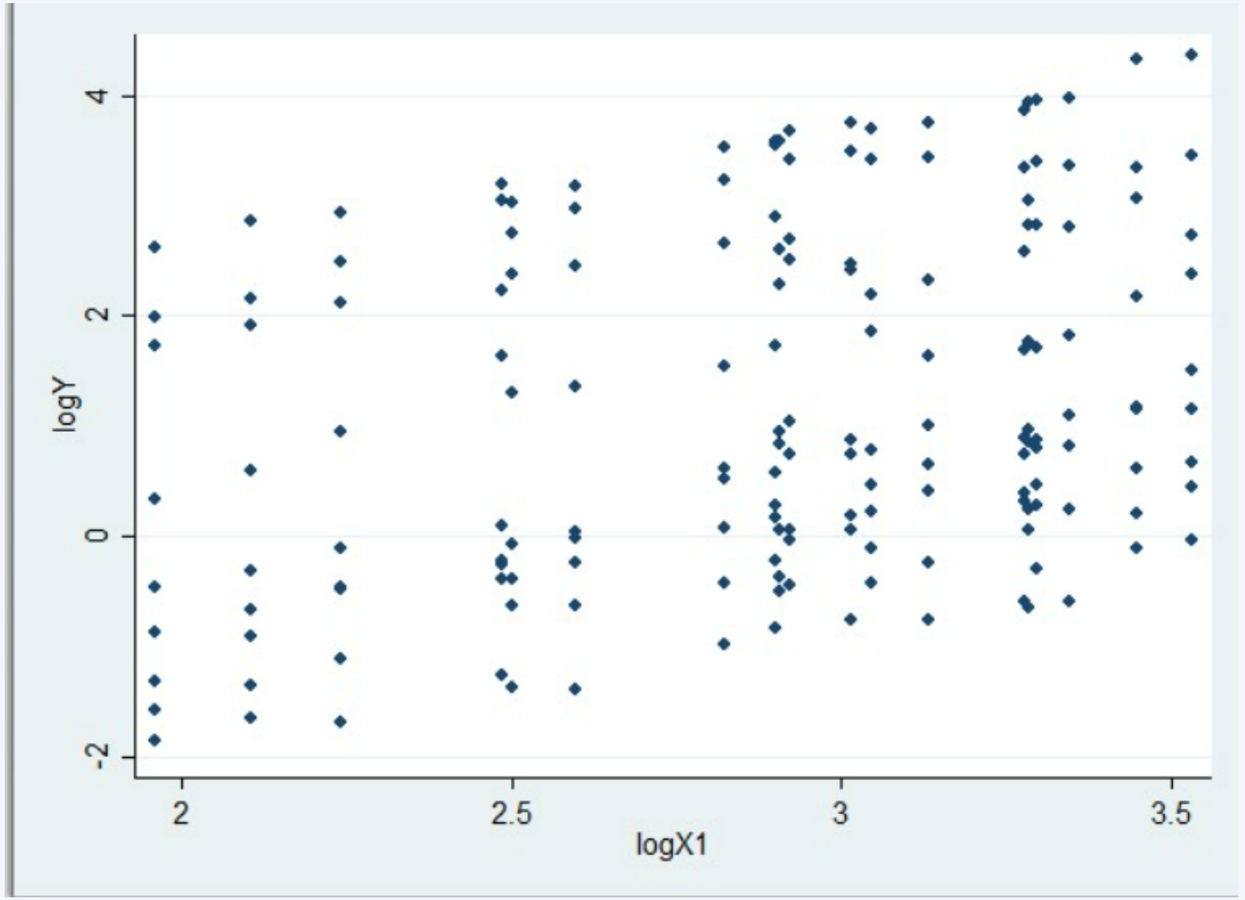
It can be seen from the technical efficiency table that Oman has the highest trade potential with India.

TECHNICAL EFFICIENCY

fegrp	Freq.	Percent	Cum.
0	13	32.50	32.50
.3	17	42.50	75.00
.6	10	25.00	100.00
Total	40	100.00	

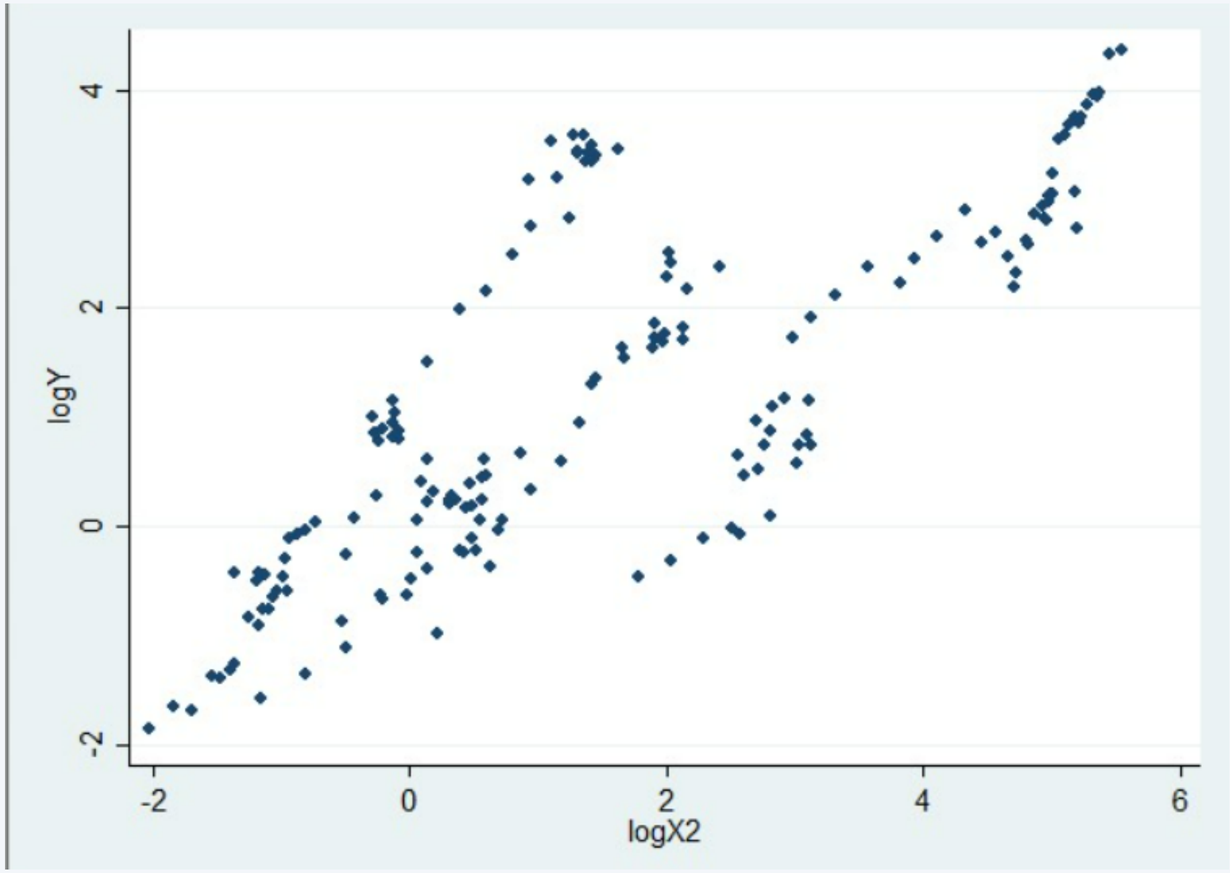
The TE for most trades came out to be nearly 30%.

RESULTS



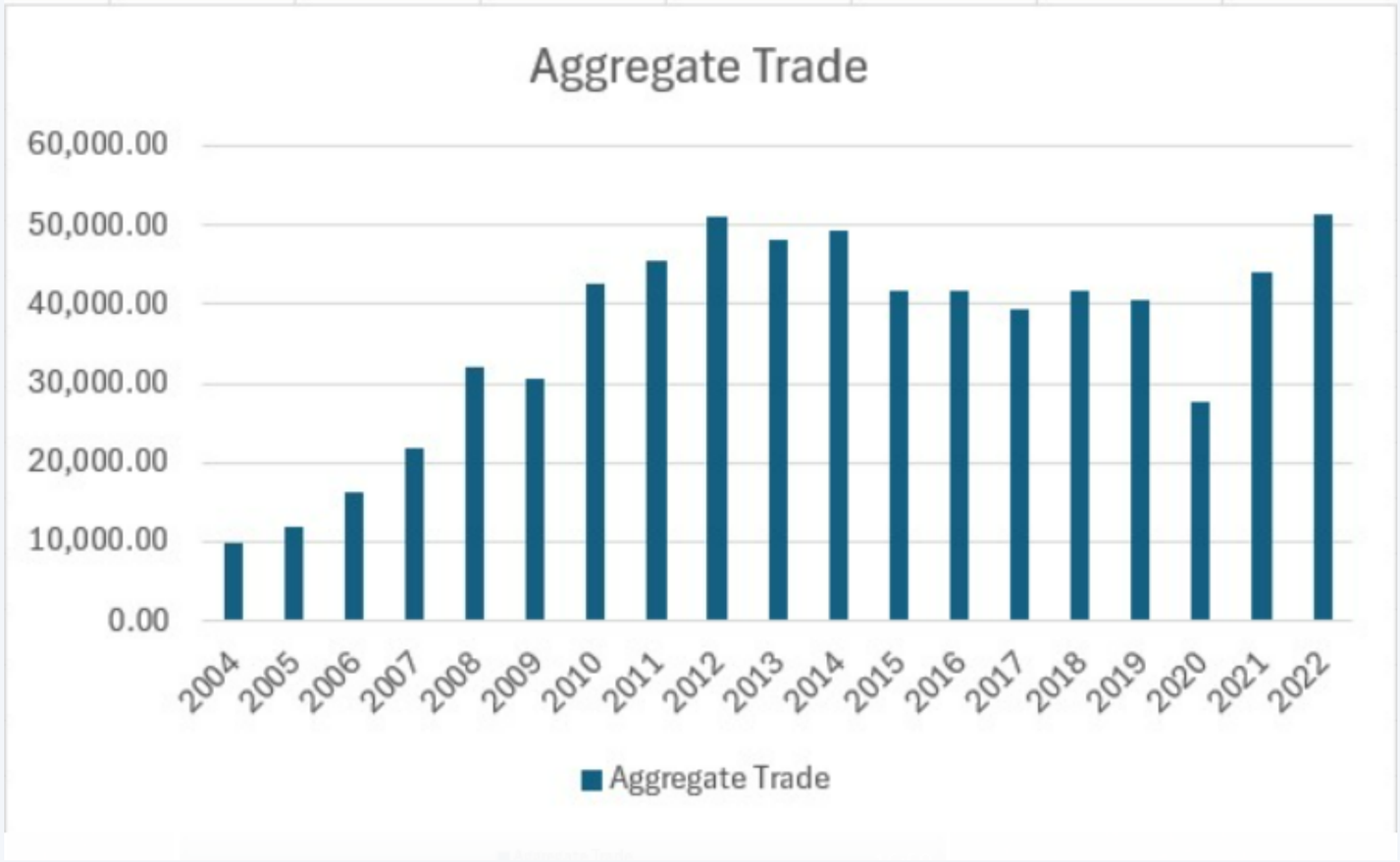
Trade vs GDP of country i

RESULTS



Trade vs GDP of country j

RESULTS



Year wise aggregate Trade

CONCLUSION

The results of the regression using true fixed effects and random effects are both as per the expectations. Let us look at the coefficients of the various variables to see how.

- First of all, the coefficients of the GDP of both countries are positive, indicating that trade is positively proportional to the size of the countries. Then we have a negative coefficient of the distance between the countries, which is also as per the logical expectations. INFR and INS too have a positive effect.
- Next, we look at the coefficients of the populations of both countries; they too are positive, as was expected. The real exchange rate is negatively proportional to the trade; this too satisfies our prediction.
- Now comes the important part: the coefficients of the Multilateral Trade Resistance (MTR) term, Diaspora, and Trade Affinity. We expect the coefficients of these to be negative, positive, and positive, in that order, respectively. The regression results satisfy our expectations, with MTR having a negative coefficient, Diaspora having a positive coefficient, and Trade Affinity also having a positive coefficient.

CONCLUSION

Finally, we move on to analyzing the effect of the FTA on the trade volume between India and GCC Countries, for this, we have plotted a bar chart for the aggregate trade of India with GCC versus year. As can be seen, using the plot attached to the previous slide, trade saw a significant rise 2004 onwards, which is when the FTA was signed, trade also saw a significant jump in 2009, which was the year when some of the terms of the FTA between India and GCC countries were brought into effect. After that, further talks with the GCC have been withheld, as GCC has deferred its negotiations with all countries and economic groups and is currently reviewing its negotiations with all countries and economic groups. Efforts are being made at various bilateral/multilateral forums for early resumption of the negotiations. This can be seen in the form of stagnation in trade after 2009, leading us to the conclusion that not much change in ease of trade has happened between the GCC and India after 2009, and there certainly is scope for further negotiations. The sudden drop in 2020 can be attributed to the COVID Pandemic.

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