General equilibrium impacts of Trade Liberalization : A Structural Gravity Analysis of the US-Middle East FTA

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(Term Paper submitted as part of ECO412)

***Abstract*— This research paper employs the structural gravity model to rigorously examine the effects of the United States-Middle East Free Trade Agreement (US-ME FTA) on bilateral trade between the United States and the Middle East region. By extending our analysis to include general equilibrium impacts, we offer a comprehensive assessment of the agreement's consequences on both economic and geopolitical dynamics. Additionally, we conduct a counterfactual analysis to understand the results of India and it's trading allies in the Middle East joining the FTA. To estimate our results, we employ the Poisson Pseudo-Maximum Likelihood (PPML) methodology, a robust approach widely recognized for its accuracy in gravity model applications. We find that the US-ME FTA yields substantial benefits for the participating nations, leading to increased trade volumes and enhanced economic integration within the region. This research contributes valuable insights to policymakers, trade analysts, and international economists by shedding light on the transformative potential of the US-ME FTA and the ripple effects of its expansion.**

***Index Terms*— Structural Gravity, Free Trade Agreement, PPML, General Equilibrium**

I. INTRODUCTION

Free Trade Agreements, which are defined as legally binding international treaties or agreements between two or more countries that aims to promote and facilitate trade and economic cooperation by reducing or eliminating barriers to trade in goods and services between the participating nations, have been important instruments in promoting trade between nations and regions.

Countries adopt Free Trade Agreements (FTAs) for a variety of reasons. Empirical research has demonstrated that Free Trade Agreements (FTAs) possess significant potential in fostering economic growth. Baier and Bergstrand (2007) conducted a study examining the impact of the North American Free Trade Agreement (NAFTA) on trade flows among the United States, Canada, and Mexico. Their findings revealed a significant rise in trade volume as a result of the agreement. Free trade agreements (FTAs) also have the objective of bolstering a nation's competitiveness through the exposure of domestic industries to global competition, thereby fostering innovation and enhancing productivity. The impact of the South Korea-United States Free Trade Agreement (FTA) on South Korean enterprises' innovation and efficiency was clearly observed, as shown by Francois and Woerz (2008).

In addition, free trade agreements (FTAs) have the capacity to entice international investment due to their ability to establish a business environment that is characterised by stability and predictability. According to the research conducted by Egger and Larch (2008), it was shown that nations engaging in free trade agreements (FTAs) had a greater propensity to attract foreign direct investment (FDI). These agreements can additionally fulfil diplomatic objectives by promoting stronger political and diplomatic relations among the states involved. The study conducted by Mansfield and Reinhardt (2008) provided empirical evidence on the strategic utilisation of Free Trade Agreements (FTAs) as a means to foster trust and cooperation among nations. Furthermore, it is worth noting that free trade agreements (FTAs) can have significant geopolitical ramifications, since they play a role in influencing the formation of strategic alliances and the establishment of ties between nations (Hufbauer et al., 2009).

The effects of Free Trade Agreements (FTAs) are diverse and complex. The implementation of free trade agreements, such as NAFTA, has resulted in a notable surge in trade activities among the included nations, as indicated by the observed expansion in both exports and imports (Baier and Bergstrand, 2007). The augmentation of commerce has a positive impact on economic expansion, as evidenced by the higher rates of GDP growth observed in nations that have effectively implemented Free commerce Agreements (FTAs). According to Ando and Kimura (2010), consumers derive advantages from free trade agreements (FTAs) in the form of reduced pricing for imported goods and an expanded assortment of products. Nevertheless, it is crucial to acknowledge that free trade agreements (FTAs) have the potential to generate employment opportunities in companies focused on exports, albeit potentially leading to job displacement in sectors that face heightened competition from imported goods (Hanson and Harrison, 1999). The overall effect on employment is contingent upon various circumstances and exhibits variability across different Free Trade Agreements (FTAs).

Furthermore, it is worth noting that free trade agreements (FTAs) have a significant impact on investment

flows. These agreements have the ability to attract international investors to countries that have lower trade barriers and offer enhanced legal protection for their investments (Egger and Larch, 2008). In addition, regulatory harmonisation may be a factor to consider since it can enhance trade efficiency, however it may also give rise to problems over sovereignty and regulatory alignment (Limão and Maggi, 2015).

The U.S.–Middle East Free Trade Agreement (MEFTA) effort was initiated in 2003 with the objective of establishing a free trade area between the United States and the Middle East region by the year 2013.

The primary aim of the United States through this initiative has been to systematically enhance trade and investment in the Middle East, while concurrently aiding Middle Eastern nations in implementing internal reforms, establishing the principles of legal governance, safeguarding private property rights (including intellectual property), and establishing a framework conducive to openness, economic expansion, and overall prosperity.

The stated objectives of the FTA include, but are not limited to, Negotiating commerce and Investment Framework Agreements to expand commerce and resolve issues, negotiating bilateral investment treaties with interested countries to require governments to treat foreign investors equally and provide legal protection equal to domestic investors, negotiating broad free trade agreements with willing countries that support economic reform and openness.

US, Saudi Arabia and UAE are some India's largest trading partners. India's combined trade with these nations is about 243 billion USD, about 23% of India's total trade. Therefore, joining the mutually beneficial US-MEFTA would be a step forward in strengthening trade relations with these partners. Additionally, Saudi Arabia and UAE are slated to join the US-MEFTA soon. We thus carry a counterfactual analysis of the results of India joining this FTA with it's top 4 trading partners in the Middle East, namely Saudi Arabia, UAE, Iraq and Qatar.

We first discuss the literature in structural gravity modelling as part of our discussion. We then discuss work on analysing India's free trade agreements. In section 3, we move on to defining the structural gravity model and carrying out a counterfactual GE impact using this model. We discuss results and economic implications in section 4 and finally conclude in section 5. All essential codes and supplementary tables are included in the appendix.

II. LITERATURE SURVEY

The impact of FTAs has been widely studied. Aforementioned examples are complimented by the work of various researchers on various FTAs. In the context of the ASEAN FTA, Elliot and Ikemoto (2004) utilised a modified gravity model to analyse the impacts of the ASEAN Free Trade Area (AFTA) on trade formation and diversion effects. Upon comparing the estimated coefficient of AFTA dummies prior to and after to the initiation of the AFTA process, it was shown that both the trade creation and trade diversion effects exhibit a statistically significant beneficial impact. The research findings suggest that the implementation of AFTA resulted in a notable rise in both intra-regional trade among member countries and trade with countries that are not part of the agreement. It is imperative to take into account not only the intra-ASEAN trade dynamics but also the impact of the ASEAN Free Trade Area (AFTA) on trade relationships between ASEAN member countries and non-member countries.

Manchin and Pelkmans-Balaoing (2007) used a gravity model with time-varying nation fixed effects, specifically MFN tariff rates, to examine how preferential AFTA tariffs affect trade flows among AFTA members. The authors estimated these effects using aggregated and disaggregated trade data. The researchers examined the trade consequences of preferential margins in four ASEAN nations from 2001 to 2003. The results show that AFTA has had little impact on intra-ASEAN trade. However, tariff reduction from the ASEAN Free Trade Area (AFTA) only benefits commodities with a preferred margin exceeding 25%.

Based on estimations drawn from the cases of Tunisia and Egypt, it has been suggested that the liberalisation of foreign investment in services, extended to encompass all trading partners, has the potential to enhance welfare by around ten percent of the Gross Domestic Product (GDP).

According to the study conducted by Miniesy, Nugent, and Yousef (2004), the implementation of a comprehensive free trade area among Arab countries in the MENA region has the potential to significantly boost intra-MENA trade by an additional 147 percent.

Rutherford, Rutstrom, and Tarr (2000) employ a computable general equilibrium (CGE) model to analyse the effects of removing tariffs on imports from the European Union (EU) in an Arab Mediterranean Country that is considered representative. The authors find that such a policy change leads to a welfare boost of 0.1% in the short-run and 1.6% in the long-run. Nevertheless, when including both tariff and non-tariff barriers, along with the harmonisation of standards and the establishment of a more efficient trade environment, the welfare impact experiences a notable increase to 3.7% in the short-term and 4.7% in the long-term.

We now discuss the structural gravity model and it's applications in GE impacts.

III. METHODOLOGY

A. Structural Gravity Model

We begin our analysis by studying the original gravity equation given by Tinbergen (1962). The traditional gravity model assumes that the volume of trade between two nations is directly related to the size of their respective economies and inversely proportionate to the distance between them.

According to the physical principles, the force of attraction between two things is directly proportional to their mass and inversely proportional to their distance. In economics, it is hypothesized that larger economies exert a stronger pull on commerce, whereas bigger distances operate as a disincentive to trade.

However, this model suffered from a lot of fallacies and was later replaced by the much more robust and comprehensive structural gravity model by Anderson and Wincoop (2003). This model was able to solve McCallum's border puzzle (1995) by including new "multilateral resistance terms" and removing the problem of omitted variable bias. The structural gravity model proposed by Anderson and Wincoop is defined for economies which have one representative consumer with the Armington Constant Elasticity of Substitution Function (CES) :

$$U_{ij} = \left[\sum_{i}^{n} \Psi_{ij}^{\frac{1-\sigma}{\sigma}} C_{ij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{1-\sigma}} \tag{1}$$

Here, is the demand of good i in country j, Ψ_{ij} is the preference parameter distribution and $\sigma > 1$ is the elasticity of substitution between goods of different countries. The budget constraint of consumers in country j is given by the equation :

$$E_j = p_{ij} C_{ij} \tag{2}$$

Where E_j is the total expenditure of country j, given by summing up the prices over all other countries, p_{ij}. Note that p_{ij} is the price of a product from country i in country j. This price is different from the price of the good in country i, i.e. p_i. The difference in price is due to unobserved trade costs between the countries, and is accounted for by the variable $t_{ij} > 1$ as follows :

$$p_{ij} = p_i t_{ij} \tag{3}$$

The value of exports from i to j is given by $x_{ij} = p_{ij} C_{ij}$. Hence, the total income of country i is given by

$$Y_i = \sum_j x_{ij} = \sum_i p_{ij} C_{ij} \tag{4}$$

On solving the consumer's maximization problem, we get the following results :

$$X_{ij} = \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \frac{Y_i E_j}{Y^w} \tag{5}$$

$$P_j^{1-\sigma} = \sum_i \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} \theta_i \tag{6}$$

$$\Pi_i^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} \theta_j \tag{7}$$

$$p_i = (\theta_i)^{\frac{1}{1-\sigma}} \frac{1}{\Psi_i \Pi_i} \tag{8}$$

$$E_i = \phi_i Y_i = \phi_i p_i Q_i \tag{9}$$

Where X_{ij} is the total value of exports from i to j, $Y^w = \sum_i Y_i$ is the world income and $\theta_i = \frac{Y_i}{Y^w}$ is country i's share in the world income.

P_i is the Inward Multilateral Resistance (IMR) and denotes the consumer price index of country j. Π_i is the Outward Multilateral Resistance (OMR) which denotes i's outward trade costs relative to destination price indices.

Silva and Tenreyro (2006) propose the use of Poisson Pseudo-maximum Likelihood estimator for estimating this model to capitalize on data points with zero trade flows as well as to account for heteroscedasticity. PPML estimation methods have henceforth gained wide usage in the literature. Stata packages ppml, ppmlhdfe and ppml_panel_sg, R packages R_glmhdfe and gravity and Python package gegravity have been used to carry out these estimations.

The following gravity model is used for estimation :

$$X_{ij} = exp(T_{ij}\beta + \pi_i + \chi_j) + \epsilon_{ij} \tag{10}$$

Where T_{ij} is the vector of trade cost variables, usually constructed as a linear sum of distance, contiguity, common colonized, language and FTA variables, β is a vector of coefficients, ϵ_{ij} is the error term, π_i is an exporter fixed effect that is used to construct the OMR term. χ_j is an importer fixed effect that accounts for expenditures and IMR. To avoid collinearity, we drop one importer fixed effect χ_0 and a constant. Since we need to normalize one multilateral resistance to solve equations 6 and 7, we set $\hat{P}_0 = 1$. Therefore, all other fixed effects are interpreted with respect to E_0. The IMR and OMR terms are obtained from π_i and χ_j as follows :

$$\hat{\Pi}_i^{1-\sigma} = E_0 Y_i exp(-\hat{\pi_i}) \tag{11}$$

and

$$\hat{P}_j^{1-\sigma} = \frac{E_j}{E_0} exp(-\hat{\chi_j}) \tag{12}$$

where $\hat{\pi_i}$ and $\hat{\chi_j}$ are the estimated fixed effects.

B. General Equilibrium impacts of trade liberalization

Yotov (2016) and Head and Mayer (2014) carried out extensive work on the general equilibrium impacts of trade cost changes between liberalizing countries by allowing for changes in the structural gravity model proposed by Anderson and Wincoop (2003) using **GEPPML**. Specifically, they carried out three stages of analysis of trade cost changes on trade flows and its ripple effects on the welfare, incomes and expenditures of countries, both members and non-members.

The **Partial Equilibrium** stage exogenously defines all other variables and changes only the trade cost factor to observe change in trade flows through equation 5. This is the most direct and observable method of capturing the effects of trade liberalization changes, as these changes affect trade costs. All other variables including the OMR and IMR terms as well as Income(Y) and Expenditure(E) are assumed to be given. A reduction in trade, as is clear from equation 5 leads to an increase in exports between

country i and j. We calculate "baseline" indices using the estimated values of X_{ij} from equation 2 and 4.

Conditional General Equilibrium takes this a step further and allows for changes in the Resistance terms (Π, P) following a change in the trade cost factor t_{ij} using equations 6 and 7. A decrease in the trade cost factor between liberalizing countries causes the resistance terms to drop as well. This leads to **trade diversion** effects with all other partners. However, by construction, the difference in t_{ij} always dominates the change in wither Π_i or P_j and thus, the trade creation effect always dominates the diversion effect in equation 5. This causes liberalizing countries to have greater trade among them relative to the rest of the world. The general trend for non-member countries is a decline in their international trade relations with all trading partners (Yotov(2016)).

For carrying out conditional general equilibrium impacts, the income and expenditure variables, as well as the factory gate prices are assumed to be exogenously derived. The final stage, the **Full Endowment General Equilibrium** allows for change in the factory gate prices (p_i) through a change in the Outward Multilateral Resistance (Π_i) using equation 8. Subsequently, the new income and expenditure variables can be obtained using equation 9. Please note that these can be obtained as we already have the baseline values of these variables from the first step. The effects of altered trade costs, expenditures, incomes and resistance terms gives us the new trade flow values. These new trade flow values (X_{ij}) give rise to a new set of Y and E values, and so on.

C. Using Structural Gravity to estimate GE Effects of Trade Policy

This section draws upon the work of Anderson and Yotov (2015). We understand how to understand the effects of trade cost on trade flow, as well as carry out counterfactual exercises to examine to effects of new sources of changes to these trade costs.

1. Baseline scenario : We use the PPML estimator to estimate the gravity model of equation 10 with importer and exporter fixed effects. This exercise yield us the estimated fixed effects as well as the trade cost coefficients. We can use any other estimator, or bootstrap the β values instead of using the PPML Estimator.

Once the estimated fixed effects are obtained, we can recover the "baseline" multilateral resistances to be used at a later stage, as well as the income and expenditures of this stage, given by equations 2 and 4.

2. Conditional GE : As discussed, this step allows for change in IMR and OMR terms but does not allow for changes in income or expenditure. We make amendments in our dataset to account for the counterfactual case (it could be an addition to an FTA, abolition of an RTA etc) and call the new trade factor cost variable as T^c_{ij}. The new equation to be estimated now becomes :

$$X_{ij} = exp\left(T^c_{ij}\beta + \pi^c_i + \chi^c_j\right) + \epsilon^c_{ij} \tag{13}$$

c in this case denote counterfactual variables and estimates. The data remains the same in the equation ; X_{ij} and Y_i and E_j remain the same.

The percentage change in welfare can be calculated by the real change in GDP is calculated as

$$\hat{W}_i = \frac{Y^c_i/\hat{P}^c_i}{Y_i/\hat{P}_i} = \frac{\hat{P}_i}{\hat{P}^c_i} \tag{14}$$

where $\hat{P}^c_i$ can be calculated from the new counterfactual $\hat{\chi}_i$.

3. Full Endowment GE : We allow for change in the real income and expenditure, given by $Y^c_i = (p^c_i/p_i)Y_i$ and $E^c_i = (p^c_i/p_i)E_i$, where p^c_i can be calculated from equation 8. These changes further effect the MR terms, which further affect the trade flows and so forth. We write the new export values as :

$$X^c_{ij} = \frac{(t^{1-\sigma}_{ij})^c}{t^{1-\sigma}_{ij}} \frac{Y^c_i E^c_j}{Y_i E_j} \frac{P^{1-\sigma}_i P^{1-\sigma}_j}{(P^{1-\sigma}_i)^c (P^{1-\sigma}_j)^c} X_{ij} \tag{15}$$

where $t^{1-\sigma}_{ij} = exp(T_{ij}\beta)$ and $(t^{1-\sigma}_{ij})^c = exp(T^c_{ij}\hat{\beta})$. Also,

$$p^c_i/p_i = \left[exp(\hat{\pi_i})^c / exp(\hat{\pi_i})\right]^{\frac{1}{1-\sigma}} \tag{16}$$

Further effects on the welfare can be analysed by using equation 14.

D. GE analysis of US-Middle East FTA and inclusion of India and it's trading partners

We define the following model for our estimation and analysis :

$$X_{ij} = exp(T_{ij}\beta + \pi_i + \chi_j) + \epsilon_{ij} \tag{17}$$

where

$$T_{ij}\beta = \beta_1 * dist_{ij} + \beta_2 * contig + \beta_3 * GDP + \hat{\beta}_4 * F\hat{T}A \tag{18}$$

and

- π_i is a full set of exporter fixed effects and is defined once for each partner. It is equal to 1 when the partner appears as exporter and 0 otherwise
- χ_j is a full set of importer fixed effects and is defined once for each partner. It is equal to 1 when the partner appears as importer and 0 otherwise
- $dist_{ij}$ is equal to the log of distance between partners i and j most populous cities
- $contig$ denotes contiguity; it takes value 1 if the countries are contiguous and 0 otherwise
- GDP is a vector of the importer and exporter country GDPs
- FTA is a dummy variable that takes a value equal to 1 if both partners belong to the US-MEFTA and 0 otherwise.

We begin by analyzing the effects of each variable by using trade data and estimating the model using PPML. Once we have baseline estimates, we amend the data to yield the counterfactual data matrix and carry out conditional and full endowment GE impacts of India and it's middle eastern trading partners joining the US-MEFTA.

IV. RESULTS

We explain the GEPPML results obtained after running the appropriate Python codes for One Sector General equilibrium impacts developed by Herman(2021) in the following steps. We first discuss the model results and coefficients to substantiate the gravity model. We then observe the baseline resistance terms for all trading partners. Having performed the counterfactual experiment of India and it's top trading partners in the Middle East joining the USMEFTA, we analyze the trade and welfare impacts of each country, and finally discuss the economic implications of India and it's trading partners entering the USMEFTA.

A. Model Results

Dep. Variable:	trade	**No. Observations:**	96
Model:	GLM	**Df Residuals:**	72
Model Family:	Poisson	**Df Model:**	23
Link Function:	log	**Scale:**	1.0000
Method:	IRLS	**Log-Likelihood:**	-5.1280e+07
Date:	Sat, 11 Nov 2023	**Deviance:**	1.0256e+08
Time:	18:31:44	**Pearson chi2:**	1.14e+08
No. Iterations:	25		
Covariance Type:	HC1		

	coef	std err	z	P>|z|	[0.025	0.975]
contig	-0.6147	0.332	-1.854	0.064	-1.265	0.035
gdp_o	1.259e-09	1.14e-10	11.002	0.000	1.03e-09	1.48e-09
gdp_d	1.185e-10	2.84e-11	4.169	0.000	6.28e-11	1.74e-10
logdist	-0.7714	0.223	-3.462	0.001	-1.208	-0.335
FTA	0.3642	0.346	1.052	0.293	-0.314	1.042

The following inferences can be drawn from the model results. **GDP** of both trading partners, which is a proxy for economic health, has a positive and significant coefficient, confirming the original gravity model. **Distance**, or more precisely, log of distance, has a negative coefficient, indicating decreased trade with increasing distance between trading partners. This substantiates the original gravity model. **Contiguity** has a negative coefficient, which could be a result of choice of countries that are middle eastern and hence, neighbouring countries are in conflict with each other. **FTA** coefficient is positive, which is expected. However it turns out to be insignificant. Fixed effects for importer and exporter were found to be predominantly significant but differing in signs, showing that other factors apart from those considered here are also key players in trade flow.

Overall, the model results substantiate the gravity model and give expected results, with GDP and Distance being the key factors in determining trade flows.

B. Baseline Results

With India and its partners not having yet joined the USMEFTA, we derive the baseline Multilateral resistances, both outward and inward for all countries, as well as a set of other variables including modelled expenditure, exports and imports. Country code for countries are as follows :

- ARE : United Arab Emirates
- BHR : Bahrain
- IND : India
- IRQ : Iraq
- ISR : Israel
- JOR : Jordan
- MAR : Morocco
- OMN : Oman
- QAT : Qatar
- SAU : Saudi Arabia
- USA : United States of America

The baseline IMR and OMR figures are reported in the following table.

Country	baseline imr	baseline omr	baseline expenditure	baseline observed exports
ARE	1.04	4.52	348743270.40	44266446.69
BHR	0.97	4.64	31858509.82	4942827.54
IND	1.00	2.52	2263522476.03	86041356.84
IRQ	1.12	5.13	171489001.47	16711680.59
ISR	0.97	4.26	318743674.88	20076275.00
JOR	1.07	5.09	38654726.14	3611719.28
MAR	1.10	5.12	101445001.22	1806990.48
OMN	1.08	5.11	66293366.78	6967451.56
QAT	1.02	4.72	152468684.80	13088327.46
SAU	1.10	4.39	646438387.71	61006698.16
USA	0.51	0.01	18569100263.42	87534614.75

Other baseline figures are reported in the appendix. We modelled all resistance terms keeping India as the reference importer, which results in the IMR term of India being equal to 1. All other inward resistances are relatively higher, indicating higher difficuty of importing with respect to India. The outward multilateral resistance terms are all comparably higher, indicating that export resistance is higher than import resistance for all countries. However, it is evident that India faces lower export resistance than other countries and thus, diversifies its trade better than other countries on the list. The only exception to this is USA, which faces significantly less import and export resistance in its trade flow.

As elaborated in Section 3C, we now carry out the counterfactual result analysis as part of the GEPPML procedure and reproduce important deviations from the baseline in the following subsection.

C. Counterfactual Scenario : India joins the USMEFTA

Were India, and its trading partners in the Middle East who are not yet part of the MEFTA (Qatar, UAE, Iraq and Saudi Arabia) to join the same, the FTA variable would change, thus altering the trade cost matrix. This would change the coefficient vector for these trade costs as well as the IMR and OMR terms, which would in effect change all other variables including expenditure and trade. The

following changes are seen in the economic indicators for all countries.

Country	factory gate price change	imr change	omr change
ARE	11.2	0	-10.1
BHR	7.2	3.7	-6.7
IND	11.2	0	-10
IRQ	12	-0.7	-10.7
ISR	6.1	4.8	-5.8
JOR	6.4	4.5	-6
MAR	6	4.8	-5.7
OMN	7.3	3.6	-6.8
QAT	11.2	0	-10
SAU	11.7	-0.5	-10.5
USA	5.5	5.3	-5.2

The table reports the percent change in given economic indicators with respect to baseline model after carrying out the counterfactual experiment. Factory gate prices increase in all countries, likely as a result of increase in demand for these export goods. This leads to an increase in the GDP of all member nations as we will observe in a subsequent table.

The experiment modelled resistances lead to interesting patterns. While observing the changes in IMR terms, we see minimum increase in IMR for India and its trading partners who are not part of the USMEFTA. For Iraq and Saudi Arabia, it is negative. For all other countries, we record positive percent change in the IMR term, which signifies increased resistance to import from non-member countries.

The percent change in OMR shows a similar pattern, with maximum decrease in outward resistance in India and her non-MEFTA partners. This means that countries which were already part of the USMEFTA now face a lower decrease in resistance in exporting to non-member countries. Consolidated, these results favor India joining the USMEFTA along with its Middle Eastern partners.

Country	GDP change	foreign exports change	intranational trade change
ARE	11.2	16.7	9.2
BHR	3.4	12.7	-5.6
IND	11.2	21.4	9.4
IRQ	12.8	15.9	4.8
ISR	1.3	11.6	0.5
JOR	1.9	8.2	-1.2
MAR	1.1	7	0.9
OMN	3.5	10.7	-5.8
QAT	11.1	15.9	9.5
SAU	12.2	17.4	6.4
USA	0.2	22.5	3.8

GDP change is positive for all countries, which is a result of the increased factory gate prices as well as a decrease in the resistance terms. Evidently, however, the GDP change is higher for countries which were originally not part of the FTA. These countries include India, Qatar, UAE, Saudi Arabia and Iraq. Foreign exports also increase, again, more so for countries who newly join the FTA. This indicates an overall positive ripple effect of joining the FTA and substantiates our attempt to analyze the same. Intra-national trade change decreases for some member countries of the USMEFTA, which indicates increased trade with new members, that leads to a decrease in internal trade.

Having examined overall results, we take the example of India, which newly enters the FTA and observe the trade impacts of its new membership into the FTA.

Exporter	Importer	baseline modeled trade	experiment trade	Trade change (percent
IND	ARE	77721684.74	84963074.27	9.32
IND	BHR	4593557.47	5599108.64	21.89
IND	IND	1347835838.19	1474601989.33	9.41
IND	IRQ	38354365.60	41069480.40	7.08
IND	ISR	33499233.45	42140458.70	25.80
IND	JOR	5956053.20	7429062.75	24.73
IND	MAR	10188578.90	12844089.13	26.06
IND	OMN	18615949.19	22674553.26	21.80
IND	QAT	27905912.72	30539767.51	9.44
IND	SAU	144647621.74	156067181.06	7.89
IND	USA	554203680.76	708534455.96	27.85

India's trade with all its trading partners increases in the experiment of India joining the MEFTA. However, trade with MEFTA countries increases more from the baseline level than with non-members. In particular, it's trade increases the most with USA, followed by Morocco and Israel, which are all part of the MEFTA. Similar results are seen for all other countries. A look at bilateral trade tables from the appendix shows us that for MEFTA countries, their trades with fellow MEFTA countries actually decreases, where as that with new entrants increases.

Overall, general equilibrium analysis of India joining the MEFTA reveals a promising outlook marked by increased trade and augmented GDP for nearly all participating countries, especially India and its non-MEFTA partners. The findings underscore the potential benefits of enhanced economic collaboration within the MEFTA framework.

Absolute figures for all figures are shown added in the appendix.

V. Conclusion

In summary, our study delved into the manifold advantages offered by Free Trade Agreements (FTAs) for member countries, employing Anderson and Wincoop's gravity model to substantiate claims. Specifically focusing on the US-Middle East Free Trade Agreement, our analysis confirmed GDP and distance as pivotal factors influencing trade flows. Building on this foundation, we expanded the scope by incorporating India and its key Middle Eastern trade partners into the FTA framework. Employing the GEPPML model, as advocated by Herman, our findings reveal a notable surge in trade volumes, accompanied by elevated factory gate prices, diminished resistance between member nations, and increased GDP for all trading partners. This comprehensive examination provides compelling evidence for the potential benefits accruing to India within the FTA, offering invaluable insights for

policymakers navigating the complexities of international trade dynamics.

VI. DATASET

We have used the CEPII gravity database to extract data for over 200 countries and refined it to our interest using python.

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VIII. APPENDIX

A. *Plagiarism check*

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B. *Codes : Python*

The following codes are the actual codes used for the GE impact

```
pip install gegravity


# In[1]:


import gegravity as ge
import pandas as pd
# Increase number of columns printed for a pandas DataFrame
pd.set_option("display.max_columns", None)
pd.set_option('display.width', 1000)
import gme as gme


# In[4]:


gravity_data_location = "init.csv"
grav_data = pd.read_csv(gravity_data_location)
# grav_data_cleaned = grav_data.dropna()

# grav_data.to_csv('cleaned_data.csv', index=False)

# print(grav_data.head())


# In[5]:


grav_data['trade'] = (grav_data['tradeflow_imf_o'] + grav_data['tradeflow_imf_o'] )/2


# In[6]:


import numpy as np
grav_data['logdist'] = np.log(grav_data['dist'])


# In[10]:


# grav_data['international'] = (grav_data['iso3_o'] == grav_data['iso3_d']).astype(int)
grav_data['intl'] = np.where(grav_data['iso3_o'] == grav_data['iso3_d'], 0, 1)


# In[7]:
```

```
gme_data = gme.EstimationData(grav_data, # Dataset
                              imp_var_name="iso3_d", # Importer column name
                              exp_var_name="iso3_o", # Exporter column name
                              year_var_name = "year",  # Year column name
                              trade_var_name="trade")  # Trade column name


# In[8]:


gme_model = gme.EstimationModel(gme_data,
                               lhs_var="trade",
                               rhs_var=[ "contig", "gdp_o", "gdp_d",
                                        "logdist", "FTA"],
                               fixed_effects=[["iso3_o"],["iso3_d"]])     # Fixed effects to use


# In[9]:


gme_model.estimate()


# In[10]:


(gme_model.results_dict['all']).summary()


# In[11]:


ge_model = ge.OneSectorGE(gme_model,                   # gme gravity model
                        year = "2016",               # Year to use for model
                        expend_var_name = "gdp_d",       # Expenditure column name
                        output_var_name = "gdp_o",       # Output column name
                        reference_importer = "IND",  # Reference importer
                        sigma = 5)                   # Elasticity of substitution


# In[12]:


rescale_eval = ge_model.check_omr_rescale(omr_rescale_range=3)
print(rescale_eval)


# In[13]:


ge_model.build_baseline(omr_rescale=0.1)
# Examine the solutions for the baselin multilateral resistances
print(ge_model.baseline_mr.head(12))
```

```
# In[14]:


exp_data = ge_model.baseline_data.copy()
exp_data["FTA"] = 1


# In[15]:


ge_model.define_experiment(exp_data)
# Examine the baseline and counterfactual trade costs
# print(ge_model.bilateral_costs.head(20))


# In[16]:


ge_model.simulate()


# In[17]:


country_results = ge_model.country_results

print(country_results[['factory gate price change (percent)', 'GDP change (percent)',
                       'foreign exports change (percent)']])


# In[18]:


# The bilateral trade results
bilateral_results = ge_model.bilateral_trade_results

print(bilateral_results)


# In[19]:


agg_trade = ge_model.aggregate_trade_results


# country multilateral resistance (MR) terms
mr_terms = ge_model.country_mr_terms
# Get the solver diaganoistics, which is a dictionary containing many types of solver diagnostic info
solver_diagnostics = ge_model.solver_diagnostics

agg_trade


# In[20]:


mr_terms = ge_model.country_mr_terms
```

```
print(mr_terms)
```

```
# In[27]:
```

```
ge_model.bilateral_costs
```

C. Detailed Results

Link to all results : Results