GENERAL EQUILIBRIUM EFFECTS OF INDIA LEAVING APTA AND JAPAN JOINING APTA

FINAL REPORT

SUPERVISED BY

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ABSTRACT:

This paper investigates the interplay between regional trade agreements (RTAs) and economic outcomes in the Indo-Pacific by performing econometric analysis. Utilizing a comprehensive dataset comprising both panel data from 2000 to 2022 and cross-sectional data from 2022, we employ a structural gravity model to assess the effects of the Asia-Pacific Trade Agreement (APTA), Indo-Pacific Economic Framework for Prosperity (IPEF), and the Association of Southeast Asian Nations (ASEAN) on participating countries' trade patterns and economic performance. Our findings reveal impacts of these RTAs on trade flows. Additionally, we employ cross-sectional data from 2022 to examine how India is affected by various trade arrangements within the region. This analysis sheds light on India's trade relations with its Indo-Pacific neighbours and provides insights into the specific channels through which regional trade agreements influence India's economic outcomes. Moreover, we delve into the implications of counterfactual scenarios through general equilibrium analysis. Specifically, we conduct a counterfactual analysis on the 2022 data to explore the potential consequences of India's withdrawal from APTA and separately analyse the effect of Japan's addition to the agreement. By simulating these scenarios, we unravel the intricate dynamics of trade diversion, welfare changes, and broader economic implications for all the countries in the analysis.

INTRODUCTION:

The Asia-Pacific Trade Agreement, formerly known as the Bangkok Agreement, stands as one of the oldest trade pacts in the region, established in 1975. With seven member countries including India, Bangladesh, Sri Lanka, Laos, South Korea, China (joined in 2000), and Mongolia (joined in 2013, becoming a full member in 2020), its core objective is to foster sustainable economic development through mutually advantageous trade liberalization policies. Initially focusing on tariff concessions, the agreement has evolved to include negotiations on investment, services trade, and trade facilitation, thereby promoting diversification.

Within the broader context of the Indo-Pacific region, which encompasses a range of countries along the Pacific belt, various trade blocs have emerged alongside APTA. These include the ASEAN Free Trade Area (AFTA), the Indo-Pacific Economic Framework (IPEF), initiated by the American government which emphasizes economic cooperation across four pillars: connectivity, resilience, environmental sustainability, and fairness.

India, known for its selective approach to trade agreements, remains proactive in fostering regional economic cooperation. This research aims to use the structural gravity model to analyse the impacts of APTA, ASEAN and IPEF on bilateral trade among its member countries, followed by a counterfactual assessment. By estimating trade cost elasticities and conducting counterfactual simulations, the study seeks to understand the role of the trade agreements in question in promoting economic development and bilateral trade flows within the Asia-Pacific region. Additionally, the research explores the potential general equilibrium effects of India joining APTA and separately analysing Japan leaving the agreement, providing insights into the broader implications of trade agreements in the region.

Theoretical Structure:

The study employs a structural gravity model for analysis, stemming from the early conceptualization resembling Newton's gravitational theory in physics. Initially, trade volume was assumed to be directly linked to the sizes of economies (measured by GDP) and inversely linked to the distance between them. Despite empirical success, these gravity models lacked solid theoretical foundations, leading to critiques by Anderson and van Wincoop (2003) highlighting issues like omitted variable bias and methodological flaws.

In response, structural gravity models emerged, incorporating multilateral resistance terms to address trade costs, market size, tariffs, non-tariff barriers, and other institutional factors. This sophisticated framework has become a key tool for policymakers, economists, and researchers to understand trade determinants and policy impacts.

Various estimation techniques for structural gravity equations have been developed, such as Non-Linear Least Squares, Structural Iterated Least Squares, fixed effects, Bonus Vetus OLS, double demeaning, and Poisson Pseudo Maximum Likelihood.
This paper utilizes the GEPPML model and PPML estimator, building upon the Constant Elasticity of Substitution (CES) function and incorporating fixed effects. General equilibrium analysis considers various impacts, including GDP changes, factory gate prices change and Welfare, providing insights into the effects of policy changes on trade dynamics.

The fundamental concept behind the gravity model of international trade, as employed by Tinbergen in 1962, can be outlined as follows:

$$X_{ni} = GY_i^a Y_n^b / \emptyset_{ni}$$

This model establishes a connection between the level of trade between two nations and the relative sizes of their economies, while also considering the distance separating them. Drawing inspiration from Newton's law of universal gravitation, the model suggests that larger economies tend to engage in more trade activities, while trade diminishes as the distance between nations increases.

The structural gravity model proposed by Anderson and Wincoop (2003) brought about a significant advancement in understanding international trade dynamics by incorporating multilateral trade resistances. The model equation is derived from the Constant Elasticity of Substitution (CES) utility function and is employed to elucidate trade volumes between countries:

$$X_{ij}^k = \frac{Y_i^k E_j^k}{Y_k}\left\{\frac{\tau_{ij}^k}{\pi_i^k P_j^k}\right\}^{1-\sigma_k}$$

Where:

$$\pi_i^k = \sum_{j=1}^{c}\left\{\frac{\tau_{ij}^k}{P_j^k}\right\}^{1-\sigma_k}\frac{E_j^k}{Y^k}$$

$$P_j^k = \sum_{i=1}^{c}\left\{\frac{\tau_{ij}^k}{\pi_i^k}\right\}^{1-\sigma_k}\frac{Y_i^k}{Y^k}$$

The equation for the Structural Gravity Model with Fixed Effects can be written as:

$$X_{ij} = \exp(\beta_1 \, ln\, DIST_{ij} + \beta_2 Comlang_{ij} + \beta_3 Contiguity_{ij} + \beta_4\, RTA_{ij} + \beta_5 Tariff_{ij} + \pi_{ij} + \chi_{ij}) * \epsilon_{ij}$$

General Equilibrium Analysis:

Baseline Gravity Equation:

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

Conditional Gravity:

$$X_{ij} = \exp(T_{ij}^c\hat{\beta} + \pi_i^c + \chi_j^c) * \epsilon_{ij}^c$$

Full Endowment Gravity:

$$\widehat{X_{ij}^c} = \frac{\left(\widehat{t_{ij}^{1-\sigma}}\right)^c}{\widehat{t_{ij}^{1-\sigma}}}\frac{\widehat{Y_i^c}\ \widehat{E_j^c}}{Y_i E_j}\frac{\left(\widehat{\pi_i^{1-\sigma}}\right)\ \left(\widehat{P_j^{1-\sigma}}\right)}{\left(\widehat{\pi_i^{1-\sigma}}\right)^c\ \left(\widehat{P_j^{1-\sigma}}\right)}X_{ij}$$

with $\widehat{t_{ij}^{1-\sigma}} = \exp\,(T_{ij}\hat{\beta})$

Estimates:

Welfare, $\widehat{W_i} = \ \widehat{p_i}/\widehat{p_c}$

DATA, DATA DESCRIPTION AND ANALYSIS PROCEDURE:

We utilized Jupyter, along with the USITC's gme package and Peter Herman's ge package in Python, to conduct a comprehensive analysis of the general equilibrium impacts of trade cost variables using gravity analysis. These packages offer a range of functions that streamline the process of general equilibrium analysis using the structural gravity model, making it more accessible to researchers and policymakers globally.

The study initially involved estimating structural gravity estimates using Poisson Pseudo Maximum Likelihood (PPML) on a dataset containing standard right-side variables along with additional variables such as production destination, production source, and an international dummy variable to distinguish between international and internal trade. The Python codes facilitated coefficient calculations and generated outputs such as changes in GDP, trade costs, outward and inward resistance, and welfare under various counterfactual scenarios.

The analysis focused on 27 countries in the Indo-Pacific region, considering regional trade agreements like APTA, ASEAN, IPEF, and USMCA. Data for the year 2022, including internal trade data, was used, along with panel data spanning from 2000 to 2022 for gravity estimates. The dataset was constructed from multiple sources, including the World Integrated Trade Solution (WITS), International Monetary Fund (IMF) for trade and tariff data, and variables like distance, contiguity, and colony data were obtained from the CEPII website.

Key variables used in the analysis included exports (Xij), bilateral distance (DISTij), tariff rates (TARIFFij), contiguity (CONTIGij), APTA (APTA_TA), ASEAN (ASEAN_TA), IPEF (IPEF_TA), USMCA (USMCA_TA). Additionally, exporter fixed effects (πij), importer fixed effects (χij), and error terms (εij) were incorporated into the model.

RESULTS:

We first analyse the trade diversion due to presence of different trading agreements in the indo-pacific region. This analysis is based upon the cross-sectional trade data of the 27 countries considered in the year 2022. We do this by considering the bilateral trades with India as exporter or importer. For this analysis we use the following model –

$$X_{ij} = exp(\beta_1 APTA\_TA + \beta_2 ASEAN\_TA + \beta_3 IPEF\_TA + \beta_4 USMCA\_TA + \beta_5 Distance + \beta_6 Tariff + \beta_7 common\_language + \beta_8 com\_col + \beta_9 contiguity)$$

Note that the trade dummy variables are unity when the partner country of India in trade is part of that trade agreement. For instance, while considering a trade value where the importer is SGP and exporter is IND, we will take the variables ASEAN_TA and IPEF_TA as 1 since SGP belongs to both the trade agreements mentioned.

The results of the regression are shown in Table 1. The model is estimated via PPML estimator along with Fixed importer and exporter effects. We see that a one-unit increase in ASEAN_TA is associated with a log increase in the expected trade value by approximately 2.8884. This coefficient is statistically significant ($p < 0.05$), indicating a strong positive effect. This is further backed with our 95% confidence interval not containing 0. For every unit increase in APTA_TA (bilateral preferential trade agreement), the log of the expected trade value increases by approximately 1.1486. However, this coefficient is not statistically significant at the conventional level ($p > 0.05$). Each unit increase in IPEF_TA (bilateral preferential trade agreement within IPEF) leads to a log decrease in the expected trade value by approximately 2.6759. This coefficient is statistically significant ($p < 0.05$), indicating a strong negative effect. The coefficient for distance is very small (7.684e-05), indicating that for each unit increase in distance, the log of the expected trade value increases by a very small amount. This is counterintuitive since the distance coefficient should be negative theoretically, however we can infer this result as the distance not affecting the trade involving India in the indo-pacific region. The Tariff coefficient is expectedly negative however it is not statistically significant and the confidence interval includes zero, suggesting that we cannot confidently conclude whether the true coefficient is positive or negative.

Generalized Linear Model Regression Results

Dep. Variable:	trade_value	**No. Observations:**	53
Model:	GLM	**Df Residuals:**	1
Model Family:	Poisson	**Df Model:**	51
Link Function:	Log	**Scale:**	1.0000
Method:	IRLS	**Log-Likelihood:**	-3.7506e+09
Date:	Wed, 17 Apr 2024	**Deviance:**	7.5012e+09
Time:	05:50:16	**Pearson chi2:**	7.53e+09
No. Iterations:	566	**Pseudo R-squ. (CS):**	1.000
Covariance Type:	HC1		

	coef	**std err**	**z**	**P>|z|**	**[0.025**	**0.975]**
APTA_TA	1.1486	1.042	1.102	0.271	-0.894	3.192
ASEAN_TA	2.8884	0.838	3.448	0.001	1.247	4.530
IPEF_TA	-2.6759	0.465	-5.751	0.000	-3.588	-1.764
common_language	0.4277	0.441	0.971	0.332	-0.436	1.291
contiguity	-1.4530	0.984	-1.476	0.140	-3.382	0.476
Tariff	-0.0448	0.039	-1.153	0.249	-0.121	0.031
Distance	7.684e-05	8.27e-05	0.929	0.353	-8.52e-05	0.000
USMCA_TA	4.9219	0.151	32.497	0.000	4.625	5.219
com_col	0.5977	0.585	1.022	0.307	-0.549	1.744

Table 1: Trade diversion analysis of India with Indo-Pacific countries 2022

Next, we do a structural gravity analysis of trade volumes on the panel dataset for the years 2000-2022. We use the following model –

$$X_{ij} = exp(\beta_1 APTA\_TA + \beta_2 ASEAN\_TA + \beta_3 IPEF\_TA + \beta_4 USMCA\_TA + \beta_5 ln\_Distance + \beta_6 Tariff + \beta_7 common\_language + \beta_8 com\_col + \beta_9 contiguity + \beta_{10} International)$$

The trade dummy variables are unity only when both the participating countries are part of the trade agreement. The model is estimated via the PPML estimator along with Exporter and Importer Time-Fixed Effects. The results of the regression are present in table 2.

We find that membership in APTA (Asia-Pacific Trade Agreement) and ASEAN (Association of Southeast Asian Nations) is associated with decreased trade value. For example, for each unit increase in APTA trade agreement participation, trade value decreases by approximately 0.4169 units, holding other factors constant. Similarly, for each unit increase in ASEAN trade agreement participation, trade value decreases by approximately 0.3937 units. The negative coefficients are further backed by the 95% confidence intervals. Furthermore, being a member of the IPEF (International Political Economy Forum) does not significantly affect trade value. The coefficient for IPEF_TA is not statistically significant, indicating that participation in this forum does not have a discernible impact on trade value.

The coefficient of ln_Distance is negative and statistically significant ($p < 0.05$) which is expected since increased distance leads to reduced trade. Similarly, the coefficient of Tariff is negative and is statistically significant ($p < 0.05$) backing the theory that increased tariff leads to reduced trade volumes. International transactions tend to have lower trade value compared to domestic ones. The coefficient for the "International" variable is -3.3903, indicating that, on average, international transactions have a trade value that is 3.3903 units lower than domestic transactions, moreover this negative value is statistically significant ($p < 0.05$) which is again backed by our confidence interval. Common_language, Contiguity, and Com_Col (common colonial history): Shared language, geographical contiguity, and a common colonial history positively impact trade value. For example, for each unit increase in the presence of a common language, trade value increases by approximately 0.2113 units. Similarly, geographical contiguity and a common colonial history contribute positively to trade value, with coefficients of approximately 0.2557 and 0.3983, respectively.

Generalized Linear Model Regression Results

Dep. Variable:	trade_value	**No. Observations:**	16765
Model:	GLM	**Df Residuals:**	15536
Model Family:	Poisson	**Df Model:**	1228
Link Function:	Log	**Scale:**	1.0000
Method:	IRLS	**Log-Likelihood:**	-3.8180e+13
Date:	Wed, 17 Apr 2024	**Deviance:**	8.8237e+13
Time:	15:28:20	**Pearson chi2:**	5.19e+19
No. Iterations:	29	**Pseudo R-squ. (CS):**	1.000
Covariance Type:	HC1		

	coef	std err	z	P>|z|	[0.025	0.975]
APTA_TA	-0.4169	0.060	-6.892	0.000	-0.535	-0.298
ASEAN_TA	-0.3937	0.055	-7.118	0.000	-0.502	-0.285
IPEF_TA	-0.0521	0.052	-1.006	0.314	-0.154	0.049
ln_Distance	-0.4870	0.018	-26.494	0.000	-0.523	-0.451
USMCA_TA	0.3530	0.069	5.098	0.000	0.217	0.489
International	-3.3903	0.064	-52.915	0.000	-3.516	-3.265
Tariff	-0.0578	0.006	-10.150	0.000	-0.069	-0.047
common_language	0.2113	0.037	5.739	0.000	0.139	0.283
contiguity	0.2557	0.060	4.274	0.000	0.138	0.373
com_col	0.3983	0.074	5.376	0.000	0.253	0.544

Table 2: Trade volume analysis on Panel dataset of trade between Indo-pacific countries from 2000-2022

Now, we proceed to the general equilibrium analysis of the 2022 cross-sectional trade data. First, we consider the baseline model of the year 2022 using the gravity estimates from the previous structural gravity analysis of the panel dataset. The table 3 shows the baseline resistances for the countries considered.

country	baseline omr	baseline imr
ARE	19.794806	2.599219
AUS	67.483872	1.434704
BGD	59.172589	2.178616
CAN	52.283235	1.000000
CHL	60.214223	2.468888
CHN	54.938478	0.564176
COL	78.040782	2.011548
DEU	11.381490	2.080917
ECU	93.127450	2.318975
IDN	67.699968	1.661044
IND	47.584398	1.422555
JPN	29.288943	1.137708
KEN	98.091869	2.654037
KHM	71.195638	3.987456
KOR	20.041270	2.166770
LAO	97.412009	3.399624
LKA	80.292885	3.461747
MDG	107.855350	3.823576
MYS	32.104064	2.555482
NZL	73.178389	2.338543
PAK	71.539139	2.032181
PHL	57.016488	2.209844
RUS	93.765530	0.997789
SGP	9.542952	2.643941
THA	33.195067	2.884044
USA	67.574219	0.231037
ZAF	64.319688	2.164558

Table 3: Baseline estimates of outward multilateral resistance and Inward multilateral resistance

Now we consider the counterfactual scenarios. First, we consider India leaving APTA, the analysis could be found in table 4. We see from the full general equilibrium analysis model that the GDP of India increases significantly by 29.6% whereas the welfare statistic decreases significantly to 0.77. We also see that welfare statistic of APTA countries such as CHN, JPN and KOR decrease slightly. We see that the GDP of countries such as JPN and USA decrease slightly and their exports as well as imports level decreases. The effect is different for CHN as its GDP increases slightly and intra-national trade value also increase. This might be attributed to the negative effect of APTA derived in the previous analysis.

Finally, we consider the counterfactual of Japan joining APTA, the analysis could be found in table 5. We see that the GDP of JPN decreases significantly in the long run by 23.8%. However, the welfare of JPN goes up significantly to 1.31. We also see a decrease in exports of IND, CHN and KOR. These results can be attributed to the negative effects of APTA in trade flow. However, we also see a slight increase in welfare of these countries which suggest that participating in APTA increases a country's welfare.

The full tables for the table 4 and table 5 can be found in the Appendix.

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Countries	imr change (percent)	omr change (percent)	GDP change (percent)	welfare statistic	foreign exports change (percent)	foreign imports change (percent)	intranational trade change (percent)
CHN	1.023584	-1.1082	0.096047	0.99904	1.802016	3.648572	3.648572
IND	-12.586	-11.793	29.69284	0.771053	0.556687	4.73733	30.75429
JPN	0.441691	-0.36576	-0.07426	1.000743	-0.29524	-0.32157	-0.13087
KOR	0.136547	-0.18063	0.044353	0.999557	1.692128	0.004491	-0.67786
USA	-0.67786	0.153363	-0.01267	1.000127	-0.17988	-1.78646	-1.2548

Table 4: Counterfactual analysis of IND leaving APTA

Countries	imr change (percent)	omr change (percent)	GDP change (percent)	welfare statistic	foreign exports change (percent)	foreign imports change (percent)	intranational trade change (percent)
CHN	-1.05674	1.168534	-0.09934	1.000994	-1.58609	-3.59825	-1.03818
IND	-0.32463	0.47438	-0.14799	1.001482	-1.16129	-0.49644	0.40728
JPN	14.23353	14.85462	-23.7819	1.312025	-6.68861	-9.00042	-24.0626
KOR	0.173721	-0.06052	-0.11296	1.001131	-4.4513	0.024506	1.431601
USA	0.160354	-0.17359	0.013512	0.999865	0.30693	2.013802	1.468711

Table 5: Counterfactual analysis of JPN joining APTA

APPENDIX

The codes used can be found at Codes

The full tables for table 4 and table 5 are present at Counterfactual Data

The datasets used is available at Data

Plagiarism Report:

The plagiarism report can be found at Plagiarism Report

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