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A gravity model analysis for the renewable energy trade potential in India, South Asia and Southeast Asia

Pratyush Raychaudhuri
Indian Statistical Institute, Kolkata

Abstract

The member countries of the Association of Southeast Asian Nations (ASEAN) and South Asian Association for Regional Cooperation (SAARC) are important markets for India's renewable energy products whereas the renewable energy trade potential of India with these countries is less explored. This work develops a gravity model of bilateral trade flow for comparing the actual and projected exports to the above countries and estimating the effects of various determining factors of international trade, such as trade logistics, bilateral distance, tariff rate and others. A matured trade relationship was derived with SAARC for hydroelectricity (Hydro) and solar plus wind energy (Solar-Wind) parameters whereas a growing trade potential of Solar-Wind was noted for ASEAN. The overall country-wise trade potential comparison showed a fall of 73.33% in 2010 to 46.67% in 2019 for Hydro implying a matured trade prospect. For Solar-Wind, however, the 57.2% in 2010 has increased to 64.3% in 2019 indicating a high trading potential in Solar-Wind, particularly in the ASEAN countries. Thus the large trading prospective in Solar-Wind may be treated as a future policy issue and the ASEAN countries may be focused as future prospective markets of renewable energy product exports.

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Contact: Pratyush Raychaudhuri - pratyush.raychaudhuri@gmail.com.
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1. Introduction

The economics of sustainable growth, climate change and renewable energy are among the most cultivable issues in today's world. Renewable energy trade has gained high momentum during the last decade (Jing et al. 2020, Kuik et al. 2019, Kaliranjan and Liu 2017, Mathur 2014). In particular, the South and South East Asian countries who are vulnerable to the threats from higher carbon dioxide emission than any other region in the world (Raitzer et al. 2015), suffered mostly from the impacts of climate change during 1999 to 2018 (Eckstein et al. 2019). These countries have rising energy demand and high potential for renewable energy generation. Yet they rely mostly on traditional fossil fuel and are challenged with wide diversity in energy resources, abrupt variation of infrastructure and discrepancy in the demand and supply of energy (Rahman et al. 2011, Singh et al. 2015, Shukla et al. 2017, Erdiwansyah et al. 2019)).

India and the member countries of the Association of Southeast Asian Nations (ASEAN) share an intense trade relationship (Khalid and Ismail, 2022) and India's exports to ASEAN countries have increased substantially after the free trade agreement (Sikdar and Nag, 2011). The strategic and geographic location and the long colonial and cultural history are identified as major factors to shape up a growing trade relationship. India's liberal trade-investment policy with south-east countries (Saini and Aggarwal, 2021) and the ability to supply lower cost pharmaceuticals and affordable chemicals (Banik and kim, 2020) have boosted the collaboration and economic integration. For the member countries of South Asian Association for Regional Cooperation (SAARC), Indian has adopted a liberal trade policy. The South Asian nations share an invaluable relation with India that needs to be cultivated into stronger economic links (Grover and Agarwal, 2019). A fluctuation in the trade relation is noted because of the economic and political conditions of these countries (Ambrose and Sundarraj, 2014). The advantage of geographical proximity and the possibility of enhancing political relations through stronger economic relations are recognized as plus points (Vadra, 2012). A general enhancement of trade openness of these countries is recently reported (Sharma and Kumar, 2020).

To promote energy cooperation and to ensure sustainable development in South and Southeast Asia, India has taken several steps. The SAARC Framework Agreement for Energy Cooperation (Electricity) has been signed recognising the significance of cross-border electricity trade, emphasizing on regional power trade and energy efficiency and recalling the decisions of the 16th SAARC Summit held in Thimphu (2010) on enhancing the cooperation in energy trade and developing efficient renewable energy sources (Asian Development Bank 2017). India and the ASEAN countries issued the Delhi Declaration recommending for energy security, cooperation in energy sector and developing renewable energy technology through international platforms (De and Kumarasamy 2020).

With the implementation of such measures, ASEAN and SAARC countries have become important markets for India's renewable energy products. India has a trade surplus with them, the market share has grown from 10% to 16.9% during 2010 to 2019 and the total export has increased from US$ 282.25 million in 2010 to 913.10 in 2019 (Table 1), as derived from the statistics of UN comtrade (https://comtrade.un.org/data/).

Yet the renewable energy trade potential of India with ASEAN and SAARC countries is less explored. This work, motivated by this fact, investigates the bilateral trade flow of India's renewable energy with these countries. A gravity model (Anderson 1979, Yotov et al. 2017, Kabir et al. 2017) is a useful mathematical framework for quantifying the effects of various determining factors of international trade. This work develops a gravity model for the bilateral trade flow for comparing the actual export and the predicted export to the above countries to estimate the trade potential and to suggest some policy issue.

Table 1. General trend and Market share of India's Renewable Energy Trade in SAARC[1] and ASEAN[2] member countries (in million US$)

Year	Export to SAARC and ASEAN countries	Import to SAARC and ASEAN countries	Trade Surplus With SAARC And ASEAN countries	Global Export	Market share Of SAARC And ASEAN countries
2010	282.25	227.79	54.46	2703.80	0.10
2011	348.71	499.39	-150.68	2817.45	0.12
2012	361.16	413.41	-52.25	2520.32	0.14
2013	515.73	314.91	200.82	2907.74	0.18
2014	581.07	418.40	162.66	3085.65	0.19
2015	638.32	609.19	29.12	3765.53	0.17
2016	607.67	656.13	-48.46	3642.50	0.17
2017	805.82	742.31	63.51	3972.98	0.20
2018	854.67	678.24	176.44	4473.16	0.19
2019	913.10	797.86	115.24	5410.91	0.17

[1]SAARC member countries other than India: Afghanistan; Bangladesh; Bhutan; Maldives; Nepal; Pakistan; Sri Lanka
[2]ASEAN member countries: Cambodia; Indonesia; Lao PDR; Malaysia; Myanmar; Papua New Guinea; Philippines; Singapore; Thailand; Vietnam

2. Data and Methodology

A gravity model is developed for the bilateral renewable energy trade flow between India-ASEAN and India-SAARC countries with the provision for separate accounting of hydroelectricity (Hydro) and solar plus wind energy (Solar-Wind) parameters. The basic gravity model is given by

$$Y_{odt} = \beta_0 \frac{G_{ot}^{\beta 1} G_{dt}^{\beta 2}}{T_{odt}^{\beta 3}} \quad (1)$$

The dependent variable Y_{odt} in Eq. (1) represents the quantity of trade flow (e.g. export value) from the country of origin (subscript-o) to the country of destination (subscript-d) for the t-th year (subscript-t). G_{ot} and G_{dt} are the gross domestic products (GDP) of these two countries, used as the proxy for their respective economic sizes. T_{odt} is the trade cost between the countries. The coefficient β_0 is a constant accounting for the inverse of the average world production value. The power coefficients of the variables G_{ot}, G_{dt} and T_{odt} are β_1, β_2 and β_3, respectively. Often the physical distance (D_d) of the destination country from the country of origin is used as a proxy for T_{odt}. To satisfy the linear estimation requirements, the model is usually log-linearized as

$$\ln Y_{odt} = \ln\beta_0 + \beta_1 \ln G_{0t} + \beta_2 \ln G_{dt} + \beta_2 \ln D_d + u_t \quad (2)$$

where u_t is an error term. The geographic distance is not the single proxy for the trade expense here and there are wide differences in the quantity of production of renewable energy. In spite of the existing free and preferential trade agreements of India with several countries, the importance of tariff and non-tariff barriers are highlighted in literature in relation to South Asia (Weerahewa, 2009) and ASEAN countries (Sharma, 2014). It is also logical to consider the logistics performance index (LPI) defined by The World Bank (https://www.lpiworldbank.org/about) for a country to quantify the challenges and opportunities in trade with a specific country. The commonly found matching features for assigning dummy variables, such as common language, religion and shared borders are not so abundant for the present countries. Considering these all, the following variables are added to Eq. (2).

$\boldsymbol{R_{dt}}$ is an indicator of the demand of specific renewable item in the destination country. It represents the absolute value of the Hydro or Solar-Wind demand, as applicable, at year t.

$\boldsymbol{T_{dt}}$ is the tariff imposed in the destination country at year t.

$\boldsymbol{L_{dt}}$ is the LPI in the destination country at year t.

$\boldsymbol{A_d}$ is a time invariant dummy variable representing the ASEAN regional trade agreements. It is assigned the value of 1 for the destination country having free trade agreement with ASEAN, otherwise the value is 0.

The final model for analysis, incorporating the above variables and an error term (v_t) is expressed by Eq. (3).

$$\ln Y_{odt} = \ln\beta_0 + \beta_1 \ln G_{ot} + \beta_2 \ln G_{dt} + \beta_3 \ln D_d + \beta_4 \ln R_{dt} + \beta_5 \ln T_{dt} + \beta_6 \ln L_{dt} + A_d + v_t \quad (3)$$

Table 2. Data sources for the explanatory variables used in Eq. (3)

Variable	Meaning	Source
Y_{odt}	The export of renewable energy products (US Dollar) from the country of origin (India) to the country of destination at year t.	UN Comtrade Database https://comtrade.un.org/data/
G_{ot} and G_{dt}	The gross domestic products (US Dollar) of the origin and destination country, respectively, at year t.	World Bank Open Data https://data.worldbank.org/indicator/NY.GDP.MKTP.CD
D_d	The geographical distance (km) between the capitals of the two countries.	CEPII Database http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp
R_{dt}	The absolute value of the total amount of Hydro or Solar-Wind, as applicable, at year t.	Our World in Data https://ourworldindata.org/renewable-energy
T_{dt}	The tariff imposed in the destination country at year t.	The World Bank Database for tariff https://data.worldbank.org/indicator/TM.TAX.MRCH.SM.AR.ZS
L_{dt}	The LPI in the destination country at year t.	The World Bank Database for LPI https://lpi.worldbank.org/international/global
A_d	Dummy variable representing the membership/non-membership of the destination country to ASEAN regional trade agreements.	Wikipedia

The data for the above variables were procured for India and the ASEAN and SAARC member countries (Table 1) from different open data sources specified in Table 2 for the period of 2010-2019. The standard specifications of harmonized system codes were followed for the Hydro and Solar-Wind export products (Jing et al. 2020, Kuik et al. 2019). The data were sorted and filtered for two separate subsets of countries, one for Hydro (15 countries) and the other for Solar-Wind (14 countries) having a minimum significant fraction of the total production of all countries (0.5% for Hydro and 0.03% for Solar-Wind).

The gravity equation [Eq. (3)] was regressed with SPSS statistical software v25.0, separately for Hydro and Solar-Wind. The input data varied widely for different years. The analysis adopted an ordinary least squares model with weakly dependent time series data represented as an autoregressive process

$$y_t = \rho y_{t-1} + e_t, \quad t = 1, 2, \ldots \tag{4}$$

where the starting point is at $t = 0$ and e_t represents an independent, identically distributed sequence with zero mean. The test for serial correlation was done with Durbin-Watson (DW) test. In order to minimize the serial autocorrelation, the feasible generalized least squares (FGLS) method was applied to the variables and the regression was repeated with the quasi-differentiated variables.

$$y_t - \rho y_{t-1} = (1-\rho)\beta_0 + \sum_{i=1}^{6} \beta_i \left(x_{ti} - \rho x_{t-1,i}\right) + e_t \quad \text{for } t \geq 2 \tag{5a}$$

$$(1-\rho^2)^{1/2} y_1 = (1-\rho^2)^{1/2}\beta_0 + \sum_{i=1}^{6} \beta_i (1-\rho^2)^{1/2} x_{1i} \quad \text{for } t = 1 \tag{5b}$$

3. Results and Discussion

Table 3 shows the results obtained separately with the coefficients for Hydro and Solar-Wind, the existence of autocorrelation being noted from DW statistic. Following the FGLS method, The DW statistic, found to be 1.9 for Hydro and 1.91 for Solar-Wind are compiled in Table 4.

Table 3: Coefficients of the explanatory variables of the present gravity model [Eq. (3)] for Hydro and Solar-Wind

Parameter	Coefficient values for Hydro	Coefficient values for Solar-Wind
Intercept	–16.233 ** (8.157)	–29.13** (14.786)
lnG_{ot}	0.877 *** (0.340)	1.344* (0.809)
lnG_{dt}	0.348 *** (0.120)	0.494 *** (0.169)
lnD_d	–0.650 ** (0.286)	–0.353* (0.195)
lnT_{dt}	–0.145 * (0.085)	–0.569 *** (0.181)
lnL_{dt}	0.759 ** (0.380)	2.971 ** (1.515)
lnR_{dt}	0.236 ** (0.104)	0.152* (0.087)
Adjusted R^2	0.618	0.337
Standard errors are reported in parentheses Significance levels: * ≈ 10%, ** ≤ 5%, *** < 1%		

Table 4. Coefficients of the explanatory variables of the present gravity model [Eq. (3)] for Hydro and Solar-Wind after autocorrelation removal

Parameter	Coefficient value (Hydro)	Coefficient value (Solar-Wind)
Intercept	–14.343* (8.487)	–28.952** (14.403)
lnG_{ot}	0.846** (0.396)	1.460** (0.657)
lnG_{dt}	0.184*** (0.069)	0.144*** (0.044)
lnD_{d}	–0.226** (0.101)	–0.084* (0.05)
lnT_{dt}	–0.45* (0.260)	–0.313*** (0.108)
lnL_{dt}	1.403** (0.665)	0.095** (0.044)
lnR_{dt}	0.132** (0.064)	0.113** (0.056)
Adjusted R^2	0.557	0.067
DW statistic	1.90	1.91
Standard errors are reported in parentheses Significance levels: * ≈ 10%, ** ≤ 5%, *** < 1%		

The regression results in Table 4 demonstrate significant influence of the variables on the export values with the following implications:

- The positive correlation of the GDP of the importing country with the export value indicate the countries as a more beneficial market for India, as their level of economic activity improves.
- For the same percentage increase in Solar-Wind and Hydro of the destination countries, the rise in the export value of Solar-Wind market is higher than that of Hydro, implying that exporting more in Solar-Wind market can be beneficial for India.
- If tariff rate increases, the export value of renewable energy products decreases, suggesting that the exports are obstructed by higher trade costs.
- If LPI increases, a country performs better in trade logistics and the value of exports increase.
- If the physical distance between the capitals of the two countries increases, the value of exports decreases, probably due to rise in shipping cost.

The regression results obtained from Table 4 were used to estimate the region-wise evolution of trade potential during 2010-2019 by generating the predicted export values and comparing with the actual ones for finding out prospective significant markets for India.

For Hydro, the actual export value was initially much lower than that estimated, thereby indicating high trade potential in ASEAN [Figure 1(a)]. During the last 5-6 years, the actual export has abruptly increased exceeding the predicted growing trend. For SAARC, the predicted trend is much below the actual export all the way [Figure 1(b)], indicating a matured trade prospective both with ASEAN and SAARC.

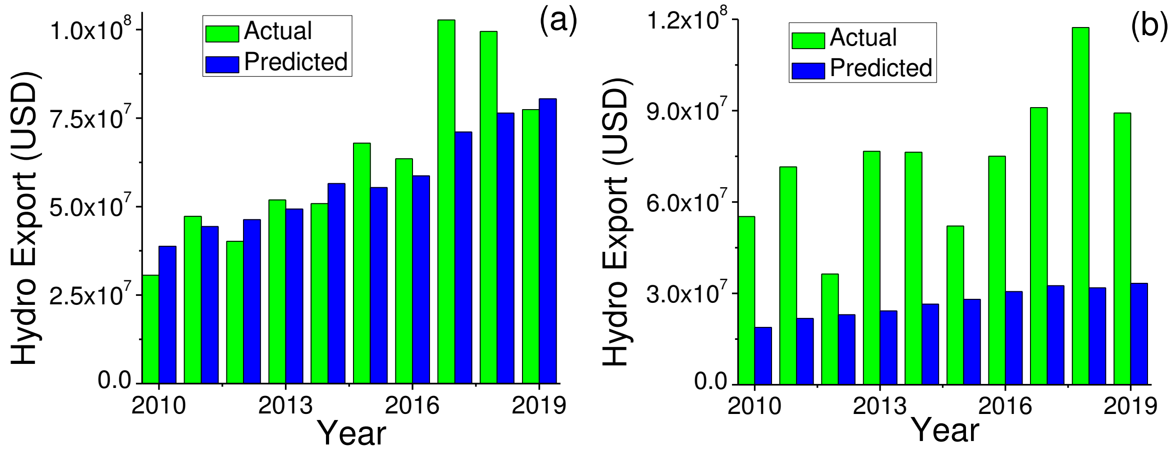

Figure 1. Comparison of the actual export of Hydro goods (US Dollar) with those predicted with the regression of Eq. (3) for (a) ASEAN and (b) SAARC countries.

For Solar-Wind, the actual trade previously exceeded the predicted trade for ASEAN. However, in the last few years, the predicted trade has surpassed the actual trade indicating a rise in the trade potential and a possible inclination to solar and wind power [Figure 2(a)]. For SAARC, the predicted export shows an increasing trend and the actual export has increased abruptly, which indicates a limited trade potential [Figure 2(b)].

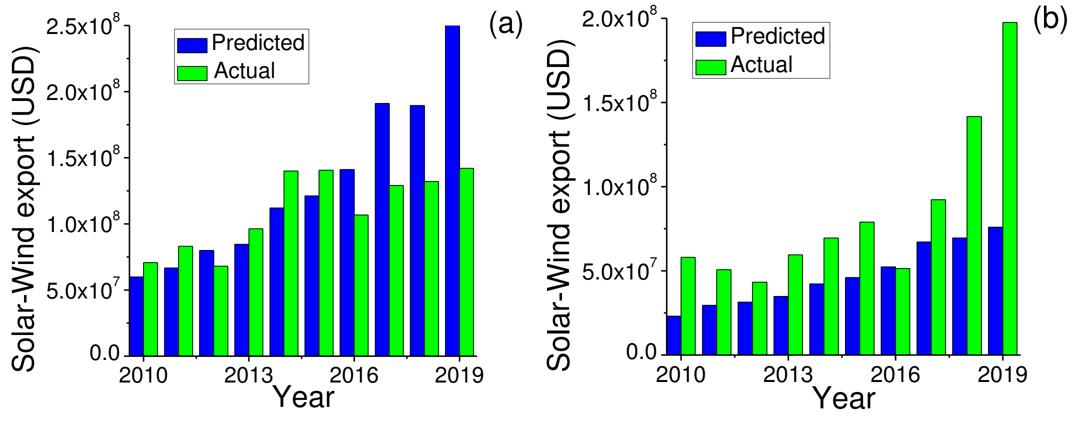

Figure 2. Comparison of the actual export of Solar-Wind goods (US Dollar) with those generated with the regression of Eq. (3) for (a) ASEAN and (b) SAARC countries.

In order to quantify the comparison of the observed and the predicted trade potentials, the well-known techniques, such as root-mean-square-error or maximum absolute error estimates were thought of but could not be implemented. The available input parameters were so widely varying, particularly for SAARC countries that sometimes the difference between the actual and regressed values were found to be more than 100%. Anyway the regressed results showed some useful directions, as mentioned in the previous paragraph. Therefore an alternative technique was devised to define different stages of trade potential. To compare the latest (2019) and the initial (2010) trade potential separately for each country, the ratio (R) of the actual to the regressed export value was calculated for each country for Hydro and Solar-Wind separately. The following three distinguishable categories of trade potential were defined based on R. If $R > 1.0$, the trade potential is 'matured', which means the trade potential has almost reached the saturation. If $0.5 < R < 1$, the trade potential is 'on the rise' and there is scope for developing the trade scenario in those countries. For $R < 0.5$, the trade potential is 'untapped' indicating immense trade potential. Based on these distinctions, the changes in trade potential for the ASEAN and the SAARC countries are summarized in Table 5.

Table 5. Change in trade potential for SAARC and ASEAN countries during the last one decade.

Countries	Hydro		Solar-Wind	
	Yr. 2010	Yr. 2019	Yr. 2010	Yr. 2019
SAARC				
Afghanistan	0.10	0.15	5.08	4.02
Bangladesh	2.45	3.11	2.36	4.45
Bhutan	0.36	3.07	--	--
Maldives	--	--	0.40	0.46
Nepal	6.63	7.34	3.79	5.03
Pakistan	0.01	0.00	0.01	0.73
Sri Lanka	11.35	3.73	3.75	1.23
ASEAN				
Cambodia	0.03	0.84	0.00	0.61
Indonesia	0.59	0.71	0.53	0.17
Lao PDR	0.20	1.06	0.04	0.15
Malaysia	0.39	0.30	0.85	0.54
Myanmar	0.63	1.86	--	--
Papua New Guinea	0.15	0.32	--	--
Philippines	0.15	0.56	0.86	0.48
Singapore	--	--	1.74	0.60
Thailand	0.55	1.24	0.97	0.19
Vietnam	2.96	1.49	1.75	1.60
Summary				
Item (Year)	No. of Countries	Untapped (%)	On the Rise (%)	Matured (%)
Hydro (2010)	15	8 (53.33)	3 (20.00)	4 (26.67)
Hydro (2019)	15	4 (26.67)	3 (20.00)	8 (53.33)
Solar-Wind (2010)	14	4 (28.6)	4 (28.6)	6 (42.8)
Solar-Wind (2019)	14	5 (35.7)	4 (28.6)	5 (35.7)

For Hydro, in 2010, India had great trade potential with Cambodia, Papua New Guinea, Philippines, Lao PDR, Malaysia, Afghanistan, Bhutan and Pakistan. The trade potential was also on the rise for Indonesia, Myanmar and Thailand. However, in 2019, India has high trade potential only with Malaysia, Pakistan, Papua New Guinea and Afghanistan. For Solar-Wind, in 2010, India had large trade potential with Cambodia, Lao PDR, Pakistan and Maldives and that with Indonesia, Malaysia, Philippines and Thailand was 'on the rise'. In 2019, there was high trade potential with Indonesia, Lao PDR, Maldives, Philippines and Thailand, that with the last two nations having increased over the years. The trade potential in 2019 is found to be 'on the rise' with Cambodia, Malaysia, Pakistan and Singapore; Singapore having moved from 'matured' to 'on the rise' state. Thus, considering together the 'untapped' and 'on the rise' conditions, India has great trading potential in Solar-wind for the ASEAN countries, which should be targeted as future prospective markets of renewable energy product exports and the same may be treated as a policy recommendation.

4. Conclusion

The prospect of renewable energy trade of India with ASEAN and SAARC countries has motivated the present work that has developed a gravity model for interpreting the possible trade flow and estimating the trade potential in bilateral trade. The trade logistics of the importing country had the greatest impact on the export value of Hydro products. The bilateral distance, the tariff rate and the renewable energy generated in the destination country have higher impact on the export value for Solar-Wind than that of Hydro. The region-wise evolution of trade potential showed a matured trade relationship with SAARC throughout and a great trade potential converged to matured trade with ASEAN during the last 5-6 years for Hydro. For Solar-Wind, a similar picture was observed for SAARC. For ASEAN, however, the last few years show the predicted trade surpassing the actual trade implying a growing trade potential. In country-wise comparison of trade potential between 2010 and 2019, India had great trade potential in Hydro previously with 73.33% of the countries in 2010 compared with the 46.67% in 2019 indicating a matured trade prospective. In contrast, it has a great trade potential for Solar-Wind; 64.3% of the countries in 2019 compared to 57.2% in 2010. The enhanced export value of Solar-Wind market in comparison with that of Hydro implies that exporting more in Solar-Wind market can be beneficial for India. Thus the large trading prospective in Solar-Wind may be treated as a future policy issue and the ASEAN countries may be focused as future prospective markets of renewable energy product exports.

References

Anderson, J. E. (1979). A Theoretical Foundation for the Gravity Equation. The American Economic Review 69(1): 106–116.

Asian Development Bank. (2017). *Harmonizing Electricity Laws in South Asia: Recommendations to Implement the South Asian Association for Regional Cooperation Framework Agreement on Energy Trade* (*Electricity*). Philippines. ISBN 978-92-9257-967-8 (Print), 978-92-9257-968-5 (e-ISBN). doi: 10.22617/TCS179071-2

Banik, N., Kim, M., (2020). India–ASEAN Trade Relations: Examining the Trends and Identifying the Potential. Global Business Review. 1–19. doi: 10.1177/0972150920953546

De, P., Kumarasamy, D., (2020). ASEAN-India Energy Cooperation: Current Status and Future Scope of Cooperation. AIC Working Paper.

Eckstein, D., Künzel, V., Schäfer, L., Winges. M., (2019). Global Climate Risk Index 2020. Germanwatch e.V. Bonn. ISBN 978-3-943704-77-8.

Erdiwansyah, Mamat, R., Sani, M. S. M., Sudhakar. K., (2019). Renewable Energy in Southeast Asia: Policies and Recommendations. Science of the Total Environment 670: 1095–1102. doi: 10.1016/j.scitotenv.2019.03.273.

Grover, M., Agarwal, S., (2019). India's Growing Trade Relationship within South Asia: Reflections from Trends of the Recent Past. SADF Working Paper. ISSN 2506-8202.

Jing, S., Zhihui, L., Jinhua, C., Zhiyao. S., (2020). China's Renewable Energy Trade Potential in the 'Belt-and-Road' Countries: A Gravity Model Analysis. Renewable Energy 161: 1025–1035. doi: 10.1016/j.renene.2020.06.134.

Kabir, M., Salim, R., Al-Mawali. N., (2017). The Gravity Model and Trade Flows: Recent Developments in Econometric Modeling and empirical evidence, Economic Analysis and Policy 56: 60–71. doi: 10.1016/j.eap.2017.08.005.

Kalirajan, K., Liu, Y., (2017). Regional cooperation in renewable energy trade: prospects and constraints, in: Globalization of Low-Carbon Technologies. Springer, pp. 459-478.

Khalid, N., Ismail, S., (2022). The dynamics of India -ASEAN trade with special reference to manufactured exports and their technological composition. Theoretical and Applied Economics. Volume XXIX (2022), No. 1(630), Spring, pp. 161-172.

Kuik, O., Branger, F., Quirion. P., (2019). Competitive Advantage in the Renewable Energy Industry: Evidence from a Gravity Model. Renewable Energy 131: 472–481. doi: 10.1016/j.renene.2018.07.046.

Mathur. S.K., (2014). Trade in climate smart goods of Ecuador: quantitative analysis using trade indices, smart and gravity analysis. European Scientific Journal vol.1, pp. 158-183. ISSN: 1857 – 7881. Special Edition.

Rahman, S. H., Wijayatunga, P. D. C., Gunatilake, H., Fernando. P. N., (2011). Energy trade in South Asia: Opportunities and challenges, Asian Development Bank, Publication Stock No. BKK124531, ISBN 978-92-9092-631-3 (PDF), Philippines, 2012.

Raitzer, D. A., Bosello, F., Tavoni, M., Orecchia, C., Marangoni, G., Samson, J.N.G., (2015). Southeast Asia and the Economics of Global Climate Stabilization. Asian Development Bank. ISBN 978-92-9257-304-1 (Print), 978-92-9257-305-8 (e-ISBN).

Saini, S.R., Aggarwal, K., (2021). India's Trade Potential with ASEAN: An Assessment. JETIR July 2021, Volume 8, Issue 7.

Sharma, S. V. (2014). Energy Trade Practices in India: Review of Tariff and Non-Tariff Barriers in Relation to ASEAN. in Han, P. and F. Kimura (eds.), Energy Market Integration in East Asia: Energy Trade, Cross Border Electricity, and Price Mechanism, ERIA Research Project Report FY2013, No.29.Jakarta: ERIA, pp.27-62.

Sharma, V., Kumar, V., (2020). Study of India's Trade Trends With Saarc Nations Pre-Safta And Post-Safta. Palarch's Journal of Archaeology of Egypt/Egyptology 17(6), 1-14. ISSN 1567-214x.

Shukla, A. K., Sudhakar, K., Baredar. P., (2017). "Renewable energy resources in South Asian countries: Challenges, policy and recommendations." Resource-Efficient Technologies 3: 342–346. doi: 10.1016/j.reffit.2016.12.003.

Sikdar, C., Nag, B., (2011). Impact of India-ASEAN Free Trade Agreement: A cross-country analysis using applied general equilibrium modelling. Asia-Pacific Research and Training Network on Trade. Working Paper Series, No 107.

Singh, A., Jamasb,T., Nepal, R., Toman. M., (2015). Cross-border electricity cooperation in South Asia, Policy Research Working Paper 7328, World Bank Group, Development Research Group, Environment and Energy Team, June 2015, http://econ.worldbank.org

Vadra, R., (2012). A study on India's trade relationship with SAARC countries. Int. J. Indian Culture and Business Management. Vol. 5, No. 1.

Weerahewa, J., (2009). Impact of Trade Facilitation Measures and Regional Trade Agreements on Food and Agricultural Trade in South Asia. Asia-Pacific Research and Training Network on Trade Working Paper Series, No 69, June 2009.

Yotov, Y. V., Piermartini, R., Monteiro, J.A., Larch, M., (2017). An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model", World Trade Organization, printed at United Nations, Geneva. https://www.wto.org/english/res_e/booksp_e/advancedwtounctad2016_e.pdf.