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ASEAN, SAARC, and the Indomitable China in Food Trade:

A Gravity Model Analysis of Trade Patterns

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Abstract

We assess food trade among and across two Asian trading blocs, the Association of Southeast Asian Nations (ASEAN) and the South Asian Association for Regional Cooperation (SAARC), and China. Using most recent innovations in the empirical trade model, we find subpar trade for several countries but some over-trading as well, likely driven by weak economic fundamentals determining trade. Further, we find that Bangladesh, Philippines, Sri Lanka, and Viet Nam under-export to China, and to nearly all ASEAN and SAARC countries, with the magnitude varying between 40 and 100 percent below the predicted trade levels. While checking for competing explanations, we identify trading pair time variant factors such as tariffs reducing the magnitude of under-exporting of ASEAN and SAARC countries by 1 and 3 percent, respectively. We also highlight unobserved variables such as trust between countries as factors important for strong agricultural trade.

Keywords: gravity model, multilateral resistance, zero trade, under-trading, over-trading, ASEAN, China, SAARC

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I. Introduction

The Association of Southeast Asian Nations (ASEAN) and the South Asian Association for Regional Cooperation (SAARC) are two of the largest trading blocks in Asia, with a combined population in 2016 of 2.4 billion (around one-third of the world).[1][2] Over one-third of the population in these regions depends on agriculture for their livelihoods (triennium average ending [TE] 2016), greater than the world average of 29 percent.[3] Further, growth in the agriculture sector (which contributes around 14 percent to their gross domestic product [GDP] on average) has slowed down over the past few years. Agricultural trade that contributes around one-tenth to the total trade of both trading blocs can possibly act as an engine of growth if countries were to trade up to their potential.

The potential to trade more between ASEAN and SAARC countries may also present opportunities to improve the livelihoods of the people dependent on agriculture. The importance of agricultural trade notwithstanding, there do not exist studies that cover trade in and among these regions. The countries in both trading blocs are also neighbors with China, the powerhouse of global trade. Analysis of trade must incorporate the outcomes in relation to trade with China. We thus include China in our analysis.

The trade literature highlighting trade potential (or trade performance) using gravity models is widely available. These models estimate the predicted trade (based on countries' economic fundamentals) against which the actual trade between the countries is compared.[4] If predicted trade is more than actual trade then the country is said to be under-trading, that is, there is presence of untapped trade potential.

In this study, we assess the food trade performance among and across the two trading blocs ASEAN and SAARC, and with China, over the last two decades.[5] Specifically, we

[1] According to authors' calculations. These calculations can be provided on request.

[2] ASEAN countries includes Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. SAARC countries includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. In this paper, we use the term "SAARC countries" and "South Asia" interchangeably.

[3] Triennium ending average (TE) means 3-year average. For instance, TE2016 refers to the average from 2014 to 2016.

[4] Economic fundamentals refer to the characteristics of a region or country that explain why countries trade and how trade patterns evolve. In the economic models of trade, fundamentals play a crucial role in determining a country's level of trade. The World Trade Organization (WTO) highlights the main determining fundamentals as demographic change, investment, level of technology, energy and other natural resources, transportation costs, and institutional framework (WTO 2013). The gravity model takes these country-time variables into account to determine the trade potential. For instance, building a deep-sea port in India will increase its potential to trade whereas inadequate road transport will reduce the potential to trade with partner countries.

[5] We use the term "food trade" and "agricultural trade" interchangeably.

examine the existence of untapped food trade, that is, the food trade potential between these countries, using robust gravity models and considering multiple identification issues and issues of consistency.

We consider the period between 1996 and 2016 for the analysis. The period encompasses important events such as the accession of China into the World Trade Organization (WTO) in 2001, the signing of ASEAN-India and ASEAN-China Free Trade Agreements (FTAs), the constitution of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), and the global financial and food price crisis of 2007/2008.[6]

The main contributions of this paper are as follows. First, it fills the gap in the analysis of food trade among and across ASEAN and SAARC countries. Studies listed in the Appendix that focus on specific regions and countries do not cover food trade among and across ASEAN and SAARC and with China. Second, the contribution is methodological. The measure of trade performance relative to a benchmark hinges on the yardstick itself. The benchmark is not known and must be estimated. In empirical trade analysis, the workhorse model of trade, that is, the gravity model, is used to get predicted or benchmark trade based on economic fundamentals. The robustness of the model then determines the fidelity of the estimated benchmark. We use the latest developments in empirical trade to correctly capture the measures of fundamentals-driven trade. Studies reviewed in the appendix address similar issues but are methodologically subpar by not accounting for the theoretical and empirical issues in the gravity model estimation. We also perform the regression specification error test (RESET test [Ramsey (1969)]) to check the adequacy of the estimated gravity models, which, to the best of our knowledge, has not been used in the existing literature on trade potential (or performance).

The demanding specifications that we implement account for country-time (exporter and importer) unobserved characteristics leaving only country pairs-time factors as possible explanators for subpar or above-par trade performance. Further, with the estimated under-trading or over-trading, we explore possible competing or complementary explanations for deviations from the predicted levels of trade. Such explanations are missing in the existing literature. The Kathuria (2018) report highlights some explanations but fails to account for them in the model. The factors that we test for comprise tariffs and non-tariff measures (NTMs) including the bilaterally determined cost to trade.

[6] BIMSTEC is a regional grouping comprising five SAARC countries, namely, Bangladesh, Bhutan, India, Nepal, and Sri Lanka, and 2 ASEAN countries, namely, Myanmar and Thailand.

Based on our assessment of trade between and within SAARC and ASEAN countries and China, we find that most country-pairs under-export (actual exports are less than predicted exports). Results indicate that in food trade, Bangladesh, Cambodia, Philippines, Sri Lanka, and Viet Nam not only under-export to China but also to nearly all ASEAN and SAARC countries, with actual exports being 40 to 100 percent below the predicted levels.

On the other side, while China's exports to ASEAN countries are largely in line with the predicted trade levels, even China under-exports to SAARC countries, with magnitudes varying between 60 and 80 percent. Overall, wherever there is under-exporting in food products, SAARC countries tend to be under-exporting to a greater degree than ASEAN countries.

Even after the Uruguay round and multilateral and regional trade liberalization in food trade, tariffs continue to be inhibiting.[7] We find that tariffs adversely affect agricultural exports and controlling for bilateral time-varying tariffs does bring down the under-exporting phenomenon of both ASEAN, as well as SAARC countries by 1 and 3 percent, respectively. We did not find any impact of documented, that is, observed, cost to trade on exports, possibly because the main ones like tariffs are already controlled for. Further, we find a host of unobservable factors such as informal trade and the trust deficit (difficult to quantify and control for in the model), which may explain the subpar trading between the countries.

The remainder of the paper is structured as follows. Section II presents the food trade profile of SAARC and ASEAN countries, Section III describes the data, Section IV outlines the methodology, Section V explains the empirical results, and Section VI outlines caveats. Section VII provides conclusions and policy implications.

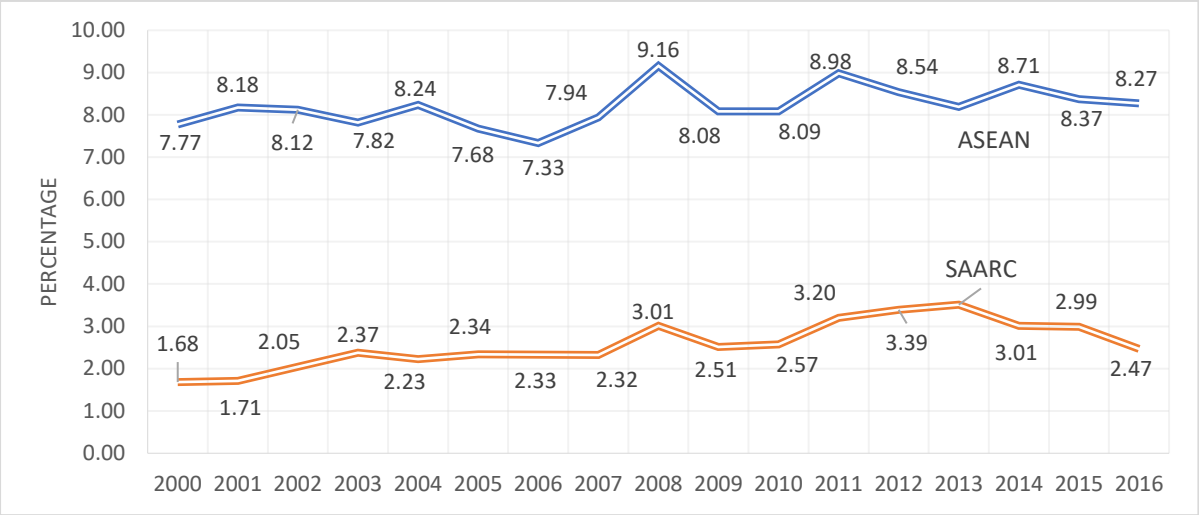
II. Food trade profile of ASEAN and SAARC countries

ASEAN's food trade—as a region—is more open as compared to SAARC (Figure 1). Trade openness is conventionally measured as the ratio of trade (exports plus imports) to GDP. Openness is posited as desirable because it allows access to larger markets, creates opportunities for specialization in production, and creates gains from economies of scale, technology transfers, and knowledge spill over (Wacziarg and Welch 2008). Greater openness to trade may also lead to an increase in the total amount and variety of food available to the

[7] The Uruguay Round was the 8th round of multilateral trade negotiations (MTN) conducted within the framework of the General Agreement on Tariffs and Trade (GATT) (now known as the WTO). In this round, for the first time, agricultural trade was brought within the GATT with commitments on market access for the imports. While developed countries were expected to reduce the overall tariff levels by 36 percent, the developing countries were expected to reduce them by 24 percent from the signing of the agreement.

national population at lower prices. Within ASEAN, Viet Nam has the highest openness of 19 percent (TE2016), followed by Malaysia, Thailand, and Myanmar (Table 1). It is remarkable that within SAARC, India and Pakistan—the two biggest countries by population—have the lowest food trade openness, of around 3 and 4 percent, respectively. Note that the least open countries, that is, Brunei, Philippines, and Indonesia among the ASEAN countries, are still more open than the average of all SAARC countries combined, that is, 3 percent.

Figure 1. Trade openness of ASEAN and SAARC



Source: United Nations (2019) and World Bank (2019a).
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation. Agricultural trade data is not available for 9 countries from 1996 to 1999. Consequently, we have presented the information beginning from the year 2000.

Table 1. Trade openness (in percentage) of ASEAN and SAARC countries

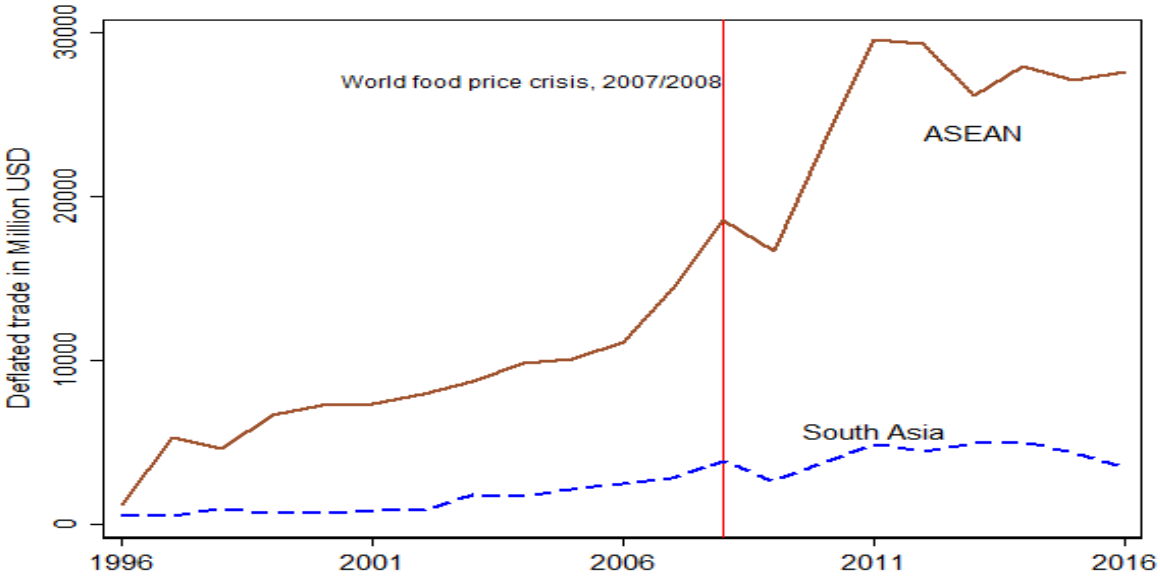
COUNTRIES	TE2016	COUNTRIES	TE2016
Brunei	4.00	Afghanistan	7.82
Cambodia	6.90	Bangladesh	4.60
Indonesia	5.39	Bhutan	-
Lao PDR	6.73	India	2.55
Malaysia	12.14	Maldives	14.08
Myanmar	9.20	Nepal	7.70
Philippines	4.97	Pakistan	3.95
Singapore	7.31	Sri Lanka	6.47
Thailand	10.80		
Viet Nam	19.19		
ASEAN (Average)	**8.45**	**SAARC (Average)**	**2.82**

Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation; TE = Triennium ending average; - = data not available.

A significant measure of the trading relationship's health is also its resilience when faced with shocks, whether idiosyncratic (for example, sanctions on Myanmar) or generalized (the great recession or the food price crisis). Brixiová, Meng, and Ncube (2015) find that the East African community's resilience to external shocks, as compared to the Southern Africa Customs Union region, improved due to intense intra-regional and intra-industry trade. Further, they highlight that deeper intra-regional and intra-industry trade ties along with other factors such as sound management of capital flows help build the resilience of a regional grouping.

We present the dynamics of intra-ASEAN and intra-SAARC food trade in Figure 2. After the food price crisis of 2007/2008, the intra-regional trade of ASEAN and SAARC fell by 10 and 31 percent, respectively, but increased sharply by 77 and 83 percent, respectively, between 2009 and 2011. While, from 2014 onwards, intra-SAARC trade gradually declined to US$3.53 billion—near to the trade level in the year 2008—the intra-ASEAN trade remained between US$26 and US$28 billion from 2011 to 2016. It appears that both regions traded more among themselves. There were dips in food exports and recovery, but the ASEAN countries moved much beyond the pre-crisis levels while SAARC countries recovered only to the levels prior to the food price and financial crises. Put alternatively, only the food trade relationship among ASEAN countries improved after the crisis.

Figure 2. Intra-regional agricultural trade of ASEAN and SAARC countries



Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation.

The sharp increase in intra-ASEAN agricultural trade between 2009 and 2011 is attributed to the significant increase in exports of rice; palm oil; and other food products such

as beverages, sugar, and vegetable fat and oils. Rice, the most traded commodity in TE2011—it contributed around 10.5 percent to the regional trade—grew by 62.5 percent between 2009 and 2011. Similarly, palm oil (crude and non-crude) and sugar (cane sugar and sucrose) witnessed an increase of 133 and 130 percent, respectively. In the case of SAARC, the increase in intra-regional trade is from oil cakes, sugar, wheat, rice, spices (capsicum or pimenta), and fruits and vegetables such as dates and tomatoes. Among cereals the exports of wheat (flour and durum) and sugar (cane sugar and sucrose) observed a significant increase by 165 and 33 times, respectively, between 2009 and 2011.

The major commodities, which contributed around 60 percent of both the intra-regional trades, grew (on average) around 180 and 319 percent for ASEAN and SAARC, respectively, between TE 2006 and TE 2011.[8] However, their growth fell to 21 and 15 percent for ASEAN and SAARC, respectively, between TE 2011 and TE 2016. This may explain the decline from US$30 to US$28 billion between 2011 and 2016 in the case of ASEAN, and US$4.9 to US$3.5 billion for SAARC.

In inter-regional trade, figure 3a and 3b show that intra-ASEAN trade occupies the highest share in the total food trade of ASEAN with the world. With an export share of around 14 percent, China has emerged as the 4th major export destination for ASEAN countries, after Other Asia and Pacific (OAP), and Europe and Central Asia (ECA) regions. ASEAN imports from Latin America and Caribbean (LAC) witnessed the biggest jump of around 9 percent from TE2000 to TE2016. The Southern Cone Common Market (MERCOSUR), a regional grouping in Latin America, has been exporting mainly milk, soya, and corn to the ASEAN countries (SELA 2015).

The percentage share of SAARC nations in ASEAN's exports and imports remained unchanged during this period. However, the same does not hold true in the case of SAARC. ASEAN's share in the total exports of the SAARC region has witnessed an increase of 10 percent between TE2000 and TE2016 (Figure 4a). The share of other regions such as the Middle East and North Africa (MENA) and Sub-Saharan Africa (SSA) also increased during this period. In the case of SAARC's import from the regions, ASEAN—which still accounts for one-third of imports—witnessed a decreased share from around 38 to 33.5 percent (Figure 4b). The share of other regions, including North America, and ECA, however, increased over the period.

[8] Major commodities are determined by considering commodities that accounted for at least 1 percent of the total intra-regional agricultural trade in TE 2011.

Figure 3a. ASEAN region exports to other regions

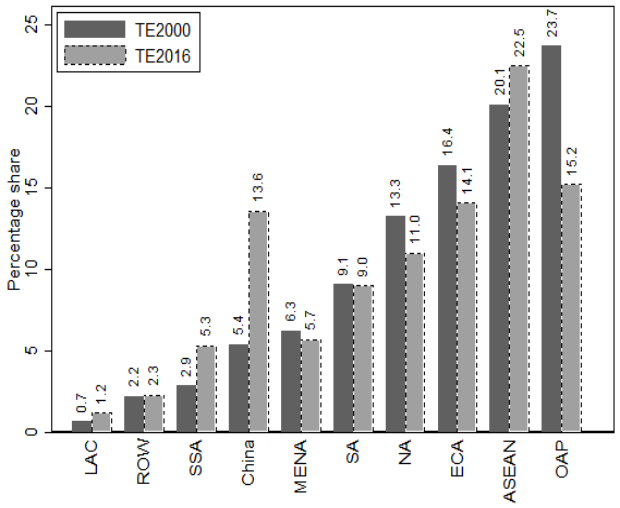
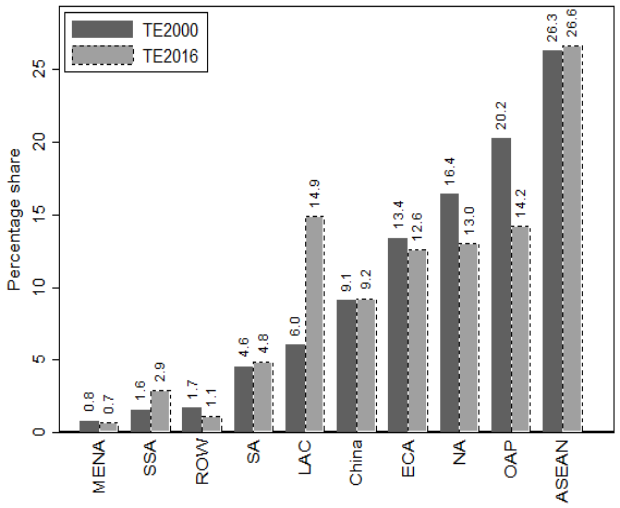


Figure 3b. ASEAN region imports from other regions



Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, NA = North America, OAP = Other Asia and Pacific, ROW = Rest of the World, SA = South Asia, SSA = Sub-Saharan Africa; TE = Triennium ending average.

Figure 4a. SAARC region exports to other regions

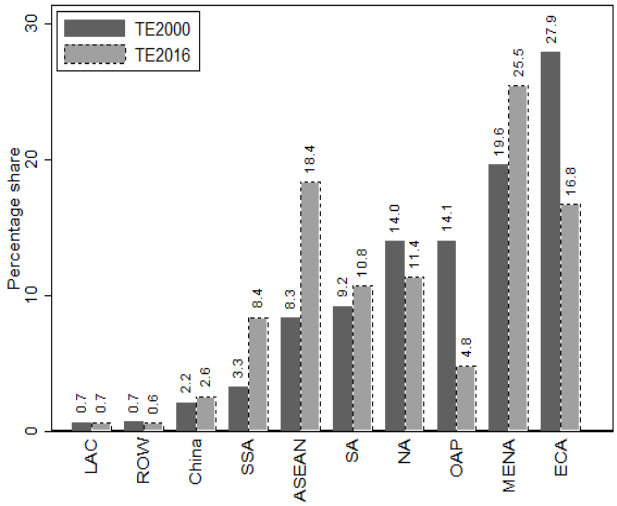
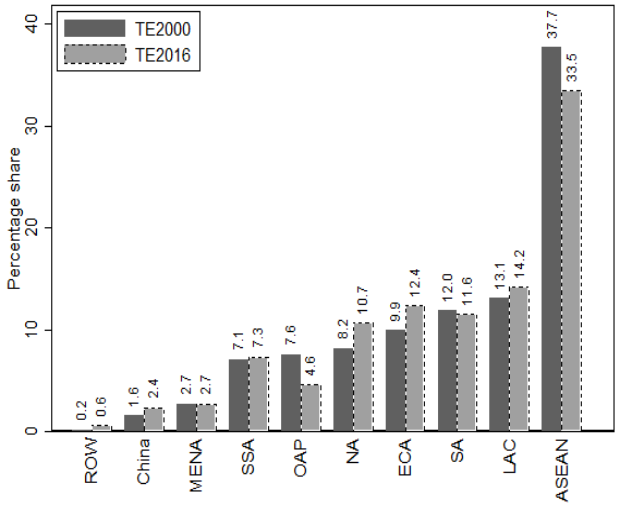


Figure 4b. SAARC region imports from other regions



Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations, ECA = Europe and Central Asia, LAC = Latin America and Caribbean, MENA = Middle East and North Africa, NA = North America, OAP = Other Asia and Pacific, ROW = Rest of the World, SA = South Asia, SAARC = South Asian Association for Regional Cooperation, SSA = Sub-Saharan Africa; TE = Triennium ending average.

The top 3 partners in exports and imports of ASEAN and SAARC countries are listed in the Appendix (Appendix Tables 3a and 3b). These tables show that the top partners of most ASEAN countries are other ASEAN members, China, India, and Japan (countries with free

trade agreements with ASEAN). This is not the case for SAARC countries, though. The top trading partners of most SAARC nations are non-SAARC countries, even after the South Asian Free Trade Area (SAFTA) took effect from 2006.

III. Data

We perform the analysis using trade data (H1 Nomenclature) obtained from UN Comtrade for 1996 to 2016 (United Nations 2019). We use harmonized system (HS) chapters related to animal and animal products (HS 01–05), vegetable products (HS 06-15), and food products (processed food) (HS 16-24) to derive food trade between the countries. The trade data is reported in current United States dollars (US$) and is deflated using the GDP deflator of the United States obtained from the US Bureau of Economic Analysis, to derive each country's real imports and exports (US Department of Commerce 2019).[9]

The values of GDP and cost to trade (ease of doing business) for SAARC and ASEAN countries are obtained from World Development Indicators (World Bank 2019a).[10] Further, tariff and non-tariff data is obtained from the World Integrated Trade Solution (WITS), developed by the World Bank.[11]

In the case of gravity estimates—for computational reasons—we confine our analysis to the set of 105 advanced, emerging, and developing economies (Appendix Table 2). The standard variables used to estimate the gravity model, for example, country-pair variables including bilateral distance, common land border, common language, and colonial ties are obtained from the CEPII Gravity Database (Centre d'Etudes Prospectives et d'Informations Internationales 2017). Note that, for the year 2016, we duplicated the time invariant pair variables of 2015. The information such as distance and common border are unlikely to vary over time.

IV. Methodology

We use the gravity model to assess the food trade performance among and across ASEAN and SAARC countries.[12] In addition, we look at the trade flows with China. The gravity model offers a well-established theoretical framework to analyze the determinants of bilateral flows

[9] The base of the GDP deflator is 2012.
[10] Cost to trade data is available for 2006 to 2015.
[11] Tariff data is available for 1996 to 2015.
[12] The traditional—atheoretical—gravity model relates bilateral trade to economic characteristics such as the GDP of the countries and the trade cost between them.

between the countries.[13] We employ the most recent developments in the panel data gravity model to gauge the trading relative to the potential, taking into account time varying multilateral resistance (Olivero and Yotov 2012), zero trade (Helpman, Melitz, and Rubinstein 2008) and heteroscedasticity leading to inconsistent estimates (Silva and Tenreyro 2006). Olivero and Yotov (2012) recommend the use of exporter- and importer-time fixed effects to account for time varying multilateral resistance. Baldwin and Taglioni (2006) label failure to account for such resistance, in the context of the gravity model, as the "Gold Medal, Silver Medal and Bronze Medal Mistake."[14] Many researchers use "remoteness indexes," constructed as functions of bilateral distance, and GDPs to control for multilateral resistance terms (Wei 1996; Baier and Bergstrand 2009). However, Head and Mayer (2014) have criticized the use of these indexes as they bear little resemblance to the theoretical counterpart of the multilateral resistance term.

The standard (logarithmic) gravity model ignores the prevalence of zeroes in the bilateral trade flows. Helpman, Melitz and Rubinstein (2008) argue that the zeroes in the trade flows may be due to fixed costs of exporting, which cause firms to self-select into exporting. They highlight the importance of accounting for zero trade values to avoid selection bias in the gravity model. Silva and Tenreyro (2006), SST (2006) henceforth, criticize the conventional practice of log-linearized regressions as it may lead to inconsistent estimates in the presence of heteroscedasticity because of Jensen's inequality.[15] Further, they recommend the Poisson Pseudo-Maximum Likelihood (PPML) estimation technique, which not only provides consistent estimates in the presence of heteroscedasticity but also provides a natural way to deal with zero trade values. SST (2006) also perform the RESET test to assess the correct specification of the regression models. This test detects whether potential variables are omitted while specifying the model or not. Like SST (2006); Baier, Kerr, and Yotov (2017); and Yotov et al. (2016), we also perform this test on our model. The test is performed by first predicting the fitted values and then including a higher order (quadratic form) of those fitted values into the model specification. If the higher order of fitted values are insignificant, then the model is correctly specified. We perform the RESET test for both, the ordinary least squares (OLS)

[13] Anderson and van Wincoop (2003) formally derived the gravity framework from a general equilibrium model of production, consumption, and trade.

[14] Olivero and Yotov (2012) demonstrate the use of exporter- and importer-time fixed effects to account for time varying multilateral resistance in the panel data gravity framework. They extended the recommendations of Feenstra (2004) to use directional—exporter and importer—fixed effects in a cross-section estimation.

[15] Jensen's inequality states that the expected value of the logarithm of a random variable, say x, is not equal to the logarithm of the expected value of x. This means $E(\log x) \neq \log E(x)$.

regression—which does not account for multilateral resistance, zero trade, and heteroscedasticity—and the PPML regression, that is, our preferred specification.

The following PPML equation (1) is used to estimate the bilateral food trade flows between the countries:[16]

$$X_{ij,t} = exp\big(\beta_0 + \pi_{it} + \tau_{jt} + \alpha_h D_{A-S} + \alpha_m D_{S-A} + \alpha_n D_{C-AS} + \alpha_p D_{AS-C} + \varphi_g Z_{ij}\big)u_{ijt} \quad (1)$$

where, $X_{ij,t}$ denotes food exports from country i to country j measured in million US$, at time t. π_{it} and τ_{jt} are the time varying exporter and importer fixed effects controlling for unobservable multilateral resistance and potentially any other observed and unobserved country-specific and time varying characteristics: changes in national policies, quality of institutions and infrastructure, and accession of countries into arrangements such as the European Union (EU) and the WTO.

Z_{ij} is a vector of time-invariant variables such as bilateral distance (in logarithm), common border, and common language, and φ_g is a vector of coefficients to be estimated in relation to these pair-wise time invariant variables. D_{A-S}, D_{S-A}, D_{C-AS}, and D_{AS-C} are dummy variables used to capture the trade performances of China and ASEAN and SAARC countries. D_{A-S} takes value 1 if any ASEAN country exports to any SAARC country. Similarly, D_{S-A}, D_{C-AS} and D_{AS-C} take value 1 if any SAARC country exports to any ASEAN country, China exports to any ASEAN country, and any ASEAN or SAARC country exports to China, respectively. α_h, α_m, α_n, and α_p are vectors of coefficients to be estimated in relation to D_{A-S}, D_{S-A}, D_{C-AS}, and D_{AS-C}, respectively. α_h, α_m, α_n, and α_p are coefficients of interest. If $\alpha_h <$ 0, then the corresponding ASEAN country's exports to the SAARC country are below the gravity-predicted export level. This implies that the ASEAN country is under-exporting to the SAARC country. The reverse will hold for $\alpha_h > 0$. A similar interpretation will follow in the case of α_m, α_n, and α_p.

The magnitude of under- or over-trading is calculated as follows:

Size of under- or over-exporting by ASEAN country to SAARC country = $e^{\alpha_h} - 1$

Size of under- or over-exporting by SAARC country to ASEAN country = $e^{\alpha_m} - 1$

[16] The ordinary least squares regression equation is as follows:

$$LogX_{ij,t} = \beta_0 + \pi_{it} + \tau_{jt} + \alpha_h D_{A-S} + \alpha_m D_{S-A} + \alpha_n D_{C-AS} + \alpha_p D_{AS-C} + \varphi_g Z_{ij} + u_{ijt}$$

where $LogX_{ij,t}$ denotes the logarithm of agriculture export from country i to country j, measured in million US$, at time t. Other symbols follow the same meaning provided in the text.

Similarly, $e^{\alpha_n} - 1$ and $e^{\alpha_p} - 1$ will provide the size of under- or over-exporting by China to an ASEAN or SAARC country, and vice versa, respectively.

V. Results

Table 2 synthesizes the core findings of the study with estimates of the gravity model. For brevity, not all the estimated coefficients (from OLS and PPML estimation techniques) are presented. The cases of India and Indonesia—the largest traders of agricultural commodities among SAARC and ASEAN countries, respectively—are presented illustrating the salient findings. Although the table presents the selected results, the magnitude of under- and over-exporting for China and SAARC and ASEAN countries can be found in the Appendix (Appendix Table 4a and 4b).

Table 2. Estimated gravity model of trade: Significance of SAARC and ASEAN countries trade

	(1)	(2)
	OLS	**PPML**
Indonesia exports to Brunei	-0.221	-0.018
	(-0.93)	(-0.04)
Indonesia exports to Cambodia	2.510***	1.928***
	(10.41)	(5.49)
Indonesia exports to Lao PDR	-2.382***	-2.076***
	(-9.09)	(-5.43)
Indonesia exports to Malaysia	-0.867***	-0.381
	(-3.60)	(-1.52)
Indonesia exports to Myanmar	2.452***	2.163***
	(8.72)	(5.50)
Indonesia exports to Philippines	0.004	-0.315
	(0.02)	(-1.42)
Indonesia exports to Singapore	-0.717***	-0.442
	(-3.38)	(-1.48)
Indonesia exports to Thailand	-0.302	-0.956***
	(-1.27)	(-3.97)
Indonesia exports to Viet Nam	-0.608***	-0.760***
	(-2.91)	(-2.97)
Indonesia exports to Afghanistan	1.230***	0.174
	(4.51)	(0.47)
Indonesia exports to Bangladesh	1.759***	0.985***
	(6.66)	(2.75)
Indonesia exports to Bhutan	-1.249**	-2.222***
	(-2.44)	(-4.74)
Indonesia exports to India	3.157***	2.371***
	(14.42)	(7.32)
Indonesia exports to Maldives	0.196	-0.032
	(0.78)	(-0.11)
Indonesia exports to Nepal	0.763***	0.576*
	(3.30)	(1.87)

	(1)	(2)
	OLS	**PPML**
Indonesia exports to Pakistan	2.968***	2.118***
	(12.47)	(7.26)
Indonesia exports to Sri Lanka	0.575**	-0.021
	(2.27)	(-0.06)
Indonesia exports to China	0.605***	-0.373
	(3.16)	(-1.31)
India exports to Brunei	-0.031	0.349
	(-0.13)	(0.77)
India exports to Cambodia	0.001	-0.131
	(0.00)	(-0.39)
India exports to Indonesia	1.310***	0.255
	(6.35)	(1.05)
India exports to Lao PDR	-2.141***	0.848**
	(-7.97)	(2.28)
India exports to Malaysia	0.610***	0.073
	(2.83)	(0.32)
India exports to Myanmar	-0.604*	0.382
	(-1.90)	(0.98)
India exports to Philippines	0.774***	0.009
	(3.69)	(0.04)
India exports to Singapore	-0.889***	-0.960***
	(-4.37)	(-3.63)
India exports to Thailand	0.315	-0.364*
	(1.34)	(-1.68)
India exports to Viet Nam	1.288***	1.200***
	(6.30)	(5.04)
India exports to Afghanistan	0.544*	-0.162
	(1.96)	(-0.45)
India exports to Bangladesh	0.247	-0.203
	(0.81)	(-0.57)
India exports to Bhutan	1.897***	3.497***
	(4.21)	(7.59)
India exports to Maldives	0.635**	0.873***
	(2.39)	(2.99)
India exports to Nepal	1.393***	2.563***
	(5.27)	(8.53)
India exports to Pakistan	-1.517***	-0.983***
	(-5.42)	(-3.35)
India exports to Sri Lanka	0.760***	0.344
	(2.85)	(1.01)
India exports to China	-1.276***	-2.047***
	(-5.45)	(-7.36)
Contiguity	1.050***	0.516***
	(7.32)	(5.59)
Common official or primary language	0.440***	0.201**
	(7.10)	(2.37)
Common colonizer post-1945	0.693***	0.551***

	(1)	(2)
	OLS	**PPML**
	(6.56)	(3.93)
Pair in colonial relationship post-1945	1.474***	0.838***
	(9.11)	(5.85)
Distance (log)	-1.519***	-1.070***
	(-50.17)	(-26.16)
Constant	10.12	-0.161
	(.)	(-0.18)
Observations	127590	186378
R-squared	0.702	0.867
Ramsey RESET Test	0.000	0.016

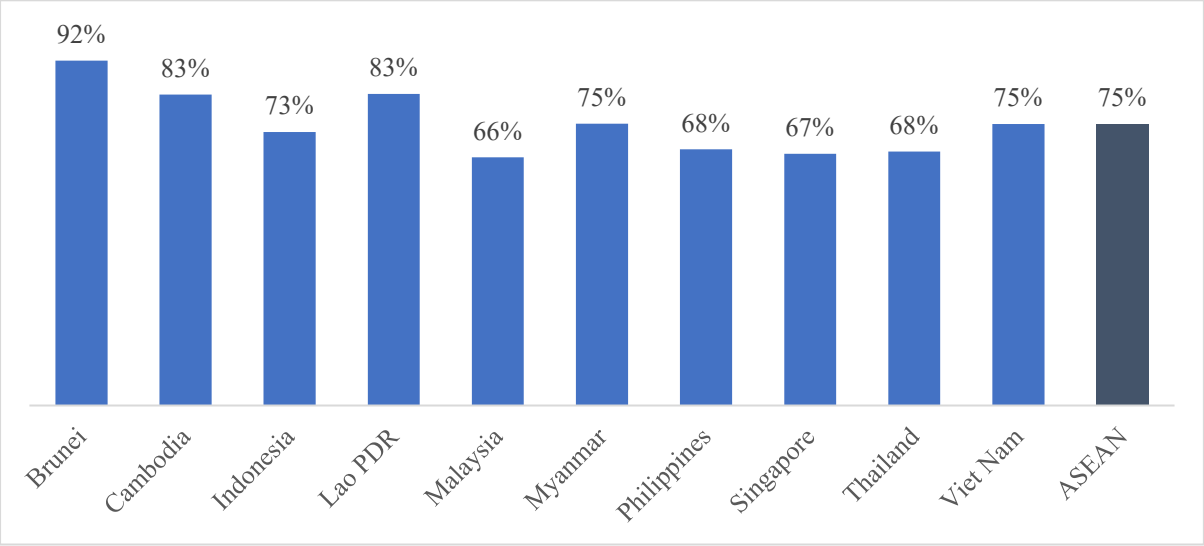
Source: Based on author's calculations.

Note: ASEAN = Association of Southeast Asian Nations; OLS = ordinary least squares; PPML = Poisson Pseudo-Maximum Likelihood; RESET = regression specification error test; SAARC = South Asian Association for Regional Cooperation. This table shows the estimates from regression equation (1) & the OLS regression in footnote 16, respectively. The regression includes exporter- and importer-year dummies. Robust standard errors are clustered at the exporter and importer pair level. Robust t-statistics are in parentheses. Significance at the 1, 5, and 10 percent level are indicated by ***, **, and *, respectively.

Our results show that more country pairs under-export than over-export. In the case of ASEAN countries, we find subpar agricultural exports for Cambodia, Philippines, and Viet Nam. Importantly, these countries generally under-export to all: that is, China, ASEAN, and SAARC countries. Thailand also under-exports to China and to nearly all SAARC countries; however, it over-exports to Brunei, Cambodia, Lao PDR, and Myanmar among the ASEAN countries. The magnitude of Thailand's under-exporting with SAARC countries varies between 55 and 100 percent of the trade level predicted by the gravity framework.

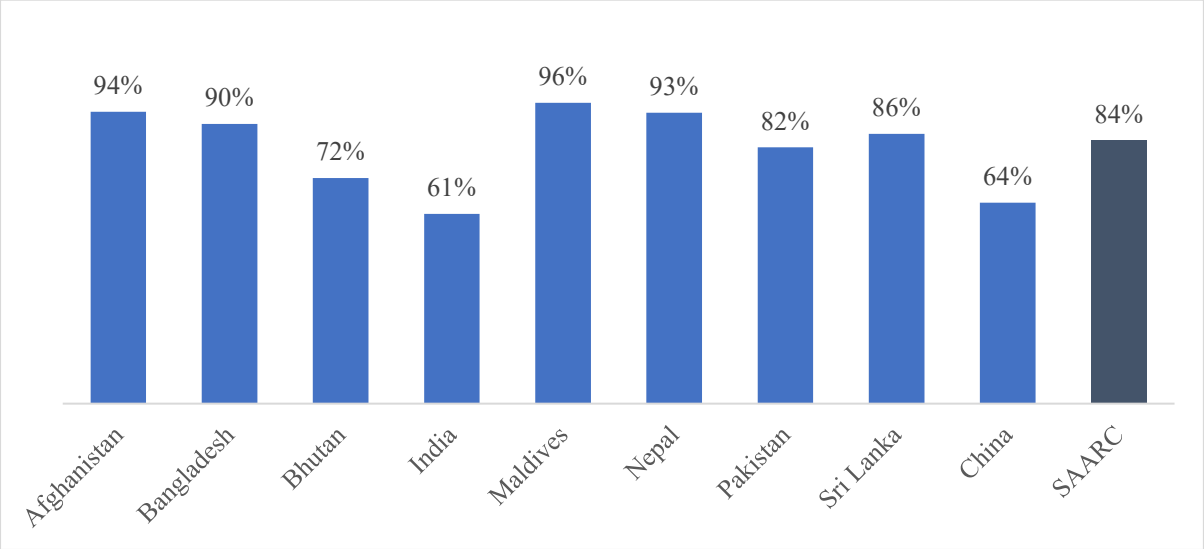
Among SAARC countries, Bangladesh and Sri Lanka under-export to China and to nearly all ASEAN and SAARC countries. We find that their realized exports are about 60 to 100 percent lower than the predicted trade level. In the case of China, the exports to ASEAN countries are largely in line with the predicted level. However, China's export to SAARC countries are around 60 to 80 percent below the expected trade. Overall, we find the magnitude of under-exporting to be significantly more among SAARC countries relative to ASEAN countries (Figures 5a and 5b).

Figure 5a. Magnitude of average under-exporting (in percentage) by ASEAN countries



Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations. Based on author's calculations.

Figure 5b. Magnitude of average under-exporting (in percentage) by China and SAARC countries



Source: United Nations (2019).
Note: SAARC = South Asian Association for Regional Cooperation. Based on author's calculations.

Note that in Table 2, the coefficients of other variables such as contiguity, common official or primary language, and distance carry the expected gravity model signs. Further, the p-values of the Ramsey RESET test, presented at the bottom of the table, reveal that the PPML regression passes the RESET test at 1 percent. This means that the RESET test provides no evidence of misspecification of the gravity equation estimated using PPML unlike OLS.

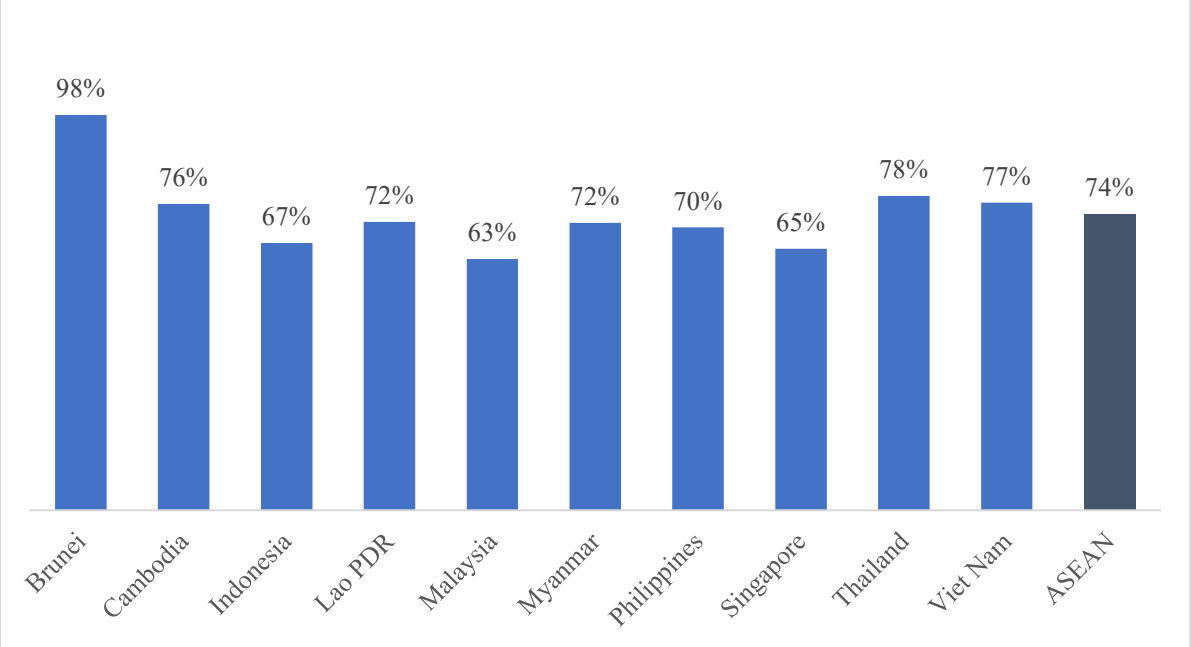
Under- and over-exporting by a country is an issue of omitted variables. In our model specification, omitted variables—variables which we do not control for—are country-pair time varying variables. These variables include barriers to trade, such as tariffs and cost to trade, which if unaccounted for may explain under-exporting. If the model is augmented to account for potential factors, the coefficient should change. We discuss these barriers below:

1. *Tariffs and non-tariff measures (NTMs)*

Traditional trade policy in terms of tariffs can act as a barrier to trade between countries. Hoekman and Nicita (2011) show that tariffs continue to impact trade (particularly in agriculture), and a reduction in the tariff trade restrictiveness index increases low-income countries' exports by 10.6 percent.

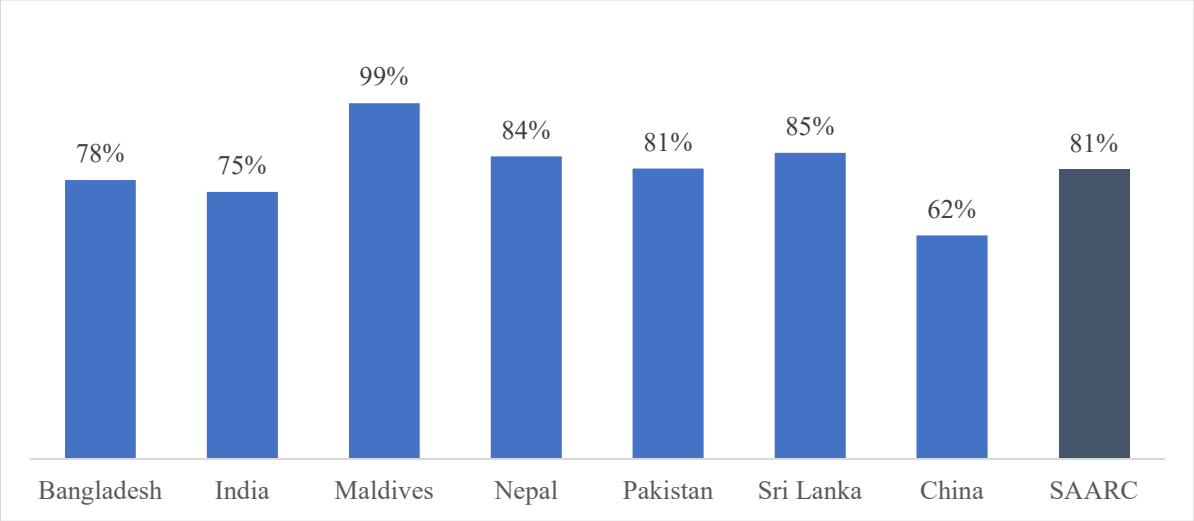
We thus first augment the model to gauge subpar trade performance by adding control for tariffs. From the coefficient of the bilateral time varying tariff, a 10 percent reduction in the tariff would increase countries' exports on average by 1 percent (Appendix: Table 5 [column 1 and 3]). Further, accounting for tariffs—and cost to trade (discussed below)—leads to reduction in the magnitude of under-exporting by 1 and 3 percent for ASEAN and SAARC countries, respectively (Figure 6a and 6b).

Figure 6a. Magnitude of average under-exporting (in percentage) by ASEAN countries after controlling for tariffs and cost to trade



Source: United Nations (2019).
Note: ASEAN = Association of Southeast Asian Nations. Based on author's calculations.

Figure 6b. Magnitude of average under-exporting (in percentage) by China and SAARC countries after controlling for tariffs and cost to trade



Source: United Nations (2019).
Note: SAARC = South Asian Association for Regional Cooperation. Based on author's calculations. Afghanistan and Bhutan's export dummies were dropped to ensure that the estimates exist.

At present, the tariff levels on food products are much higher in South Asian countries relative to ASEAN countries, making access to South Asian markets more difficult. SAARC countries, on average, levy a 25 percent tariff on agricultural exports from ASEAN countries whereas ASEAN countries in comparison impose only a 10 percent average tariff on food exports from South Asian countries (Appendix: Table 6). Thus, focusing on tariff reduction, particularly in South Asia, may facilitate in realizing the untapped export potential for these countries, particularly for intra-group trade, which is comparatively low for SAARC countries.

In the case of the trade effect of NTMs, studies have conducted meta-analyses demonstrating that NTMs can act as barriers or catalysts to trade (Li and Beghin 2012; Santeramo and Lamonaca 2019). Further, the effect of NTMs is case-specific depending upon specific countries and products. In our study, we are not able to account for NTMs due to non-availability of country-pair time data.

However, the coverage and frequency ratios are calculated to show the use of NTMs by the ASEAN and SAARC countries. While the coverage ratio measures the share of total imports, the frequency ratio measures the percentage of imported products subjected to NTMs.[17] Both

[17] Frequency ratio is defined as (Gourdon 2014):

$$F_j = \left(\frac{\sum D_i P_i}{\sum P_i}\right) \times 100$$

the ratios lie between 0 and 100, with a higher value indicating greater coverage by the NTMs. We find that the ASEAN countries apply more NTMs on agricultural imports compared to SAARC countries (Appendix Table 7). If stringent NTMs restrict market access, then it may explain the subpar export performance, especially in the case of SAARC countries' exports to ASEAN countries.

2. Cost to trade

Hoekman and Nicita (2011) find that the policies reducing trade costs, including clearance costs, domestic trade cost, logistic expenses, and licenses and fees, generate large trade gains, especially in terms of exports. Similarly, Djankov, Freund, and Pham (2010) show that an additional day of delay in the shipment of products reduces trade by more than 1 percent. Further, the effect of the delay is more severe on exports of time-sensitive goods such as agricultural products.

In our analysis, we also control for trade cost, focusing on US$ cost per container (deflated over time) between the countries. It is the cost associated with exporting and importing a standardized cargo of goods by sea transport through 4 predefined stages: document preparation, customs clearance and inspections, inland transport and handling, and port and terminal handling. We did not find any significant impact of such cost on trade, however (Appendix Table 5 [columns 2 and 3]). The trade cost between the country-pair is derived by adding the export and import cost incurred in the exporting and importing country, respectively. It does not include the bilateral trade cost corresponding to each country-pair, however. For instance, the export cost incurred by India to send a cargo to Nepal or Philippines (or any other country) is the same, that is, US$1332 per container (deflated) for 2015. The cost does not include the difference in transportation costs from India to Nepal or Philippines. Similarly, Nepal's import cost, that is, US$2650, is the same when receiving a cargo from India or Philippines (or any other country). Thus, the trade cost between India (exporter) and Nepal (importer) is US$3982, and in the case of the Philippines (exporter) and Nepal (importer) is

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where F_j is the frequency ratio of NTMs imposed by country j. D_i takes value 1 on the presence of one or more NTMs. P, also a dummy variable, indicates whether there are imports of good i.

Coverage ratio is defined as:

$$C_j = \left(\frac{\sum D_i V_i}{\sum V_i}\right) \times 100$$

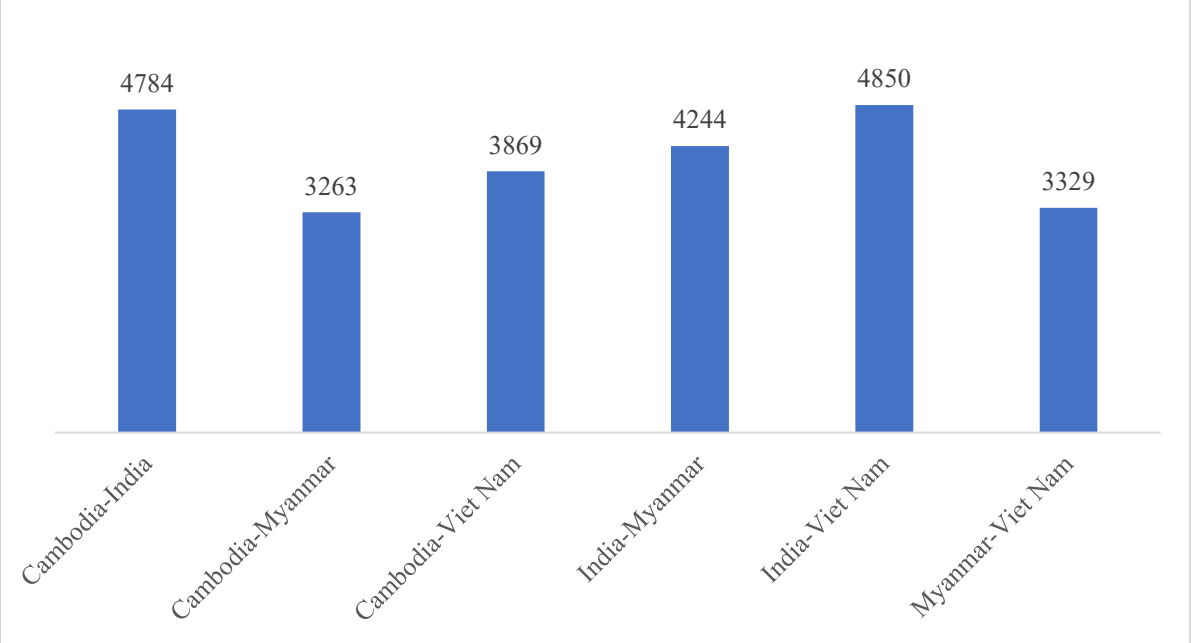
where C_j is the coverage ratio of NTMs imposed by country j. D_i takes value 1 on the presence of one or more NTMs. V is the value of imports in good i.

US$3045 for 2015. Therefore, the missing bilateral trade cost between the countries may be the reason for the insignificant impact of the cost on trade.

Note that Hoekman and Nicita (2011) and Djankov, Freund, and Pham (2010), when highlighting the significant impact of cost (or time) on trade, use misspecified models. Hoekman and Nicita (2011) use remoteness indexes instead of country-fixed effects, which are recommended in the empirical gravity literature. Similarly, Djankov, Freund, and Pham (2010) use log linearized gravity regressions, thereby failing to account for zero trade and heteroscedasticity.

Nevertheless, countries may learn among themselves and adopt policies to bring down their export and import costs. The tables highlighting the costs are presented in the Appendix (Appendix Table 8a and 8b). We observe that the cost incurred in SAARC countries, at an average (US$1930 and US$2144 per container for export and import, respectively), is more than double the cost incurred in ASEAN countries (US$858 and US$943 per container for export and import, respectively). Further, emerging economies such as India and Viet Nam have a higher cost to trade as compared to least developed countries (LDCs) such as Cambodia and Myanmar (Figure 7).

Figure 7. Average trade cost between country-pairs (US$ per container [deflated]), 2006-2015



Source: World Bank (2019a)
Note: Cost is calculated by adding the average trade cost between the country-pairs from 2006 to 2015. For instance, the average trade cost of Cambodia from 2006 to 2015 is US$1901 per container (that is, cost to export [US$874 per container] and import [US$1027 per container]). Similarly, the average trade cost of India is US$2882 per container. Therefore, the average trade cost between Cambodia and India from 2006 to 2015 is US$4784 per container.

3. Other possible unobservable factors

Omitted variables can also be unobservable to the extent that they cannot be quantified. This leads to a lack of data and cannot be controlled for in the model. Examples include informal trade—trade which takes place between the countries but is not included in the official statistics. The high level of informal trade provides indirect evidence of trade potential between the countries. The ADB (2018) report finds that informal trade among South Asian countries is 50 percent of their formal trade. Further, it highlights that India's informal trade with Pakistan and Sri Lanka is around 91 and 30 percent, respectively, of their formal trade. Similarly, studies have also found the presence of informal trade among ASEAN countries (Thiesmeyer 2010; Aung 2009). These studies have highlighted issues such as higher tariffs, stringent NTMs, distorted domestic policies, and non-economic and institutional factors, which prompt informal trade.

Another unobservable factor is trust. Lack of trust between the countries can severely affect their bilateral trade flows. The Kathuria (2018) report describes trust between South Asian economies as fragile because of their complicated history, conflicts, and size asymmetry, which prevent them from reaping the full economic benefits of geographical proximity and complementary resource endowments. The trading below potential could very well be a function of the trust deficit.

VI. Caveat

It should be noted that we only account for observed and unobserved country-specific and time-varying characteristics using country-time fixed effects. Our model specification does not account for country pair-time fixed effects to control for country pair-time varying characteristics affecting trade. Therefore, we use conjecturing country pair-time variables such as tariffs, cost to trade, and other unobservable trade barriers instead to explain the extent of under- and over-trading between the countries. Further, we focus on aggregate food trade between the countries and do not account for variation within the food trade. For instance, we look at the total food exports from Myanmar to India and not at dried legumes (pulses), which dominate the food exports from Myanmar to India.

VII. Conclusions and policy implications

In this paper, we assess the food trade performances of ASEAN and SAARC countries among and across themselves and with China. The performances are assessed by using a standard gravity model, including the indicators of trade between the country-pairs over the period 1996-

2016. After controlling for challenges such as time-varying multilateral resistance, zero trade, and heteroscedasticity in the gravity framework, and testing for model specification, we find most country-pairs to be under-exporting. Further, countries such as Bangladesh, Cambodia, Philippines, Sri Lanka, and Viet Nam under-exported to China and to nearly all ASEAN and SAARC countries.

What could explain the subpar export performance of these country-pairs? One possible reason for a country-pair to under-trade can be the overall subpar export or import performance of either the exporter or importer country. Country-time fixed effects used to control for multilateral resistance in the model also capture the overall trade performance of a country. However, we find that nearly all countries over export and import through the period.

Alternatively, under- or over-trading is an issue of omitted variables. In our model, we control for country-time (exporter and importer) unobserved characteristics, leaving only country pairs-time factors as possible contributors to subpar or above par trade performance. Examples include trade barriers such as tariffs, and trade cost, which changes over time between the countries. After controlling for such time varying observable characteristics, we find that tariffs adversely affect the exports of a country and accounting for them reduces the magnitude of under-exporting by 1 and 3 percent for ASEAN and SAARC countries, respectively. Further, we also examine NTMs and unobservable characteristics such as informal trade and the trust deficit, which are difficult to quantify and account for and may explain the country's subpar exports.

What are the policy implications of our findings? A country may over-trade with its potential partners due to its weak economic fundamentals which determine trade. For instance, LDCs such as Cambodia and Nepal export around US$538,000 and US$225,000 to Pakistan, respectively (TE 2016). Our results show that Nepal over-exports to Pakistan despite exporting less than Cambodia, which under-exports to Pakistan with around one-third the cost to export incurred in Nepal (Appendix Table 8a). Thus, it is possible that relatively weak economic characteristics such as domestic infrastructure and an unfavorable investment climate may predict a lower trade level resulting in over-exporting for a country. Further, over-exporting may highlight the importance of focusing on policies that enhance the trade potential of the country.

In the case of under-trading, countries may expand their exports by focusing on their competitive commodities which have high export potential in foreign markets. Ajmani et al. (2018) and (2019) highlight, for Myanmar and Cambodia, respectively, the potential agricultural exports with low intra-ASEAN competition. ASEAN and SAARC countries

seeking to expand exports may also focus on reducing tariff barriers through negotiations among themselves. In addition, the trust deficit between the countries can be reduced by improving people-to-people connectivity and constant inter-governmental engagement, thus facilitating more trade. The Kathuria (2018) report highlights the importance of building more border haats, as they reduce informal and illegal trade and improve cross-border relations.[18]

[18]Border haats are trading markets located along the borders of countries: for example, local markets situated along the Indo-Bangladesh border. For more information, https://blogs.worldbank.org/endpovertyinsouthasia/connecting-communities-through-india-and-bangladeshs-cross-border-markets.

References

Ajmani, M., P. K. Joshi, D. Roy, and R. VR. 2019. "Assessing Agricultural Market Integration of Cambodia within and beyond ASEAN." Accessed March 3, 2020. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/133278.

Ajmani, M., P. K. Joshi, R. VR, and D. Roy. 2018. "Market Integration with ASEAN and Beyond : The Case of Myanmar." Accessed March 3, 2020. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/132974.

Anderson, J. E., and E. van Wincoop. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle." *American Economic Review* 93 (1): 170–92. https://doi.org/10.1257/000282803321455214.

Armstrong, S., P. Drysdale, and K. Kalirajan. 2008. "Asian Trade Structures and Trade Potential: An Initial Analysis of South and East Asian Trade." Accessed March 3, 2020. https://dx.doi.org/10.2139/ssrn.1767686.

ADB (Asian Development Bank). 2018. "Next Steps to South Asian Economic Union: A Study on Regional Economic Integration (Phase II): Commissioned by the SAARC Secretariat." Accessed March 3, 2020. https://www.adb.org/publications/next-steps-south-asian-economic-union-study-rei-phase-2.

Atici, C., and J. Furuya. 2008. "Regional Blocs and Agricultural Trade Flow: The Case of ASEAN." *Japan Agricultural Research Quarterly* 42 (2): 115–21. https://doi.org/10.6090/jarq.42.115.

Atif, R. M., H. Liu , and H. Mahmood. 2017. "Pakistan's Agricultural Exports, Determinants and Its Potential: An Application of Stochastic Frontier Gravity Model." *The Journal of International Trade and Economic Development* 26 (3): 257–76. https://doi.org/10.1080/09638199.2016.1243724.

Aung, W. S. 2009. *The Role of Informal Cross-Border Trade in Myanmar*. Stockholm, Sweden: Institute for Security and Development Policy.

Baier, S. L., and J. H. Bergstrand. 2009. "Estimating the Effects of Free Trade Agreements on International Trade Flows Using Matching Econometrics." *Journal of International Economics* 77 (1): 63–76. https://doi.org/10.1016/j.jinteco.2008.09.006.

Baier, S. L., A. Kerr, and Y. V. Yotov. 2017. "Gravity, Distance, and International Trade." CESifo Working Paper No. 6357, Center for Economic Studies and Ifo Institute (CESifo), Munich, Germany.

Baldwin, R., and D. Taglioni. 2006. "Gravity for Dummies and Dummies for Gravity Equations." Accessed March 3, 2020. http://www.nber.org/papers/w12516.

Brixiová, Z., Q. Meng, and M. Ncube. 2015. "Can Intra-Regional Trade Act as a Global Shock Absorber in Africa?" *World Economics* 16 (3): 141-162.

Centre d'Etudes Prospectives et d'Informations Internationales. 2017. "CEPII Gravity Database." Accessed March 3, 2020. http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=8.

Dembatapitiya, P. 2015. "An Analysis of Determinants of Agriculture Trade Intensities of South Asia." *Sri Lankan Journal of Agricultural Economics* 14: 59–81. https://doi.org/http://doi.org/10.4038/sjae.v14i0.4602.

Dinh, T. T. B., V. D. Nguyen, and M. C. Hoang. 2013. “Applying Gravity Model To Analyze Trade Activities of Vietnam.” Accessed March 3, 2020. https://freit.org/WorkingPapers/Papers/TradePatterns/FREIT639.pdf.

Djankov, S., C. Freund, and C. S. Pham. 2010. “Trading on Time.” *The Review of Economics and Statistics* 92 (1): 166–73.

Feenstra, R. C. 2004. *Advanced International Trade: Theory and Evidence*. Princeton, NJ: Princeton University Press.

Gourdon, J. 2014. “CEPII NTM-MAP: A Tool for Assessing the Economic Impact of Non-Tariff Measures.” Accessed March 3, 2020. http://www.cepii.fr/pdf_pub/wp/2014/wp2014-24.pdf.

Head, K., and T. Mayer. 2014. "Gravity Equations: Workhorse,Toolkit, and Cookbook." In *Handbook of International Economics*. Vol. 4, edited by G. Gopinath, E. Helpman, and K. Rogoff, 131-95. Amsterdam: Elsevier B.V.

Helpman, E., M. Melitz, and Y. Rubinstein. 2008. “Estimating Trade Flows: Trading Partners and Trading Volumes.” *Quarterly Journal of Economics* 123 (2): 441–87. https://doi.org/10.1162/qjec.2008.123.2.441.

Hoekman, B., and A. Nicita. 2011. “Trade Policy, Trade Costs, and Developing Country Trade.” *World Development* 39 (12): 2069–79. https://doi.org/10.1016/j.worlddev.2011.05.013.

S. Kathuria, ed. 2018. *A Glass Half Full: The Promise of Regional Trade in South Asia*. Washington, DC: World Bank.

Kodithuwakku, S., J. Weerahewa, and H. Boughanmi. 2016. “Food and Agricultural Trade in the GCC: An Opportunity for South Asia?” *Review of Middle East Economics and Finance* 12 (3). https://doi.org/https://doi.org/10.1515/rmeef-2016-0010.

Li, Y., and J. C. Beghin. 2012. “A Meta-Analysis of Estimates of the Impact of Technical Barriers to Trade.” *Journal of Policy Modeling* 34: 497–511. http://dx.doi.org/10.1016/j.jpolmod.2011.11.001.

Masudur Rahman, M., and L. Arjuman Ara. 2010. “Bangladesh Trade Potential: A Dynamic Gravity Approach.” *Journal of International Trade Law and Policy* 9 (2): 130–47. https://doi.org/10.1108/14770021011054296.

Olivero, M. P., and Y. V. Yotov. 2012. “Dynamic Gravity : Endogenous Country Size and Asset Accumulation.” *The Canadian Journal of Economics* 45 (1): 64–92.

Ramsey, J. B. 1969. “Tests for Specification Errors in Classical Linear Least-Squares Regression Analysis.” *Journal of the Royal Statistical Society: Series B (Methodological)* 31 (2): 350–71.

Santeramo, F. G., and E. Lamonaca. 2019. “The Effects of Non-Tariff Measures on Agri-Food Trade: A Review and Meta-Analysis of Empirical Evidence.” *Journal of Agricultural Economics* 70 (3): 595-617. https://doi.org/10.1111/1477-9552.12316.

SELA (Latin America and Caribbean Economic System). 2015. “Analysis of the Economic Relations of Latin America and the Caribbean with the Association of Southeast Asian Nations (ASEAN).” Accessed March 17, 2020. http://s017.sela.org/media/2087753/di-12-alc-asean-ing.pdf.

Silva, S. J. M. C., and S. Tenreyro. 2006. “The Log of Gravity.” *The Review of Economics and Statistics* 88 (4): 641–58.

Thapa, S. B. 2012. “Nepal’s Trade Flows: Evidence from Gravity Model.” *NBR Economic Review* 24 (1): 16–27.

Thiesmeyer, L. 2010. *Informal and Illegal Movement in the Upper Greater Mekong Subregion: Costs and Benefits of Informal Networks for Goods and People*. Bangkok, Thailand: Institut de Recherche sur l’Asie du Sud-Est Contemporaine. https://doi.org/10.4000/books.irasec.1094.

US Department of Commerce. 2019. “Bureau of Economic Analysis.” Accessed March 3, 2020. https://www.bea.gov/.

United Nations. 2019. “UN Comtrade Database.” Accessed May 14, 2019. https://comtrade.un.org/.

Wacziarg, R., and K. H. Welch. 2008. “Trade Liberalization and Growth: New Evidence.” *World Bank Economic Review* 22 (2): 187–231. https://doi.org/10.1093/wber/lhn007.

Wei, S.-J. 1996. *Intra-National versus International Trade: How Stubborn Are Nations in Global Integration?* NBER Working Paper No. 5531. Cambridge, MA, US: National Bureau of Economic Research.

World Bank. 2017. “World Integrated Trade Solution.” Accessed July 24, 2017. https://wits.worldbank.org/Default.aspx?lang=en.

World Bank. 2019a. “World Development Indicators.” Accessed September 17, 2019. https://databank.worldbank.org/reports.aspx?source=world-development-indicators.

World Bank. 2019b. “World Integrated Trade Solution.” Accessed October 09, 2019. https://wits.worldbank.org/Default.aspx?lang=en.

WTO (World Trade Organization). 2013. “Factors Shaping the Future of World Trade.” Accessed March 3, 2020. https://www.wto.org/english/res_e/publications_e/wtr13_e.htm.

Yotov, Y. V., R. Piermartini, J.-A. Monteiro, and M. Larch. 2016. "An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model." World Trade Organisation. Accessed March 3, 2020. https://doi.org/10.30875/abc0167e-en.

Zhang, Y., and S. Wang. 2015. “Trade Potential of China’s Export to ASEAN: The Gravity Model Using New Economic Mass Proxies.” *Journal of Systems Science and Information* 3: 411–20.

Appendix

Table 1. Studies highlighting trade potential for China, ASEAN, and SAARC countries

Study No.	Author (Year)	Focus area (Country/ Region)	Methodology to estimate trade potential	Results	Our relative contributions
1	Armstrong, Drysdale, and Kalirajan (2008)	Overall trade (Asia)	Stochastic frontier gravity model	ASEAN and Australian economies achieved higher trade performance due to domestic economic reforms accompanied by trade reform. They also found South Asia to be under performing within the region and with other regional groupings	1. Literature cited on trade potential (or performance) of SAARC and ASEAN countries do not account for recent challenges highlighted in the empirical gravity literature, such as time varying multilateral resistance, zero trade, and heteroscedasticity. We control for such challenges. 2. World Bank report (Kathuria 2018) also uses the PPML estimation technique. However, it uses remoteness indexes to account for the multilateral resistance term instead of country-time fixed effects (which is recommended in the literature). 3. Further, we explore and account for competing explanations such as trade barriers like tariffs and cost to trade to explain the extent of subpar or above par trade performances of the countries. Such explanations are also missing in the existing literature.
2	Atici and Furuya (2008)	Agricultural and overall trade (ASEAN)	Augmented gravity model—ordinary least squares (OLS)	Study shows that income and population have a significant and positive impact on these countries' trade. The authors also find that the distance variable is negative and significant for total trade; however, it is not significant for some countries in the case of agricultural trade flows.	
3	Masudur Rahman and Arjuman Ara (2010)	Overall trade (Bangladesh)	Ordinary and generalised least squares	The study highlights that a large part of Bangladesh's potential trade has remained unrealized. The rising trade transaction cost is one of the major barriers causing non-realization of Bangladesh's trade potential.	
4	Thapa (2012)	Overall trade (Nepal)	Augmented gravity model—OLS	The study highlights that Nepal under trades with Bangladesh, Brazil, and 7 other trading partners, and over-trades with Australia, Canada, China, India, and 6 other trading partners.	
5	Dinh, Nguyen, and Hoang (2013)	Overall trade (Viet Nam)	Augmented gravity model—OLS	Viet Nam has a high level of trade potential with other countries, especially the European Union, Africa, and Western Asia. It also over-trades with countries such as United States, Switzerland, and Ireland.	
6	Dembatapitiya (2015)	Overall and agricultural trade (South Asia)	Augmented gravity model using trade intensities—OLS	The study shows that India, Nepal, and Sri Lanka have higher agricultural trade	

Study No.	Author (Year)	Focus area (Country/ Region)	Methodology to estimate trade potential	Results	Our relative contributions
				relationships with each South Asian country and the strongest relationship prevails for Pakistan and Afghanistan. The study also shows that exporters' gross domestic product, importers' population, distance, and colonial ties are significant determinants of trade intensities.	
7	Zhang and Wang (2015)	Overall trade (China and ASEAN countries)	Augmented gravity model using new economic mass proxies	China's export potential with Singapore, Malaysia, and Lao PDR were found to be fully developed. Among other ASEAN countries, the trade potential of China was not fully developed with Philippines, Thailand, and Viet Nam. Further, China had huge untapped export potential with the remaining ASEAN countries.	
8	Kodithuwakku, Weerahewa, and Boughanmi (2016)	Agricultural trade (SAARC and Gulf Cooperation Council [GCC] countries)	Augmented gravity model—OLS	The study shows that all the top 20 exports with the highest indicative trade potential for SAARC countries have a value exceeding US$100 million. Further, among SAARC nations, India and Sri Lanka have higher export potential with GCC countries.	
9	Atif, Liu, and Mahmood (2017)	Agricultural trade (Pakistan)	Stochastic frontier analysis gravity model	Actual agriculture exports of Pakistan were less than potential exports and therefore, exports gaps were found negative for all trading partners.	
10	Kathuria (2018)	Overall trade (South Asia)	Poisson Pseudo-Maximum Likelihood (PPML)	The study shows that India under-trades with countries such as Pakistan, Bangladesh, and Afghanistan. The study also highlights over-trading between Afghanistan and Pakistan, India and Sri Lanka, and India and Nepal.	

Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation.

Table 2. List of countries considered for regression analysis

Afghanistan	Gambia	New Zealand
Albania	Germany	Nicaragua
Algeria	Ghana	Niger
Angola	Greece	Nigeria
Argentina	Guatemala	Norway
Australia	Guinea-Bissau	Pakistan
Austria	Guyana	Panama
Bangladesh	Haiti	Paraguay
Belgium	Honduras	Peru
Bhutan	Hungary	Philippines
Bolivia	India	Poland
Brazil	Indonesia	Portugal
Brunei	Iran, Islamic Republic of	Romania
Bulgaria	Ireland	Saudi Arabia
Burkina Faso	Israel	Senegal
Cambodia	Italy	Sierra Leone
Cameroon	Jamaica	Singapore
Canada	Japan	Spain
Chile	Kenya	Sri Lanka
China	Korea, Republic of	Sudan
Colombia	Lao PDR	Sweden
Congo, Democratic Republic of the	Luxembourg	Switzerland
Congo	Madagascar	Syrian Arab Republic
Costa Rica	Malawi	Thailand
Côte d'Ivoire	Malaysia	Trinidad and Tobago
Cyprus	Maldives	Tunisia
Denmark	Mali	Turkey
Dominican Republic	Mauritania	Uganda
Ecuador	Mauritius	United Kingdom
Egypt	Mexico	United States
El Salvador	Morocco	Uruguay
Ethiopia	Mozambique	Venezuela
Finland	Myanmar	Viet Nam
France	Nepal	Zambia
Gabon	Netherlands	Zimbabwe

Source: Authors.

Table 3a. Top three export and import destinations of ASEAN countries in TE2016

ASEAN countries	Top export destinations	Top import destinations
Brunei	Malaysia (74.1)	Malaysia (46.9)
	Papua New Guinea (5.4)	Singapore (11.0)
	Singapore (4.6)	Thailand (10.3)
Cambodia	China (17.1)	Indonesia (22.8)
	France (12.0)	Thailand (22.1)
	Malaysia (10.1)	Viet Nam (12.1)
Indonesia	India (11.8)	Australia (17.5)
	China (11.3)	United States (15.2)
	United States (10.3)	China (10.1)
Lao PDR	Viet Nam (48.2)	Thailand (73.1)
	China (22.1)	China (10.5)
	Thailand (18.1)	Viet Nam (9.2)
Malaysia	China (11.0)	Indonesia (13.6)
	Singapore (10.2)	China (10.5)
	India (9.7)	Thailand (8.1)
Myanmar	China (54.0)	Thailand (18.5)
	India (20.6)	Indonesia (17.7)
	Thailand (6.3)	India (15.1)
Philippines	United States (25.6)	United States (23.5)
	Japan (13.1)	China (8.1)
	Netherlands (9.0)	Indonesia (7.7)
Singapore	Viet Nam (12.6)	China (8.4)
	Malaysia (11.6)	France (10.5)
	Japan (9.6)	Indonesia (8.6)
Thailand	Japan (13.2)	United States (13.0)
	China (12.2)	China (12.7)
	United States (11.0)	Brazil (11.0)
Viet Nam	China (19.5)	Argentina (14.5)
	United States (14.2)	United States (10.9)
	Japan (7.1)	Brazil (10.1)

Source: United Nations (2019).

Note: ASEAN = Association of Southeast Asian Nations. 1) Authors' calculations are based on United Nations (2019). These calculations can be provided on demand. 2) Trading partners are listed in the order of rank based on the value of exports and imports, respectively. 3) Figures in parentheses represent the percentage share of a country in the total trade flow of ASEAN countries during triennium ending average (TE) 2016.

Table 3b. Top three export and import destinations of SAARC countries in TE2016

SAARC countries	Top export destinations	Top import destinations
Afghanistan	India (50.2)	Pakistan (28.7)
	Pakistan (26.8)	Kazakhstan (19.7)
	Iran (6.3)	Malaysia (11.6)
Bangladesh	United Kingdom (12.0)	Indonesia (19.0)
	Saudi Arabia (11.7)	India (14.9)
	Netherlands (9.0)	Brazil (14.3)
Bhutan	-	-
India	Viet Nam (11.6)	Indonesia (19.6)
	United States (11.6)	Malaysia (11.4)
	United Arab Emirates (6.2)	Argentina (9.7)
Maldives	Thailand (31.3)	United Arab Emirates (17.7)
	France (11.5)	India (16.8)
	United States (9.6)	Sri Lanka (11.5)
Nepal	India (77.3)	India (61.6)
	Bangladesh (6.0)	Argentina (6.3)
	Afghanistan (4.0)	Indonesia (5.7)
Pakistan	Afghanistan (21.0)	Indonesia (27.1)
	United Arab Emirates (8.8)	Malaysia (8.4)
	China (7.2)	India (7.8)
Sri Lanka	India (8.4)	India (21.7)
	United States (6.9)	Canada (10.2)
	Russian Federation (6.5)	New Zealand (8.1)

Source: United Nations (2019).

Note: - = data not available; SAARC = South Asian Association for Regional Cooperation. 1) Authors' calculations are based on United Nations (2019). These calculations can be provided on demand. 2) Trading partners are listed in the order of rank based on the value of exports and imports, respectively. Figures in parentheses represent the percentage share of a country in the total trade flow of SAARC countries during triennium ending average (TE) 2016.

Table 4a. Magnitude of under- and over-exporting of ASEAN countries derived from PPML

→Exporting ASEAN countries	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
↓Importing countries										
Brunei		8.22	0.00	-1.00	2.84	0.00	0.00	14.64	2.07	0.00
Cambodia	-1.00		5.88	1.66	0.00	-0.63	-0.54	13.66	1.77	0.00
Indonesia	-0.86	-0.80		0.00	-0.74	0.00	-0.57	0.00	-0.36	-0.59
Lao PDR	-0.96	1.38	-0.87		-0.76	-0.74	-0.99	38.06	11.91	0.00
Malaysia	5.40	0.00	0.00	-0.83		2.05	0.00	-0.67	-0.73	-0.61
Myanmar	-0.99	-0.94	7.70	-0.80	5.46		0.00	13.67	2.24	-0.64
Philippines	-0.87	-0.70	0.00	-0.64	0.00	0.00		1.66	-0.32	0.00
Singapore	0.00	0.00	0.00	0.00	-0.77	5.15	-0.40		-0.65	-0.60
Thailand	0.00	-0.85	-0.62	2.96	-0.73	0.00	0.00	0.00		-0.87
Viet Nam	-0.69	-0.88	-0.53	2.11	-0.40	0.00	-0.72	1.47	-0.80	
Afghanistan			0.00		0.00	-0.66	-0.97	0.00	-0.99	-0.77
Bangladesh	-1.00	-1.00	1.68		0.00	-0.61	-0.85	0.00	-0.84	-0.87
Bhutan			-0.89		-0.56		0.00	7.08	0.00	-0.99
India	-1.00	0.00	9.71	-0.98	2.26	13.07	-0.79	0.00	-0.80	-0.56
Maldives		-0.85	0.00		1.60	-1.00	-0.40	15.33	0.00	-0.91
Nepal	-0.94	-0.80	0.78		0.00	-0.88	-0.49	8.04	0.00	-0.71
Pakistan	-1.00	-0.82	7.31	-0.92	9.34	2.49	-0.55	0.00	-0.67	0.00
Sri Lanka	-1.00	0.00	0.00	-0.63	0.00	-0.73	-0.74	0.00	-0.55	-0.90
China	-0.70	-0.63	0.00	0.00	0.00	3.98	-0.85	0.00	-0.72	-0.72

Source: Based on author's calculations.

Note: ASEAN = Association of Southeast Asian Nations; PPML = Poisson Pseudo-Maximum Likelihood. Magnitude is calculated as $e^{\alpha_h} - 1$ and $e^{\alpha_p} - 1$. In the case of interpretation, Indonesian exports to Cambodia are around 5.9 times more as compared to the gravity-predicted level of exports. Normal-trading is represented by "0.00" as the dummy coefficient in model B is insignificant.

Table 4b. Magnitude of under- and over-exporting of SAARC countries and China, derived from PPML

→Exporting SAARC countries	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	China
↓Importing countries									
Brunei		-0.98	52.04	0.00		-0.98	0.00	-0.89	0.00
Cambodia		-0.96		0.00		-0.96	-0.97	-0.84	0.00
Indonesia		-0.96	-0.90	0.00	-0.86	-0.94	0.00	-0.56	0.00
Lao PDR		-1.00		1.33		51.93	-0.90	-0.99	0.00
Malaysia	-0.99	-0.79	1.52	0.00	-0.93	2.16	0.00	-0.92	0.65
Myanmar		-0.99		0.00		-0.95	0.00	-0.94	2.05
Philippines		-0.85	-0.58	0.00	-0.98	-0.98	0.84	-0.96	0.00
Singapore	-0.96	-0.83	12.26	-0.62	0.00	4.09	-0.65	-0.79	0.00
Thailand	-0.99	-0.93	3.16	-0.31	10.94	1.37	0.00	-0.92	0.00
Viet Nam	-0.92	-0.81	0.00	2.32	-0.96	3.15	0.00	-0.88	-0.35
Afghanistan		0.00		0.00		93.92	31.75	-0.89	-0.82
Bangladesh	-0.87		290.49	0.00	-0.99	36.64	0.00	-0.94	-0.62
Bhutan		7.19		32.02		299.97	-0.95	-0.92	-0.75
India	45.53	-0.61	2089.17		-0.99	93.73	-0.79	0.00	-0.74
Maldives		0.00		1.39		-0.78	2.13	4.03	-0.58
Nepal		-0.96	171.78	11.97	-0.99		-0.79	-0.57	0.90
Pakistan	28.31	0.00		-0.63	-1.00	0.98		0.00	0.00
Sri Lanka		-0.94	-0.84	0.00	4.03	8.20	2.35		0.00
China	-0.88	-0.93	-0.57	-0.87	-0.97	0.00	-0.70	-0.96	

Source: Based on author's calculations.

Note: SAARC = South Asian Association for Regional Cooperation; PPML = Poisson Pseudo-Maximum Likelihood. Magnitude is calculated as $e^{\alpha_m} - 1$, $e^{\alpha_n} - 1$, and $e^{\alpha_p} - 1$. In the case of interpretation, Indian exports to Viet Nam are more than 2 times as compared to the gravity-predicted level of exports. Normal-trading is represented by "0.00" as the dummy coefficient in model B is insignificant

Table 5. Effect of tariffs and time to trade on agricultural exports

Variables	(1)	(2)	(3)
Average tariff with EU (log)	-0.0985***		-0.129***
	(-4.362)		(-7.197)
US$ per container, Lag (log)		-0.447	0.626
		(-0.942)	(1.535)
Constant	-3.200***	12.69***	-6.854**
	(-3.791)	(2.678)	(-2.075)
Observations	91,960	70,939	34,215
R-squared	0.880	0.904	0.845
Importer-time FE	Yes	Yes	Yes
Exporter-Time FE	Yes	Yes	Yes

Source: Based on author's calculations.
Note: EU = European Union. This table shows the estimates from regression equation (1) augmented to include tariffs and cost to trade. Robust standard errors clustered at the exporter and importer pair level. Robust t-statistics are in parentheses. Significance at 1, 5, and 10 percent are indicated by ***, **, and *, respectively.

Table 6. Average effective applied tariff (in percentage) on agricultural trade, TE 2015

	Exporter→			
Importer↓	**ASEAN**	**China**	**South Asia**	**Average**
Afghanistan	10.2	5.3	6.7	7.4
Bangladesh	20.2	17.6	13.8	17.2
Bhutan	77.0	50.0	8.8	45.3
India	31.2	37.3	53.4	40.7
Maldives	8.6	5.9	6.0	6.9
Nepal	15.0	15.1	15.5	15.2
Pakistan	16.9	12.7	8.6	12.8
Sri Lanka	24.3	20.2	9.2	17.9
SAARC	**25.4**	**20.5**	**15.3**	**20.4**
Brunei	0.0	0.0	0.2	0.1
Cambodia	4.2	4.5	11.4	6.7
Indonesia	0.2	0.2	13.2	4.6
Lao PDR	2.6	9.5	18.5	10.2
Malaysia	2.1	0.9	1.2	1.4
Myanmar	9.5	12.5	7.1	9.7
Philippines	0.3	2.4	8.5	3.7
Singapore	0.0	0.0	0.0	0.0
Thailand	9.3	12.0	19.8	13.7
Viet Nam	1.8	3.3	14.7	6.6
ASEAN	**3.0**	**4.5**	**9.5**	**5.7**
China	1.5		7.9	4.7

Source: World Bank (2017)
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation; TE = triennium ending average.

Table 7. Non-tariff measures (NTMs) on agricultural trade

Country	Year	Coverage ratio	Frequency ratio
Brunei	2015	99.4	98.6
Cambodia	2015	97.5	98.1
Indonesia	2015	99.4	96.9
Malaysia	2015	99.6	99.5
Myanmar	2015	100.0	100.0
Philippines	2015	100.0	100.0
Singapore	2015	97.1	90.2
Thailand	2015	87.9	89.9
Viet Nam	2015	93.1	98.0
ASEAN	**2015**	**97.1**	**96.8**
Afghanistan	2012	30.0	53.5
India	2012	95.2	94.5
Nepal	2012	39.2	18.2
Pakistan	2016	46.1	57.3
Sri Lanka	2016	96.9	98.3
SAARC		**61.5**	**64.4**

Source: World Bank (2019b)
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation.

Table 8a. Cost to export (in US$ per container, deflated), 2006-2015

Country	Mean	Standard deviation	Minimum	Maximum	Number of observations
Brunei	675	76	561	792	9
Cambodia	874	114	772	1092	10
Indonesia	596	34	572	620	2
Lao PDR	2313	192	1950	2541	10
Malaysia	502	46	438	589	10
Myanmar	686	58	620	729	3
Philippines	827	177	597	1077	10
Singapore	429	13	416	460	10
Thailand	759	195	595	1138	10
Viet Nam	913	222	610	1252	10
ASEAN (average)	**858**	**113**	**713**	**1029**	**8**
Afghanistan	4258	507	3629	5045	10
Bangladesh	1282	1	1281	1283	2
Bhutan	2245	482	1716	3017	10
India	1374	60	1332	1416	2
Maldives	1781	119	1625	1970	10
Nepal	2847	411	2234	3487	10
Pakistan	794	41	765	822	2
Sri Lanka	856	212	560	1212	10
SAARC (Average)	**1930**	**229**	**1643**	**2282**	**7**
China	831	11	823	838	2

Source: World Bank (2019a).
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation.

Table 8b. Cost to import (in US$ per container, deflated), 2006-2015

Country	Mean	Standard deviation	Minimum	Maximum	Number of observations
Brunei	752	77	643	869	9
Cambodia	1027	118	921	1210	10
Indonesia	660	19	647	674	2
Lao PDR	2508	335	1910	2954	10
Malaysia	488	38	423	560	10
Myanmar	675	57	610	718	3
Philippines	910	162	673	1141	10
Singapore	402	22	368	440	10
Thailand	953	230	760	1398	10
Viet Nam	1054	341	600	1567	10
ASEAN (Average)	**943**	**140**	**755**	**1153**	**8**
Afghanistan	4425	788	3496	5680	10
Bangladesh	1524	12	1515	1532	2
Bhutan	2843	306	2330	3389	10
India	1508	65	1462	1555	2
Maldives	1770	126	1610	1970	10
Nepal	3030	466	2370	3759	10
Pakistan	1043	53	1005	1080	2
Sri Lanka	1008	225	690	1367	10
SAARC (Average)	**2144**	**255**	**1810**	**2542**	**7**
China	807	10	800	815	2

Source: World Bank (2019a).
Note: ASEAN = Association of Southeast Asian Nations; SAARC = South Asian Association for Regional Cooperation.

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