Journal of Southeast Asian Economies Vol. 36, No. 3 (2019), pp. 380–99 *ISSN 2339-5095 print / ISSN 2339-5206 electronic*

DOI: 10.1355/ae36-3f

ORIGINAL RESEARCH ARTICLES

Unlocking the Trade Potential in China-ASEAN Relations

The China-Vietnam Context

Evelyn S. Devadason and V.G.R. Chandran

The China-ASEAN trade relationship is multidimensional. The trade situation between China and Vietnam is not similar to that of China and the ASEAN-5, as the former records trade surpluses with Vietnam in agriculture and manufactures. Bilaterally, China's exports are also more homogeneously distributed relative to Vietnam, and comprise higher value-added intermediates. Despite the asymmetry in terms of economic capacity between China and Vietnam, it is not one-sided nor is it all downside, as there is a high level of economic interdependence between the two. The empirical results from the stochastic frontier analysis indicate that Vietnam's trade efficiency scores with China are somewhat comparable with the efficiency levels achieved by the other ASEAN members in trade with China. Importantly, Vietnam's exports of agriculture products to China are operating closer to their potential level than China's exports to Vietnam. Overall, there remains scope for improving export efficiency in the China-Vietnam partnership. It is therefore untrue to assume that only the larger side could get more from this relationship.

Keywords: gravity model, stochastic frontier analysis, trade efficiency, China, Vietnam.

Article received: February 2018; revised: December 2018; accepted: May 2019

1. Introduction

China and Vietnam have a checkered past. Bilateral trade was restored when both countries normalized their relations in 1991 (Nguyen 2015). The two economies have also signed a bilateral agreement and

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are members of the China-ASEAN Free Trade Area (or CAFTA). Since then, the China-Vietnam trade ties gained momentum and posted impressive growth over the past few decades. At present, Vietnam is China's eighth largest trading partner and biggest trading partner in the ASEAN region (Oh 2017), while China is the largest trading partner of Vietnam. Trade balances in this partnership have, however, remained consistently in favour of China, though recent evidence points to a narrowing of deficits from the Vietnamese standpoint.

China's trade patterns with the newer ASEAN member countries (Cambodia, Laos, Myanmar and Vietnam; known as CLMV) have long been recognized to be different—or less optimized—as compared to those with the ASEAN-6, which have then increased the disadvantages of CLMV relative to the ASEAN-6. CLMV countries have become more reliant on China (Hao 2008), and the process of asymmetric trade interdependence[1] between China and CLMV is considered to be even more radical at the country level (Qin, Xu, and Zhang 2016). In the CLMV group, Vietnam presents a special case in terms of its economic cooperation and asymmetric relationship (Womack 2010), given China's growing strength and regional presence. China is a distinct import source for Vietnam (ADB online database) because of the latter's heavy dependence on intermediate products (Ngoc 2016), resulting in a burgeoning deficit. Recent evidence, however, points to some shifts in the trade structure of Vietnam, including: the narrowing of trade deficits with China as exports to that country gained momentum; and increase in export market share as a global value chain (GVC) partner by Vietnam (ADB 2016).

Although trade deficit per se should not be perceived as being bad for a country, in the case of the Vietnam-China partnership, the deficits can indeed signal a risky problem for Vietnam given its high concentration of trade on a single market like China (Nga 2018). There are also concerns that those trade imbalances with China have not been well managed to date, since Vietnam has only been able to export low value-added goods to the country (Nguyen 2015). In fact, Vietnam has recently called upon China to import more of its agriculture products, given the vast untapped consumer market in China, in efforts to balance bilateral trade and ensure a sustainable and healthy trading partnership (*Retail Asia*, 6 November 2018).

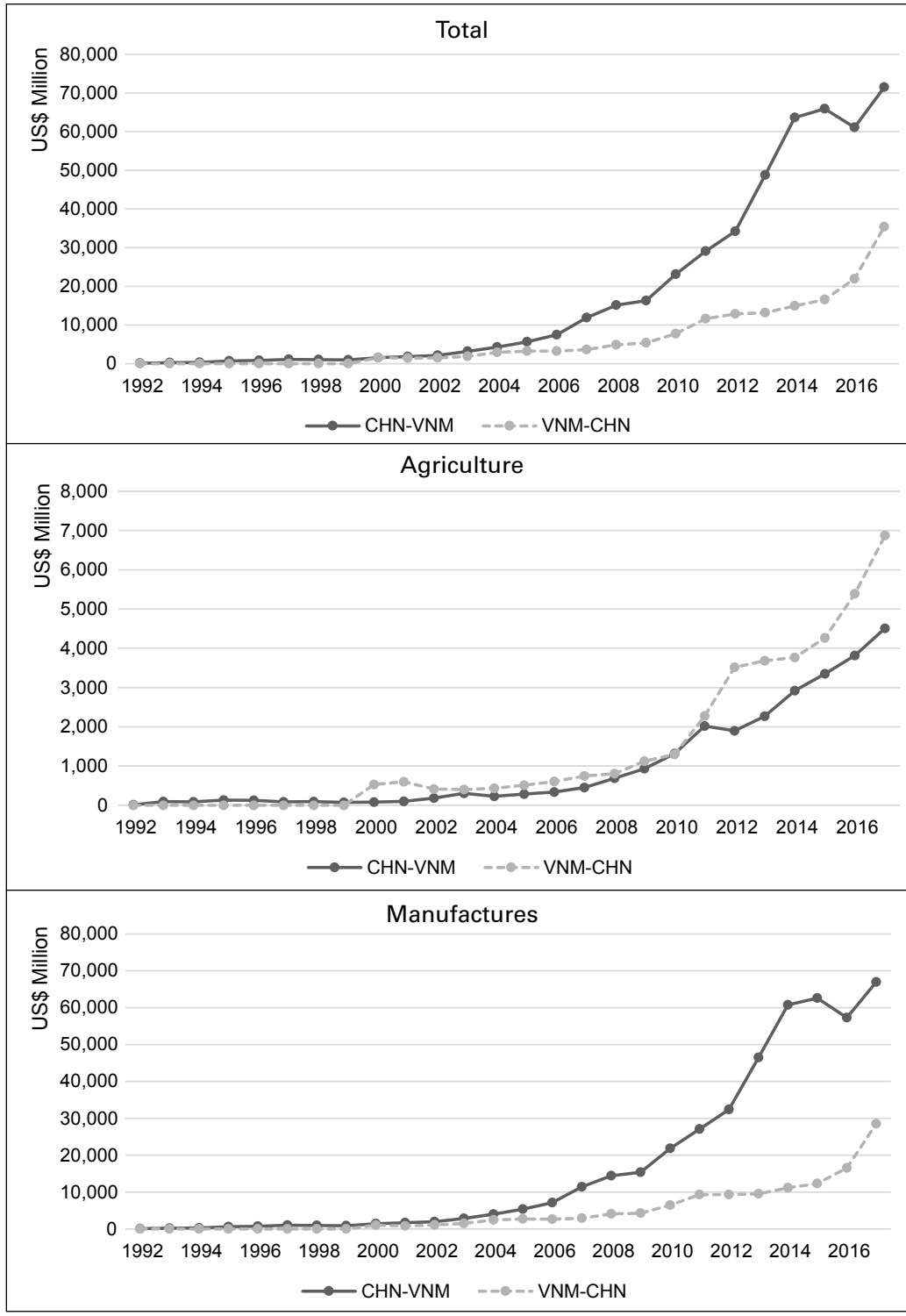
With the dramatic rise in the China-Vietnam bilateral trade volume to US$122 billion in 2017, compared to just US$4 billion each for China-Cambodia and China-Myanmar (calculated from UN Comtrade), an important question is whether the full potential has been unleashed in the China-Vietnam partnership. For this, Vietnam's current (disadvantaged) position in terms of its trade with China needs to be reassessed and contextualized within the region. The paper therefore compares the trade potential of China-Vietnam, within the broader framework of the China-ASEAN trade,[2] to inform the debate on the dichotomous trade outcomes of China's partnership with the older and newer ASEAN member states. For this purpose, the paper applies a stochastic frontier approach to the gravity model to identify the efficiency of trade integration relative to the maximum potential levels, based on a three-dimensional panel data set of two-way bilateral exports from China to the ten ASEAN members over the 1992–2016 period. The findings of the study provide the broader implications for (asymmetrical) economic interdependence or disparities in two-way trade potential in the China-ASEAN partnership.

2. China-ASEAN Trade: Framing the China-Vietnam Partnership

2.1 Trade Patterns and Intensity of Integration

Although waves of tension prevail as China and Vietnam contest sovereignty over the South China Sea, trade between the two nations has transcended these disputes (Nguyen 2015). China's exports to Vietnam grew from US$106 million in 1992 to US$71 billion in 2017 (see Figure 1). Conversely, Vietnam's exports to China consistently lagged behind inflows of merchandise goods from China for the entire period of

FIGURE 1
Two-Way Export Flows in the China-Vietnam Partnership, 1992–2017 (in US$ million)

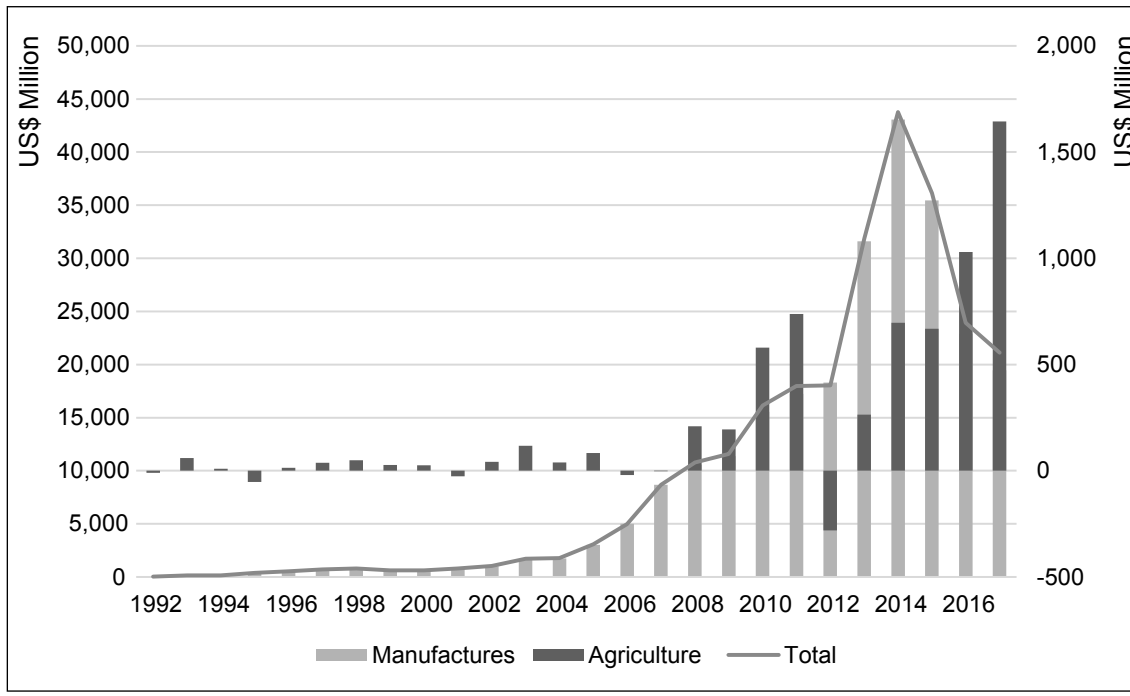


NOTE: CHN-VNM (China = reporter and Vietnam = partner); VNM-CHN (Vietnam = reporter and China = partner).
SOURCE: UNCOMTRADE.

review. Vietnam's exports to China recorded a mere US$35 billion in 2017. The observed patterns for two-way exports of manufactures mirror that of total exports in this trading relationship. Consequently, total trade balances and, more specifically, trade balances in manufactures were constantly in favour of China (see Figure 2). China's total trade surplus with Vietnam widened from US$34 million in 1992 to US$21 billion in 2017, which is considered large relative to surpluses of US$4 billion each in trade with Cambodia and Myanmar. China's deficits in agriculture trade with Vietnam were noted for specific years, namely in 1992, 1995, 2001, 2006–7 and 2012. Overall, trade surpluses in manufactures are found to be much higher than those for agriculture in the China-Vietnam trading relationship.

China is a distinctive import source for Vietnam (and Myanmar) vis-à-vis the other ASEAN members, commanding 34.37 per cent of global exports of China in 2016 (see second panel of Table 1). This explains the larger share of total trade dependence of Vietnam on China relative to the other ASEAN members. From China's perspective (see panel 1 of Table 1), Vietnam has emerged as the most important ASEAN export destination for China, replacing Singapore and Malaysia, which held special positions in the China-ASEAN trade relationship as both countries were the largest trading partners of China in the region (Lean and Smyth 2016). Having said that, China's relative dependence on the ASEAN market has generally not changed much for the period of review (see also Qin, Xu, and Zhang 2016), while the opposite is observed from the ASEAN perspective. The CLMV countries have become more reliant on China (Hao 2008), both as an export destination as well as an import source. Clearly, ASEAN attaches more importance to China than vice-versa (Table 1).

FIGURE 2
Trade Balances in the China-Vietnam Partnership, 1992–2017 (in US$ million)



NOTES: (1) Trade balances (exports minus imports) from China's perspective (China as reporter and Vietnam as partner).
(2) The left axis refers to trade balances for total trade and trade in manufactures, while the right axis refers to trade balances for agriculture.
SOURCE: UNCOMTRADE.

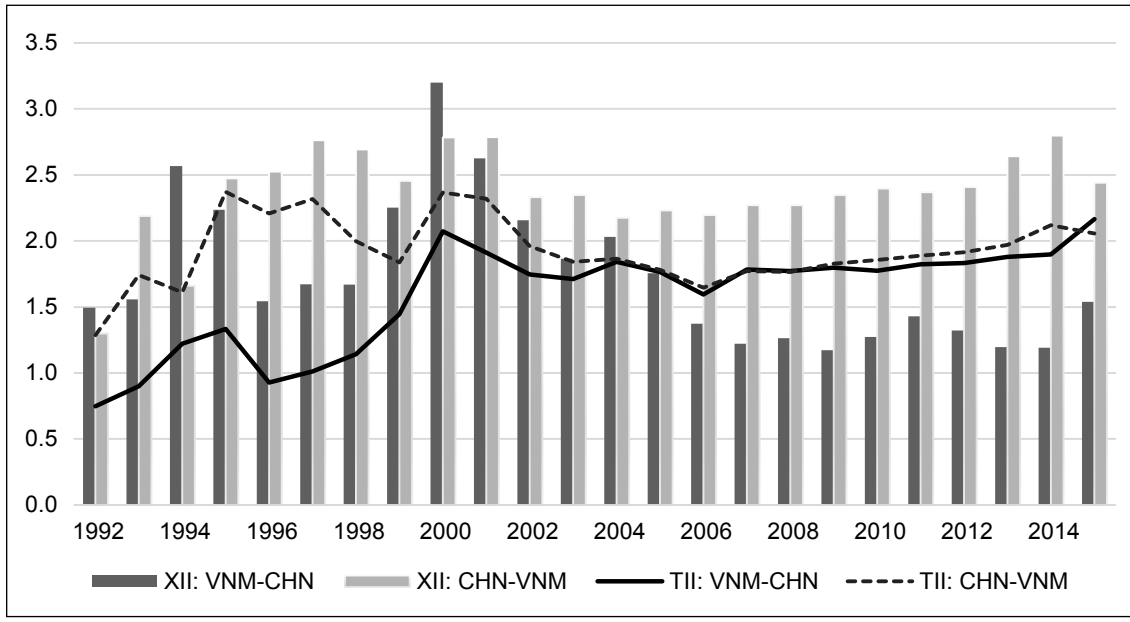
TABLE 1
Two-Way Importance of China and ASEAN, 1992–2016 (Percentage)

	Importance of ASEAN to China (Reporter i = China; Partner j = ASEAN)														
	1992			*2000*			*2005*			*2010*			*2015*		
	X	*M*	*TT*	*X*	*M*	*TT*	*X*	*M*	*TT*	*X*	*M*	*TT*	*X*	*M*	*TT*
Malaysia	0.75	1.01	0.88	1.03	2.43	1.70	1.39	3.05	2.16	1.51	3.61	2.50	1.94	3.32	2.51
Singapore	1.51	1.51	1.95	2.31	2.25	2.28	2.19	2.50	2.34	2.05	1.76	1.91	2.33	1.62	2.04
Thailand	0.79	0.52	0.79	0.90	1.95	1.40	1.03	2.12	1.53	1.25	2.38	1.78	1.68	2.32	1.94
Philippines	0.19	0.19	0.22	0.59	0.74	0.66	0.62	1.95	1.23	0.73	1.16	0.93	1.17	1.19	1.18
Indonesia	1.90	1.90	1.21	1.23	1.95	1.57	1.10	1.28	1.18	1.39	1.49	1.44	1.51	1.24	1.40
Brunei	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.03	0.02	0.02	0.05	0.03	0.07	0.01	0.04
Cambodia	0	0	0.01	0.07	0.03	0.05	0.07	0	0.04	0.09	0.01	0.05	0.17	0.04	0.11
Lao	0.02	0	0.02	0.01	0	0.01	0.01	0	0.01	0.03	0.04	0.03	0.06	0.08	0.07
Myanmar	0.30	0.16	0.23	0.20	0.06	0.13	0.12	0.04	0.09	0.22	0.07	0.15	0.41	0.33	0.38
Vietnam	*0.11*	*0.09*	*0.11*	*0.62*	*0.41*	*0.52*	*0.74*	*0.39*	*0.58*	*1.46*	*0.50*	*1.01*	*2.91*	*1.49*	*2.32*
China-ASEAN	*5.45*	*5.39*	*5.42*	*6.96*	*9.85*	*8.33*	*7.28*	*11.36*	*9.17*	*8.76*	*11.07*	*9.84*	*12.23*	*11.64*	*11.98*
	Importance of China to ASEAN (Reporter i = ASEAN; Partner j = China)														
Malaysia	1.90	2.44	2.17	3.09	3.94	3.47	6.60	11.60	8.83	12.53	12.55	12.54	15.95	19.83	17,75
Singapore	1.75	3.12	2.48	3.90	5.29	4.58	8.61	10.25	9.37	10.36	10.83	10.58	13.73	14.21	13.95
Philippines	1.16	1.26	1.22	1.74	2.28	1.99	9.89	6.27	7.95	11.09	8.42	9.65	15.14	20.96	18.47
Thailand	1.19	3.00	2.19	4.07	5.45	4.72	8.27	9.44	8.87	11.11	13.25	12.15	11.07	20.25	15.56
Indonesia	4.11	2.75	3.51	4.46	6.03	5.01	7.78	10.13	8.72	9.95	15.06	12.31	10.12	20.51	15.21
Brunei	0.19	2.07	0.91	1.76	1.18	1.58	3.34	3..55	3.39	7.04	12.69	8.61	1.48	24.92	13.42
Cambodia	0.10	1.87	1.55	1.74	8.00	4.92	0.47	16.64	7.87	1.16	24.20	11.93	5.09	21.88	15.41
Lao	3.24	11.85	9.38	1.49	5.49	4.04	3.22	9.13	6.98	23.27	14.46	17.78	26.90	18.54	21.61
Myanmar	17.45	27.24	23.37	5.73	17.96	13.14	6.72	28.84	17.55	13.54	38.49	28.67	37.56	42.13	40.57
Vietnam	*3.28*	*1.05*	*2.14*	*10.61*	*8.96*	*9.75*	*9.95*	*16.05*	*13.19*	*10.47*	*24.01*	*17.84*	*13.27*	*34.37*	*25.21*
ASEAN-China	*2.13*	*2.87*	*2.51*	*3.84*	*5.06*	*4.40*	*8.05*	*10.50*	*9.21*	*10.86*	*13.55*	*12.15*	*13.38*	*21.76*	*17.56*

NOTES: Export (X) share is the percentage of exports from country *i* to country *j* to total global exports of country *i*. Import (M) share is the percentage of imports of country *i* from country *j* to total global imports of country *i*. Trade (TT) share is the percentage of total trade of country *i* with country *j* to total global trade of country *i*. A higher share indicates a higher degree of integration between partner countries. Latest data available is 2015.
SOURCE: ADB online database.

In terms of intensities in trade, the export intensity index (XII) in the Vietnam-China and China-Vietnam bilateral relations is greater than unity for the entire period of review, suggesting that export flows between the countries are larger than expected given their importance in global trade (see Figure 3). The same holds true for the trade intensity index (TII). However, the export intensity is much lower for Vietnam's exports to China than vice versa. With lower intensities in exports relative to total trade with China, it is not surprising to note that Vietnam's bilateral trade balances have been consistently in favour of China (Figure 2). Consequently, Vietnam has expressed concerns of managing the huge trade deficits with China. The deficits are attributed to the country's heavy dependence on cheap inputs from China (Ngoc 2016), mainly in the garment and footwear industries. Additionally, the importance of border trade in the Vietnam-China relations is often not captured in official trade statistics, especially the smuggling of

FIGURE 3
Two-Way Export Intensity and Trade Intensity Indices in the China-Vietnam Partnership, 1992–2015



NOTES: The ratio of export (trade) share of a country to the share of world exports (trade) going to (with) a partner:

$$XII_{ij} = \frac{x_{ij} / X_{iw}}{x_{wj} / X_{ww}}$$

$$TII_{ij} = \frac{t_{ij} / T_{iw}}{t_{wj} / T_{ww}}$$

Where x_{ij} is the dollar value of exports of country i to country j, X_{iw} is the dollar value of the exports of country i to the world, x_{wj} is the dollar value of world exports to country j, and X_{ww} is the dollar value of world exports.
Where t_{ij} is the dollar value of total trade of country i with country j, T_{iw} is the dollar value of the total trade of country i with the world, t_{wj} is the dollar value of world trade with country j, and T_{ww} is the dollar value of world trade. An index of more than one indicates that trade flow between countries is larger than expected given their importance in world trade.
SOURCE: ADB online database.

goods and trading of imitation goods (Ha and Do 2001; Hao 2008; Nguyen 2015). The trade gap between Vietnam and China could therefore be much higher than what the official statistics suggest.

The bilateral trade profile further shows that manufacturing products are the type of goods traded between China and Vietnam (see also Tham and Yi 2014). In 2016, manufactures[3] constituted 95.7 per cent of China's exports to Vietnam, and 92.5 per cent of Vietnam's exports to China (calculated from UN Comtrade). The structure of trade changed in the case of China-Vietnam unidirectional exports and not vice versa (Qin, Xu, and Zhang 2016). In 1992, agriculture products constituted a sizeable proportion of China's exports to Vietnam, at 73.47 per cent. Since 2010, China has been the biggest supplier of key inputs and manufacturing resources for Vietnam's manufacturing sector. Though manufactures dominate trade flows in the China-Vietnam partnership, China is losing some of its comparative advantage in labour-intensive activities, such as garments, footwear and electronic assembly. Here, China is leveraging with countries like Vietnam, as the latter occupies the lower end of the supply chain (ADB 2016).

The unchanged trade structure for Vietnam reflects its growing trade deficits and the dependence of Vietnam's production services on Chinese inputs. Alternatively, the shifts in trade structure for China project positive development for China to move away from labour-intensive activities. Figure 4 indicates a steep increase in the number of products exported to China from Vietnam, from 70 in 1995 to 208 in 2014, and the corresponding decline in the merchandise export concentration of Vietnam to China. Potential appears to exist for China expanding exports to Vietnam, and vice versa. Bilaterally, China's exports are more homogeneously distributed relative to that for Vietnam (see also Womack 2010).

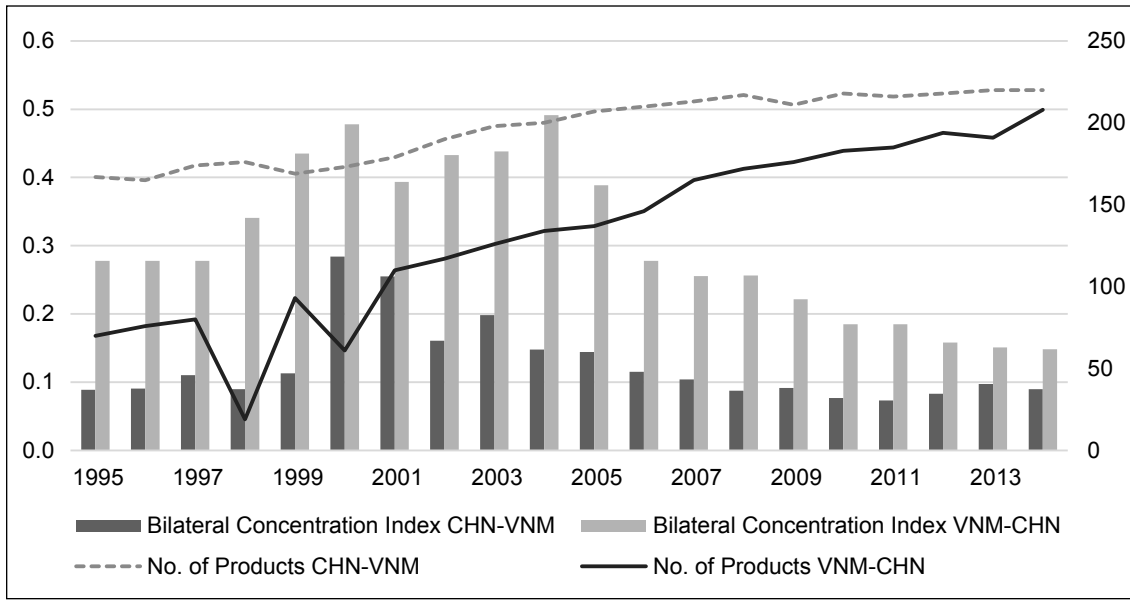
2.2 Integration through Production Networks

To provide a more accurate understanding of the trade relationship between China and ASEAN, it is also important to look at: (a) the extent of processing trade; and (b) the domestic value-added (DVA) in trade flows between the two economies. This is because China's engagement with ASEAN is characterized by global production networks (Qin, Xu, and Zhang 2016; Tham and Yi 2014).

The preceding section implies that trade balances are largely in favour of China. As trade between China and ASEAN is characterized by manufacturing parts and components, Figure 5 distinguishes trade balances between the China and ASEAN for final and intermediate goods,[4] respectively. China records consistent deficits in trade in final and intermediate goods with ASEAN. However, China has maintained surpluses in trade with Vietnam, irrespective of the type of trade (see also Ha 2011). In line with the growing trade in intermediates between China and ASEAN, which is most relevant to the electronics industry, it is also important to compare trade balances for information and communication technology (ICT) products in final goods and intermediate goods trade between the two. Large surpluses are noted for intermediates in ICT trade between China and Vietnam as the latter happens to be less integrated in the production sharing of electronics (Devadason 2010). The ADB (2016), however, reports that Vietnam is recently gaining market share as a GVC partner—by taking over the space vacated by China in lower-skill production activities. A caveat is that firm conclusions on the status (net exporters or net importers of parts and components)[5] of the integration of through regional production networks cannot be drawn from the broad definition of intermediates.

At this juncture, it is also worth looking at the regional positioning of Vietnam, a new ASEAN member, as an emerging trade partner of China. Recording the highest trade intensity (largely from the import side) with China and experiencing a dramatic expansion of the manufacturing sector, Ngoc (2016) explains that Vietnam's deepening integration with the region and China has dual effects. The larger the manufacturing sector of Vietnam, the higher the trade deficits the country has to endure. Though Vietnam anticipates that the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) is

FIGURE 4
China-Vietnam Bilateral Concentration Indices and Number of Products Exported



NOTES: (1) Based on the number of products exported at the three-digit SITC Rev.3 level.
(2) VNM – Vietnam; CHN – China.
(3) The maximum number of products (right axis) is 261.
(4) The degree of product concentration (left axis) is measured based on the normalized Herfindahl-Hirschmann (HH) index. An index value closer to 1 indicates maximum concentration.

$$H_{jk} = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_{ijk}}{X_{jk}}\right)^2} - \sqrt{1/n}}{1 - \sqrt{1/n}}$$

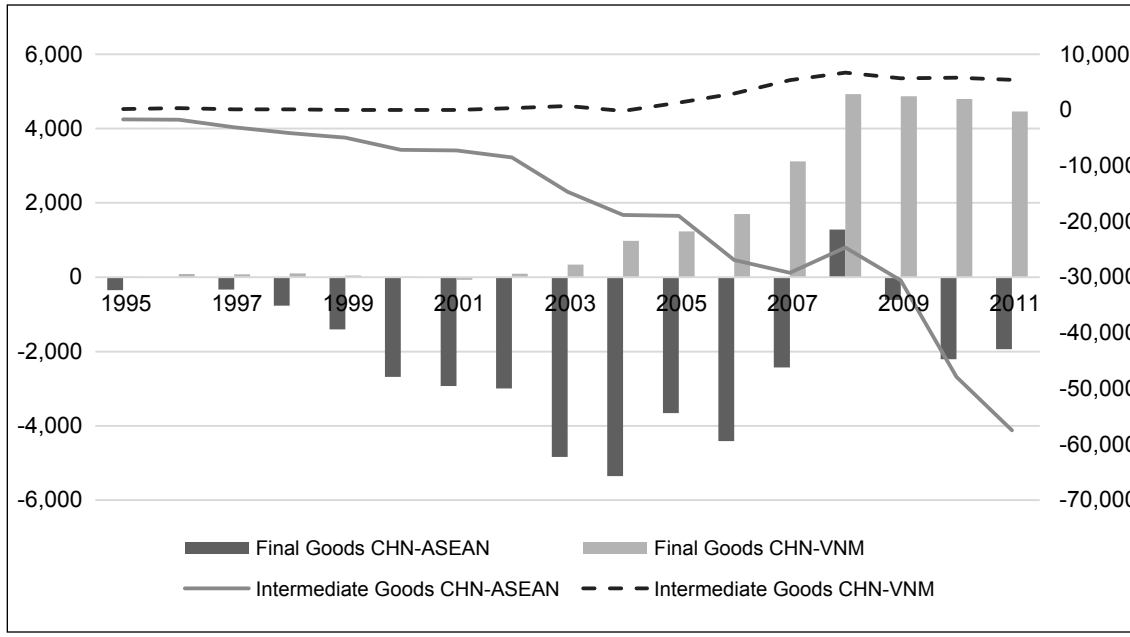
$$X_{jk} = \sum_{i=1}^{n} x_{ijk}$$

where
H_{jk} = concentration index of country or country group j exports to / imports from partner country group k
x_{ijk} = exports or imports of product i for reporter country j and trading partner k
X_{ik} = total value of exports/imports for country j to/from country k and product i
n = number of products
SOURCE: UNCTADstat online.

important for balancing its alarming deficits in trade with China, the benefits of the agreement are not going to be immediate for Vietnam.

Acknowledging the fact that trade in intermediates only tells half the story of production networks, it is also important to complement the discussion with the extent of DVA in two-way export flows of the China-ASEAN partnership. Figure 6 shows that the DVA content in gross export flows for China-ASEAN, and vice versa, has increased over the years. The DVA content in gross export flows of China to ASEAN

FIGURE 5
China-ASEAN and China-Vietnam Trade Balances, by Final and Intermediate Goods, 1995–2011
(in US$ million)



NOTES: (1) The left axis represents final goods and the right axis is for intermediate goods.
(2) CHN – China; ASEAN – Association of Southeast Asian Nations (does not include Lao PDR and Myanmar).
(3) For the ASEAN region, it does not include intraregional trade flows.
(4) The data is only available for 1995–2011.
SOURCE: OECDStat.

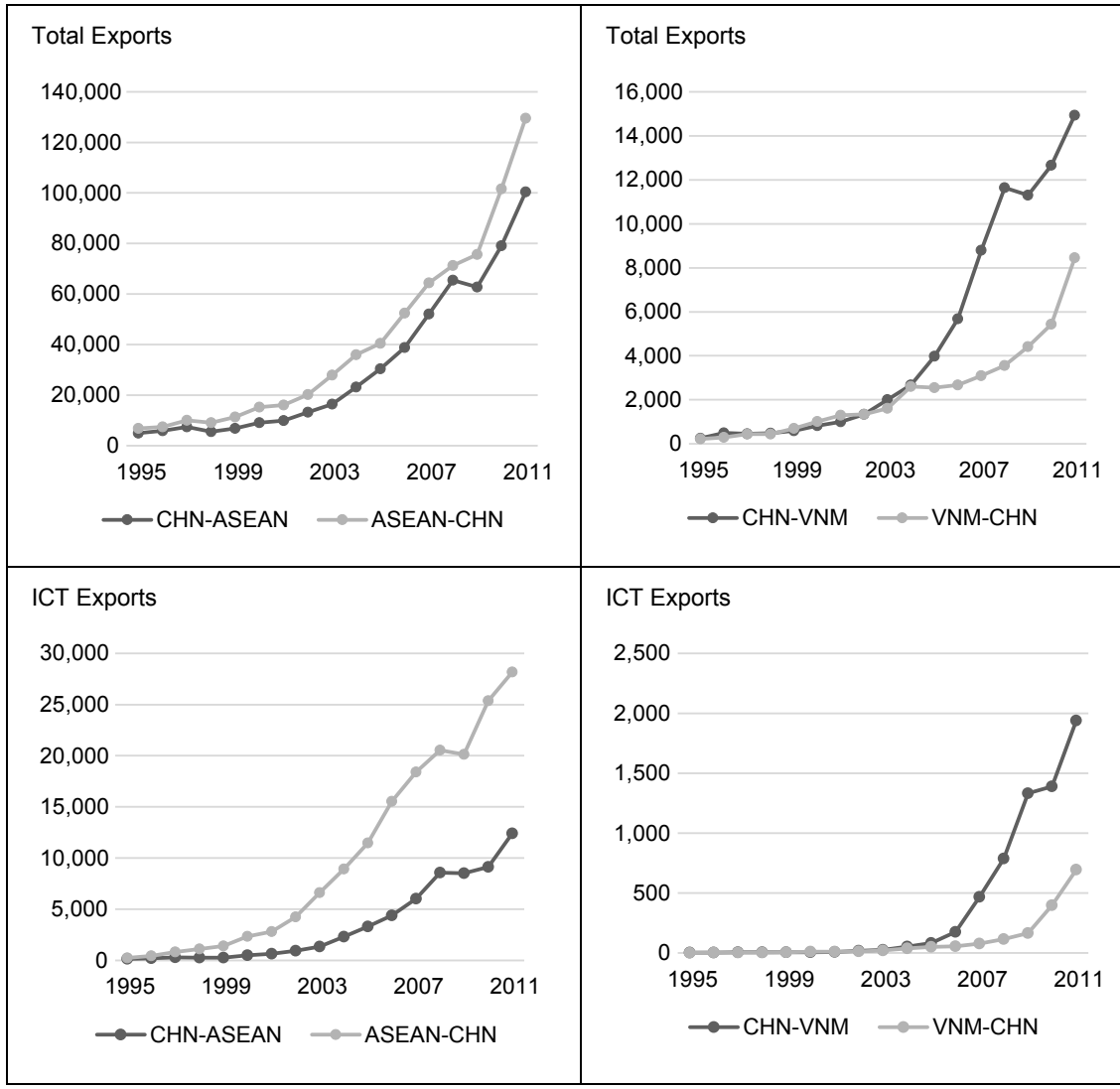
is only marginally lower than that for ASEAN to China. The reason behind this trend is that China has upgraded from a mere assembler of imported inputs to manufacturer (see Xu and Mao 2018) of hi-tech intermediate goods (Amighini 2005), sourced mainly from advanced nations (Baldwin and Gonzalez 2015).[6] The resulting effect of this structural change in China is a drop in imports of parts and components from the region (Lemoine and Unal-Kesenci 2002; Engardio 2007; ADB 2016). Conversely, China has experienced a rise in value-added in exports to Vietnam since 2004. It should also be noted that the DVA for ICT exports of China to Vietnam has also increased. Gao and Zhang (2016) therefore assert that China is in the upper stream compared to Vietnam in the international division of labour.

3. Trade Potential for China-Vietnam: A Comparative Perspective

3.1 Gravity Model and Trade Efficiency

The gravity model has become the workhorse for examining the determinants and potential of bilateral trade flows (Baldwin 1994; Nilsson 2000; Egger 2002). The standard gravity model relates trade between

FIGURE 6
China-ASEAN and China-Vietnam Two-Way DVA Content of Gross Exports and ICT Exports, 1985–2011 (in US$ million)



NOTES: (1) CHN – China; ASEAN – Association of Southeast Asian Nations (does not include Lao PDR and Myanmar).
(2) Covers the exported value-added generated anywhere in the domestic economy. For the ASEAN region, it represents the average of the region's members (does not include intraregional trade flows).
(3) ICT goods refer to computer, electronic and optical equipment (C30T33X).
(4) The data on DVA is only available for 1995–2011.
SOURCE: OECDStat.

two countries positively to both of their incomes and negatively to the distance separating them. The theoretical support for the basic model was initially somewhat poor. It has, however, undergone several modifications in terms of the theories that guide its application since the mid-1970s. These range from models of complete specialization and identical consumer preferences (Anderson 1979; Bergstrand 1985; Deardorff 1998), to models of product differentiation in a regime of monopolistic competition (Helpman 1987), to hybrid models of different factor proportions and product varieties (Krugman 1979, 1980; Lancaster 1980; Helpman 1981, 1987, 1988; Bergstrand 1989; Evenett and Keller 2002), and to models of incomplete specialization, increasing returns to scale and trade costs (Krugman 1980; Helpman 1981; Haveman and Hummels 2004).

Today, various specifications of the gravity model have emerged in the literature. The conventional gravity model, however, cannot satisfactorily control for the various resistances to trade as most of them are hard to quantify. Hence, they are added into the unobserved disturbance term (Baier and Bergstrand 2009). Armstrong (2007) therefore forwards the Stochastic Frontier Analysis (SFA) approach (Aigner, Lovell and Schmidt 1977; Meeusen and van den Broeck 1977), as this method is appropriate for estimating unobservable resistances to trade. The SFA, widely used with the gravity equation (Drysdale, Huang, and Kalirajan 2000; Drysdale and Xu 2004; Kalirajan and Findlay 2005; Adil, Thangavelu and Kalirajan 2009), is commonly employed to identify trade potential[7] and trade efficiencies.[8] The SFA estimates a production frontier indicating the maximum possible (and not the average) output that is produced given certain level of inputs. A fully efficient unit operates at the frontier, and inefficient units operate at a point within the frontier, signifying a shortfall between the observed and the maximum possible levels of output.

3.2 Empirical Strategy

The analysis is based on the gravity specification[9] of Gros and Gonciarz (1996), Nilsson (2000) and Ravishankar and Stack (2014) in the form of SFA as follows:

$$X^t_{ij} = f(GDP^t_i, GDP^t_j, GDPPC^t_i, GDPPC^t_j, DIST_{ij}, X^t_{ij}, Z_{ij}) \exp(v^t_{ij}) \exp(-u^t_{ij}) \quad (1)$$

where X^t_{ij} are the bilateral trade flows between countries i and j at time t; GDP^t_i and GDP^t_j are the economic size of both countries; $GDPPC^t_i$ and $GDPPC^t_j$ are the per capita income levels of the reporter (exporter) and partner (importer) countries, respectively, that capture the wealth potential and subsequently the consumption strength of the countries; $DIST_{ij}$ is the distance between the two partner countries; X^t_{ij} represents the time-varying trade-stimulating/resisting variables; and Z_{ij} stands for the time invariant explanatory variables. The error term of the gravity model comprises two components, namely: v^t_{ij}, representing statistical noise due to measurement error; and one-sided inefficiency element represented by u^t_{ij}, which measures the trade performance. v^t_{ij} follows a normal distribution, while u^t_{ij} is assumed to be distributed independently of the random error and the regressors.

The one-sided inefficiency representing the technical inefficiency is a non-negative random variable. It denotes the degree to which actual trade levels deviate from the potential or maximum trade levels. A zero value of u^t_{ij} indicates that the inefficiency term reduces to the random noise component, when the actual and potential trade levels become equal. Whereas, a non-zero value of u^t_{ij} indicates that there is a deviation between actual and potential trade, offering scope for trade integration. This deviation can be due to multilateral resistances, which are often unobservable and difficult to quantify. In other words, it can be the combined effects of inherent economic distance bias or behind-the-border constraints that are specific to the exporting countries with respect to the particular importing countries. The estimate of the total error variance is represented by $\sigma^2 = \sigma^2_u + \sigma^2_v$, while the estimate of the ratio of the standard deviation of the inefficiency component to the standard deviation of the idiosyncratic components is represented by

$\lambda = \sigma_u/\sigma_v$. If λ is significant, then it signifies the use of SFA since it assesses the degree of inefficiency relative to random error. In addition, testing the presence of trade efficiency (TE) requires the one-sided likelihood ratio (LR) test to be performed on the null hypothesis, H_0: $\sigma_u^2 = 0$ against the alternative hypothesis, H_1: $\sigma_u^2 > 0$. If one fails to reject the null hypothesis, then the SFA model reduces to an ordinary least squares (OLS) model. The point estimates of the TE for each bilateral partner can be computed as $TE_{ij}^t = \exp(-u_{ij}^t)$. The estimated TE ranges between zero and one. TE with a unitary value implies that the actual and potential trade levels coincide (100 per cent efficiency or 0 per cent inefficiency) and zero indicates that there is a scope to raise actual trade levels to the maximum levels (0 per cent efficiency or 100 per cent inefficiency).

The full gravity stochastic frontier model specification of export determinants between China and the ASEAN members is specified below. The data set constitutes a three-dimensional (the cross-section comprises country-pair-product group) panel framework covering two-way export flows and spanning the 1992–2016 period. The number of observations is 1,000 (twenty country-pairs * two product groups * twenty-five years). The specified model is:

$$X_{ij}^t = \beta_0 + \beta_1 GDP_i^t + \beta_2 GDP_j^t + \beta_3 GDPPC_i^t + \beta_4 GDPPC_j^t + \beta_5 DIST_{ij} + \beta_6 TR_j^t + \beta_7 REER_i^t + \beta_8 CL_{ij} + \beta_9 BORDER_{ij} + \beta_{10} LANDLOCKED_{ij} + v_{ij}^t - u_{ij}^t \quad (2)$$

where, TR_j^t, $REER_i^t$, CL_{ij}, $BORDER_{ij}$, and $LANDLOCKED_{i,j}$ are tariff rates, real effective exchange rates, common language, border sharing (contiguity) and landlocked economy, respectively. *TR* and *REER* are time-variant explanatory variables, while the vector of time-invariant explanatory variables includes *CL*, *BORDER* and *LANDLOCKED*. Other definitions of the explanatory variables follow equation (1). All the explanatory variables, except for dummies, *TR* and *REER*, are transformed into the logarithmic form.

The level of *GDP* of both exporting and importing countries is supposed to positively affect their exports. It captures the economies of scale or the size effect. The higher the *GDP*, the larger the export flows, because a greater division of labour and specialization becomes feasible under a larger scale of operation. Likewise, the higher the *GDPPC*, the higher the export flows. However, if the argument of income similarity and shift in consumption patterns is considered, one can also expect the signs to be negative. Linder (1961) argues that if the countries' incomes are similar, then they may have similar consumption patterns and trade more with each other. Hence, equation (2) can be restated by replacing *GDPPC* with per capital income differences (*DGDPPC*) between the trading partners (Ravishankar and Stack 2014). In other words, the *DGDPPC* reflects the differences in consumption patterns, which is measured as the log of absolute difference of the *GDPPC* of trading partners, i.e., $DGDPPC_{ij}^t = \mid GDPPC_i^t - GDPPC_j^t \mid$. A positive $DGDPPC_{ij}^t$ indicates that exports are driven by income differences in line with the relative factor endowment argument, while a negative coefficient suggests that exports decrease when income differences become larger reflecting different consumption patterns.

The third core argument of the gravity model is the *DIST* variable. *DIST* remains important for considerations of transport costs (Egger 2000), transaction costs (Bergstrand 1985; Edmonds, Croix and Yao 2008) and timeliness in delivery (Rojid 2006), and is therefore included in the estimation. In fact, *DIST* and *TR* denote the trade resistance factors in the model. Thus, the expectations are for $\beta_5 < 0$ (Tinbergen 1962; Poyhonen 1963) and $\beta_6 < 0$. Conversely, an increase in *REER* would make goods cheaper relative to those of foreign partners, and thus encourage exports. Therefore, the coefficient of *REER* is expected to have a positive sign for exports.

There are also three dummies incorporated in equation (2) to control for the omitted variable effects, namely *CL*, *BORDER* and *LANDLOCKED*, on export flows. The dummy variables for *CL* and *BORDER* take the value of one if both the trading partners share these common features and zero otherwise. Common language measures cultural distance. The argument is that trade partners with a common

language can communicate easily to establish business relationships and have lower transaction costs. Thus, the expectations are for common language and common border or adjacency to facilitate trade. Landlocked is another dummy, which takes the value of one for countries with no sea nor ocean access (only Laos in the sample). Landlocked countries have a certain disadvantage, since they cannot easily use ship transport for their goods. The expected sign for β_{10} is thus negative.

3.3 Data Description and Sources

Exports (*X*) are compiled from the UN Comtrade database at the HS2-digit level. Data for the gross domestic product (*GDP*) and GDP per capita (*GDPPC*) are sourced from the World Development Indicators (WDI) database of the World Bank (2017a). Tariffs (*TR*) imposed by China and Malaysia on each product group at the HS6-digit level are taken from the database of the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS) within the World Integrated Trade Solution (WITS) developed by the World Bank (2017b). It is the applied weighted average tariff rates of HS6-digit subheading products, for primary and manufactured products. Data for the real effective exchange rate (*REER*), sourced from the Bruegel (2017) data set, are measured as the real value of a country's currency against the basket of sixty-seven trading partners. Data for geographical distance (*DIST*), based on the average distance between the capitals of country pairs and the information for country-pair common language (*CL*), country-pair contiguity (*BORDER*) and landlocked economy (*LANDLOCKED*), are extracted from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII 2017) database. All values for *X*, *GDP*, *GDPPC* and *REER* are expressed in 2010 constant US dollar.

3.4 Empirical Results

Table 2 presents the results of the SFA estimations between China and ASEAN. The results are reported for total China-ASEAN two-way export flows, and for agriculture and manufacture exports separately. Two tests confirm the appropriateness of the SFA approach to estimate the gravity model. The model favours the SFA estimation as it rejects the null hypothesis, where H_0: $\sigma_u^2 = 0$, and H_1: $\sigma_u^2 > 0$. The statistical significance of the λ parameter (the ratio of the standard deviation of inefficiency to the standard deviation of the random error component of the composed error term σ_u/σ_v) additionally supports these results. For instance, the full model inefficiency is 7.8 times that of random error.

The estimated coefficient signs concur with theory. The positive signs for the *GDP* coefficients suggest that larger countries trade more. The negative and significant *DGDPPC* coefficient in the case of agriculture exports indicates that exports reduce with income differences between trading partners. For manufacturing trade, the positive (albeit insignificant) coefficient sign for *DGDPPC* suggests that factor endowments are somewhat different between China and ASEAN. Trade resistance factors, such as *DIST,* significantly matter for exports between China and ASEAN, while *TR* is significant only for total and manufacturing trade. Alternatively, remoteness reduces export flows of agriculture. Trade enablers such as common language and border are important for all trade flows. Similarly, exchange rate affects export flows.

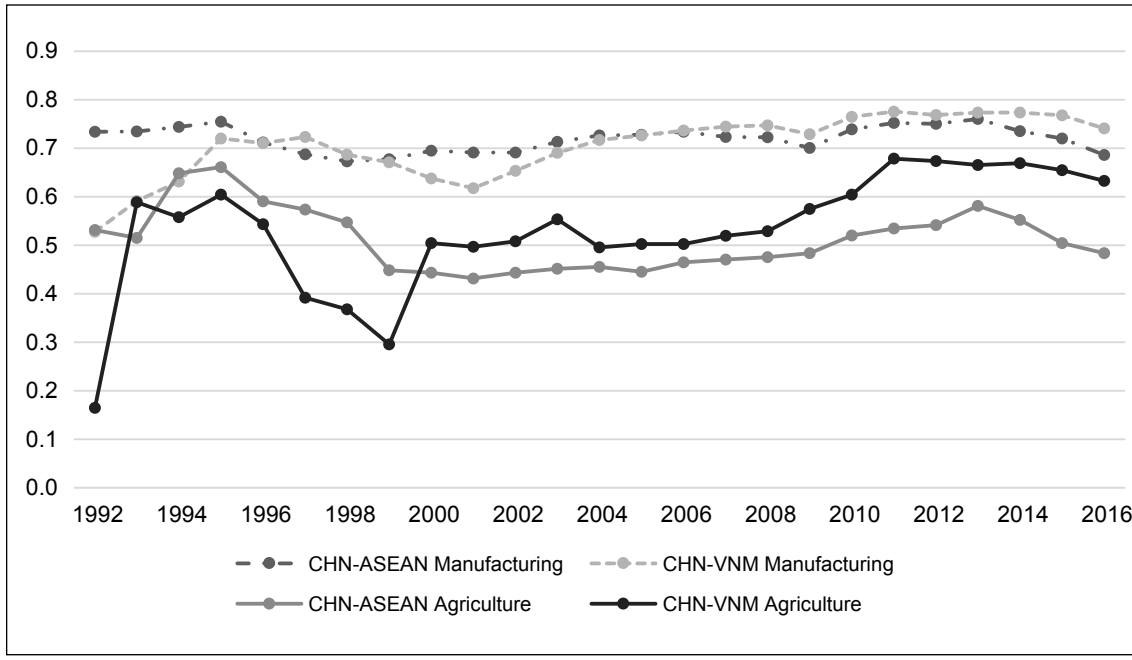
From the above estimations, the export efficiency scores by trading partners (China-ASEAN and China-Vietnam) over the years are derived for both manufacturing and agriculture exports. Figure 7 shows the estimated export efficiency scores for each bilateral pair of countries, averaged over 1992–2016. Overall, for the two-way bilateral export flows in the China-ASEAN and China-Vietnam partnerships,

TABLE 2
China-ASEAN Two-Way Export Flows: Gravity Stochastic Frontier Analysis

Variables	*Total Exports*		*Agriculture Exports*		*Manufacturing Exports*	
ln*GDPi*	1.217***	1.231***	1.333***	0.913***	1.301***	1.294***
	(0.042)	(0.047)	(0.043)	(0.054)	(0.037)	(0.045)
ln*GDPj*	0.971***	0.975***	1.249***	0.858***	1.012***	0.990***
	(0.033)	(0.037)	(0.031)	(0.045)	(0.029)	(0.036)
ln*GDPPCi*	0.079		–0.683***		0.023	
	(0.06)		(0.067)		(0.052)	
ln*GDPPCj*	–0.231***		–0.515***		–0.287***	
	(0.048)		(0.047)		(0.042)	
ln*DGDPPCij*		0.084		–0.653***		0.059
		(0.088)		(0.095)		(0.08)
ln*DISTij*	–1.839***	–1.802***	–1.219***	–0.720**	–1.949***	–1.961***
	(0.256)	(0.264)	(0.295)	(0.304)	(0.241)	(0.251)
TRj	–0.027***	–0.007	–0.006	0.002	–0.032***	–0.012**
	(0.005)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)
REERi	0.011***	0.009***	0.013***	0.008**	0.012***	0.009***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
CLij	1.762***	1.557***	2.276***	2.097***	1.936***	1.715***
	(0.15)	(0.177)	(0.142)	(0.172)	(0.133)	(0.157)
BORDERij	0.221	0.486***	0.599***	1.476***	0.088	0.414***
	(0.142)	(0.14)	(0.162)	(0.166)	(0.133)	(0.131)
LANDLOCKEDij	–0.002	–0.348	–0.435**	–1.587***	–0.279	–0.097
	(0.200)	(0.198)	(0.198)	(0.229)	(0.178)	(0.19)
constant	–22.181***	–24.293***	–32.233***	–22.730***	–23.844***	–24.980***
	(2.462)	(2.732)	(2.877)	(3.137)	(2.284)	(2.531)
σv	0.348 ***	0.421***	0.479***	0.546***	0.35***	0.409***
	(0.049)	(0.053)	(0.056)	(0.065)	(0.047)	(0.049)
σu	2.706***	2.706***	1.499***	1.609***	1.28***	1.318***
	(0.082)	(0.086)	(0.090)	(0.102)	(0.071)	(0.078)
λ	7.767***	6.418***	3.132***	2.942***	3.658***	3.22***
	(0.112)	(0.122)	(0.132)	(0.152)	(0.106)	(0.116)
Observations	883	880	440	440	443	443

NOTES: (1) Figures in parentheses are the standard errors.
(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.
(3) The Likelihood Ratio (LR) test of no inefficiency component in the composed error term is rejected for all estimations.
SOURCE: Authors' calculations.

FIGURE 7
China-ASEAN vs China-Vietnam: Average Export Efficiency Scores for Two-Way Export Flows, by Sectors, 1992–2016



SOURCE: Derived from the SFA.

the efficiency scores are higher for manufactures relative to agriculture. By country-pairs, the efficiency scores are high (TE > 0.5) for most manufactures, suggesting high degrees of export integration. On average, bilateral exports flows are achieving 51 per cent and 72 per cent[10] of the estimated trade potential for 1992–2016 for agriculture and manufactures, respectively. The implication is that frictions are larger for agriculture flows relative to trade in manufactures. China's export efficiency score with Vietnam is higher for manufactures relative to agriculture; the same results hold true in the case of China's bilateral trading relationship with the other ASEAN members. The reason for this is that China has a relatively complete industrial structure and can make most commodities by itself (Hao 2008).

Nevertheless, agriculture is considered a strategic area for Vietnam in the China-Vietnam partnership (see also Oh 2017; Jun and Chunlai 2008). Table 3 further confirms the relatively high degree of Vietnam's export integration with China in agriculture trade. The efficiency scores for Vietnam's exports to China are consistently higher relative to the scores for the opposite flows from China to Vietnam for all subperiods. For example, for the overall 1992–2016 period, the efficiency score for agriculture exports from Vietnam to China was 0.655, while it was only 0.477 for China's exports to Vietnam. This is not surprising since China offered concessions to open up the agricultural market under the Early Harvest Plan (EHP) in 2004, which made it possible for Vietnam (and the other newer member economies) to tap into the Chinese market. Likewise, the memorandum of understanding on cooperation in the field of trade of agricultural products between China and Vietnam in 2013 resulted in steady growth in bilateral trade.

Interestingly, it can also be observed from Table 3 that the efficiency score for Vietnam's exports of manufactures to China (0.774) had surpassed that for China's exports of manufactures to Vietnam (0.765)

TABLE 3
China-ASEAN: Average Export Efficiency Scores for Two-Way Export Flows, by Country-Pair and by Subperiods, 1992–2016

	Agriculture				*Manufacturing*			
Country-Pair	*1992–2016*	*1992–2000*	*2001–10*	*2011–16*	*1992–2016*	*1992–2000*	*2001–10*	*2011–16*
CHN-MY	0.4734	0.5122	0.4576	0.4415	0.6727	0.6381	0.7103	0.6622
CHN-SGP	0.5338	0.7211	0.4600	0.3757	0.8031	0.8246	0.8171	0.7477
CHN-THA	0.5177	0.4182	0.4912	0.7109	0.7629	0.7844	0.7568	0.7410
CHN-PHL	0.5801	0.6054	0.5558	0.5824	0.6797	0.6835	0.6861	0.6634
CHN-IDN	0.4861	0.5119	0.4826	0.4530	0.7287	0.7197	0.7458	0.7139
CHN-BRN	0.5628	0.5106	0.5812	0.6104	0.6376	0.5925	0.5909	0.7831
CHN-CAM	0.5725	0.6462	0.5561	0.4895	0.7976	0.7777	0.8138	0.8005
CHN-LAO	0.4302	0.6244	0.2540	0.4325	0.6728	0.6658	0.6589	0.7063
CHN-MYA	0.4490	0.6174	0.3267	0.4003	0.7365	0.8041	0.6866	0.7181
CHN-VNM	*0.4773*	*0.4216*	*0.4409*	*0.6214*	*0.7231*	*0.6647*	*0.7503*	*0.7653*
MY-CHN	0.6140	0.6173	0.6399	0.5659	0.6812	0.6604	0.7016	0.6782
SGP-CHN	0.4441	0.5476	0.3883	0.3818	0.7342	0.7350	0.7528	0.7020
THA-CHN	0.7148	0.6978	0.7008	0.7735	0.7715	0.7317	0.7956	0.7950
PHL-CHN	0.2534	0.3042	0.2238	0.2605	0.6965	0.5734	0.7665	0.6823
IDN-CHN	0.5633	0.4372	0.6069	0.6796	0.7087	0.7525	0.6978	0.6609
CAM-CHN	0.2376	0.2155	0.1016	0.4680	0.6699	0.8286	0.5792	0.7947
LAO-CHN	0.5388	0.4933	0.4733	0.7161	0.7523	0.7181	0.7202	0.8571
VNM-CHN	*0.6551*	*0.7295*	*0.6164*	*0.7176*	*0.6984*	*0.5553*	*0.6751*	*0.7737*

NOTES: (1) There are forty bilateral country-pairs (reporter-partner) for the ten ASEAN members as the study considers two-way export flows in the estimations. BRN-CHN and MYA-CHN are not included due to many zero trade observations.
(2) The TE scores are averaged for the period 1992–2016.
SOURCE: Derived from SFA.

in the recent 2011–16 subperiod. This finding lends support to the decline in export concentration of Vietnam to China as noted from Figure 4.

4. Conclusion

The China-ASEAN trade relationship is obviously multidimensional. The main message from the trade data analysis is that there is asymmetry in terms of economic capacity and structure between China and Vietnam. Vietnam's integration with China through trade is largely from the import side, and is therefore considered relatively unbalanced. Specifically, trade balances for manufactures are constantly in favour of China, both for final and intermediate goods. The imbalances are also reflected in a more homogeneous distribution of products exported from China to Vietnam than vice versa. Further, China has experienced a rise in DVA in exports to Vietnam; China is in the upper stream compared with Vietnam in the international division of labour. As such, Vietnam faces a daunting task of managing large deficits in trade with China, and diversifying and upgrading its export structure.

The relationship is, however, not one-sided nor is it all downside, as there is a high level of economic interdependence between the two countries. More recently, there has been decline in merchandise export concentration (steep increase in the number of products exported) from Vietnam to China. Evidently, two-way potential exists for export expansion in the China-Vietnam case as reflected in the declining concentration in bilateral merchandise exports, particularly since 2006 for Vietnam. This is supported by the comparable efficiency scores for manufacture exports from China to Vietnam, and from Vietnam to China. Vietnam is deemed to have benefited the most in the region from China's climb up the value chain and rising labour costs as low cost manufacturers choose to move their production bases elsewhere from China (Deorukhkar and Le 2016; IMF 2016). In the case of agriculture exports, though they do not dominate each other's trade flows, Vietnam's degree of export integration with China was found to be considerably higher than the opposite case of China with Vietnam. Nevertheless, much of the agriculture exports have been harnessed through cross-border trade between Vietnam and China, which has already formed an important part of their trade relationship (*Vietnam Pictorial*, 29 March 2016). Overall, there is still scope for improving efficiency in agriculture export flows in the China-Vietnam partnership.

NOTES

A revised version of the paper was prepared for the 42nd Conference of the Federation of ASEAN Economic Association (FAEA) "Drivers of ASEAN Integration", Sunway Hotel Resort, Kuala Lumpur, 5–8 December 2017.

1. The idea of asymmetrical relations was introduced by Womack (2010) to characterize China's relations with Asia based on population and economic capacity, among others. The basic point is that the disparity that defines asymmetric relations implies that the relationship of the larger country to the smaller will be quite different from the relationship of the smaller country to the larger.
2. Vietnam joined ASEAN in 1995 and the World Trade Organization (WTO) in 2006.
3. The classification of broad product groups are based on agriculture (HS01-HS24) and manufacturing (HS25-HS99).
4. Intermediate goods based on the OECDStat database is a broad classification encompassing the following subcategories: primary food and beverages, mainly for industry; processed food and beverages, mainly for industry; industrial supplies not elsewhere specified; parts and accessories for capital goods; parts and accessories for transport equipment.
5. This report does not attempt to derive trade in parts and components between China and ASEAN as there is still no clear and systematic definition in the literature to construct an accurate database.
6. The utilization of network technology through the backward participation allows countries to capture more value in GVCs and thereby upgrade along the supply chain (Kam 2017).
7. Trade potential is the trade achieved at a frontier; a level of trade that may be attained when an economy is highly open or without any trade friction (Drysdale, Huang and Kalirajan 2000; Kalirajan 2000; Armstrong 2007).
8. Trade efficiency (TE) is a measure of actual levels of trade against potential trade (predicted trade from the frontier estimation (Kalirajan and Findlay 2005). A country is considered to have a low efficiency in its international trade and low degree of trade integration (Stack, Pentecost and Ravishankar 2018) if the potential trade is far greater than actual trade.
9. The estimation of the frontier (or potential trade) is made using only fundamental (or core) determinants of trade as the theoretical derivations would suggest (Armstrong 2007).
10. It is worth noting here that the estimated trade potential is sensitive to: the way in which the frontiers are defined; the different countries being analysed in the study; the different time periods; and the different specification of the distribution of the non-negative disturbance term (Kumbhakar and Lovell 2000).

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