Article

Integration of Two-Region Input-Output Tables from a Border Trade Perspective: Economic Patterns of Yunnan and Myanmar

Ei Ei Thein*
Kazuo Inaba**

Abstract

This study integrates two-region input-output (I-O) tables for Yunnan and Myanmar by using a non-survey approach, with the aim to develop the analysis of cross-border trade relations between two regions at the industrial level. It explains the compilation of Yunnan's I-O tables, extracted from China's multi-regional I-O framework, and Myanmar's tables, obtained from the OECD I-O database, for the years 2012 and 2017. As preliminary analyses, the study examines the economic structures of Yunnan and Myanmar through value-added assessment as well as backward and forward linkage analyses. The results show that Yunnan experiences remarkable increase in value-added performance between 2012 and 2017, while Myanmar's industrial structure remains stable and creates relatively lower value-added contributions. The linkage analysis further indicates that manufacturing sectors play a central role in both economies. Yunnan's economic expansion is predominantly manufacturing-driven, whereas Myanmar's growth relies on a mixed pattern combining agriculture, mining, and some manufacturing activities. Moreover, manufacturing sectors in both regions exhibit only minor differences in sectoral contributions from both demand- and supply-side perspectives, which indicates insignificant structural change of both economies over time.

Keywords: Border trade, input-output analysis, economic structure, value-added

1. Introduction

Cross-border relations play a crucial role in regional economic integration and the economic development of both host and neighboring countries through trade connections.

*Senior Researcher, BKC Research Organization of Social Sciences, Ritsumeikan University.
Contact: eieithein.9380@gmail.com
**Senior Researcher, Institute of Social System Studies, Ritsumeikan University.

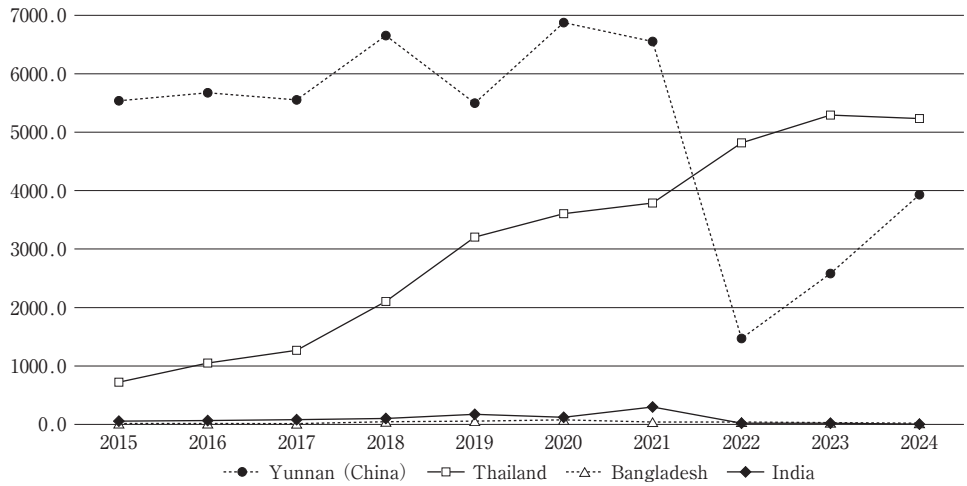
These relations facilitate not only the exchange of goods and services but also the cross-border movement of labor, technology, finance, and infrastructure. As a result, it generates broad economic and social benefits for the regions involved. Ge et al. (2014) demonstrate that border trade exerts a significant influence on the economic development of frontier regions and contributes to the regional integration of inland areas. Similarly, Mao et al. (2021) emphasize that cross-border economic cooperation constitutes an important form of international collaboration. Consequently, the promotion of cross-border trade has become a key driver of regional economic development. Effective enhancement of cross-border trade requires a clear understanding of the underlying economic structures and trade relationships between participating economies. This study focuses on the cross-border relations and economic structures of Yunnan and Myanmar.

Yunnan Province, located in southwestern China, shares an extensive border with northern Myanmar and plays a pivotal role in facilitating bilateral trade between the China and Myanmar. Cross-border trade between Yunnan and Myanmar is conducted through five major border checkpoints and accounts for a large share of total China-Myanmar trade. In 2014, trade conducted through the Yunnan-Myanmar border represented approximately 30% of overall China-Myanmar trade and 49% of Yunnan's total trade with ASEAN (Hong Kong Trade Development Council, 2016). Figure 1 presents the evolution of Myanmar's cross-border trade[1)] with its neighboring countries: China, Thailand, India, and Bangladesh, over the period 2015–2024. Prior to Myanmar's political crisis in 2021, Yunnan (China) consistently accounted for the largest share of Myanmar's border trade value, followed by Thailand. Before 2021, Yunnan served as Myanmar's principal border trade counterpart. However, the political turmoil in Myanmar in 2021 led to an obvious contraction in Yunnan-Myanmar border trade, causing Yunnan's share to fall below that of Thailand. Trade flows subsequently began to recover after 2023.

Myanmar's exports to Yunnan are dominated by agricultural outputs, mineral resources, and other primary commodities, while Yunnan supplies Myanmar mainly with manufactured products, including machinery, electrical and electronic equipment, chemical products, and related industrial goods (Zhu, 2011). This complementary trade structure supports regional productivity by improving the availability, circulation, and efficiency of goods and services across the border. Motivated by this trade relations, this study aims to conduct insightful analysis on the trade relations between Yunnan and Myanmar at industrial level.

A two-region input-output (I-O) framework enables the identification of key sectors that significantly contribute to regional economies and clarifies how sectoral demand and supply linkages support production across regions (Leontief, 1936). To the best of our knowledge, no empirical study has examined cross-border trade relations between Yunnan and Myanmar at the industry level, primarily due to the limited availability of two-region I-O tables for these economies. This data constraint has discouraged the application of interregional

Figure 1 Myanmar's cross-border trade values in the period 2015–2024



Source: Ministry of Commerce, Myanmar

I-O analysis in this context. To address this gap, this study constructs a two-region I-O table for Yunnan and Myanmar using a non-survey approach and provides one of the first empirical analyses of their cross-border economic linkages. Accordingly, the study pursues two main objectives: (i) to compile a two-region I-O table for Yunnan and Myanmar, and (ii) to identify key sectors that drive regional economic development of Yunnan and Myanmar.

The remainder of this paper is organized as follows. Section 2 reviews the historical evolution of trade and economic relations between Yunnan and Myanmar. Section 3 describes the construction of the two-region input-output tables for Yunnan and Myanmar and outlines the analytical framework. Section 4 presents and discusses the empirical results in comparison with existing studies. Section 5 concludes by summarizing the main findings and highlighting their implications.

2. Literature Review

Border trade generally denotes the exchange of goods and services across international land boundaries, typically occurring within a limited geographical range of approximately 30 kilometers from the border (Ge et al., 2014). A defining feature of border trade is its relatively low transportation costs, which enhance its economic relevance for adjacent regions despite the modest scale of such transactions (Aseff et al., 1995; Kubo, 2016). Existing studies indicate that border trade promotes regional economic growth primarily by facilitating cross-border flows of goods and services (Jarreau and Poncet, 2012). Moreover, the geographical positioning of border regions allows them to function as strategic nodes for the movement of goods and labor across national boundaries. This role supports the ex-

pansion of transport and logistics infrastructure, encourages investment, and attracts transnational firms to establish production or commercial operations, thereby contributing to sustained local economic development (Lyu, 2024).

Mao et al. (2021), drawing on evidence of Wang (2018), Wen, et. al. (2019), and Liu and Jin (2016) who conduct empirical studies based on the data of 199 cross-border cities in China, demonstrate that China's border regions experience remarkable cross-border spillover effects when they engage in international trade and cross-border cooperation, although the magnitude of these effects varies across regions and distance bands. These studies further indicate that geographical conditions, infrastructure quality, levels of economic development, and policy frameworks jointly shape the degree of openness and regional cooperation in China's border areas. Mao et al. (2021) also identify Myanmar as a key node within the Belt and Road Initiative, serving as China's primary land connection to South Asia and exhibiting strong development potential due to its strategic location and resource endowments. From Myanmar's perspective, border trade has historically depended mainly on Yunnan, China's southwestern gateway, until the political crisis in 2021. Maintaining cross-border trade relations is critically important not only for the economic development of Yunnan and Myanmar but also for China's broader objective of regional trade integration.

Existing research has examined the constraints and barriers affecting cross-border economic development between Yunnan and Myanmar. To analyze such barriers, Ratti and Reichman (1993) identify two broad approaches: (i) an examination of the decision-making behavior of microeconomic actors, grounded in industrial organization theory; and (ii) an analysis of the broader institutional, spatial, and contextual conditions shaping bilateral development from a regional economic development perspective. Most existing studies adopt the latter approach. Xu and Zhang (2016) identify three key factors requiring improvement to promote Yunnan-Myanmar border trade: customs clearance efficiency, logistics facilitation, particularly warehousing and transportation, and the convenience of capital settlement through banking systems. Dan (2022) evaluates the benefits and costs of cross-border trade and finds that improvements in border trade can contribute to economic development in certain borderland areas. However, the study also highlights unintended negative consequences for Myanmar, including environmental degradation, governance challenges such as corruption, and land losses associated with increased Chinese investment. To support this view, Fredrich et al. (2004) highlight concern regarding the heavy reliance of local communities in northern Myanmar on logging activities and the expansion of cross-border timber trade and emphasize the associated risks to ecological sustainability and environmental preservation.

Kudo and Mieno (2007) examine the contribution of border trade to Myanmar's economy during the period 1990–2005, following the implementation of the open-door policy. Their findings indicate that Myanmar's economic structure exhibited little change over this peri-

od, particularly with respect to the contribution of trade to GDP. Using bilateral trade data for Yunnan Province from 1988 to 1999, Poncet (2006) applies a gravity model of trade and finds that trade between Yunnan and Myanmar gradually declined from an above-normal level to one consistent with gravity-based expectations. By contrast, employing data from 2000 to 2012, Taguchi and Oizumi (2014) show that Yunnan's exports to and imports from Myanmar substantially exceeded levels predicted by the gravity model. Notably, Myanmar accounted for 53.3 percent of Yunnan's exports and 33.9 percent of its imports in 2012.

An industry-level analysis of the economic contribution of border trade can improve the awareness of economic integration between Yunnan and Myanmar which enhance the industrial and trade policies between two economies. In this regard, the study constructs a two-region input-output table using a non-survey approach and, as a first step, identifies the key sectors that play a major role in Yunnan's and Myanmar's economies by employing value-added analysis and backward and forward linkage approaches.

3. Data and analytical methods

This research consists of two main components: (i) constructing a two-region I-O table for Yunnan and Myanmar using a non-survey approach, and (ii) exploring the sectoral contributions of Yunnan's and Myanmar based on two-region I-O tables.

3.1 Data

This study constructs a non-competitive, two-region input-output (I-O) table for Yunnan and Myanmar using a non-survey approach. The national I-O tables of Myanmar and regional I-O tables of Yunnan are applied for constructing two-region I-O tables. The I-O tables for Myanmar are obtained from the Organization for Economic Cooperation and Development (OECD) input-output database, while those for Yunnan are derived from the Chinese Multi-Regional Input-Output (MRIO) tables compiled by the Carbon Emission Accounts and Datasets (CEADs). The Chinese MRIO tables are available for only three benchmark years: 2012, 2015, and 2017. To conduct five-year interval analysis, this study selects the years 2012 and 2017 for both Yunnan and Myanmar. Cross-border trade data are employed to estimate the intermediate trade flows between the two regions. To estimate the intermediate trade flows, this study utilizes the trade statistics between Yunnan and Myanmar sourced from the Ministry of Commerce (MOC) of Myanmar and trade data between China and Myanmar collected from the World Integrated Trade Solution (WITS) database.

3.2 Compilation of Yunnan-Myanmar two-region I-O table

Firstly, this study extracts Yunnan's I-O data from the Chinese MRIO tables by consolidating relevant data using Microsoft Excel. The MRIO tables are compiled by 42 industries for 31 provinces and provide detailed economic transactions at the regional level. From these tables, Yunnan's data on intermediate inputs, value added, final demand, and international trade are extracted. In constructing Yunnan's regional I-O table, this study treats trade between Yunnan and the rest of China as interregional (domestic) trade, while trade with countries outside China is categorized as foreign trade. As a result, unlike conventional I-O tables, Yunnan's I-O table includes both interregional trade within China and international trade.

Yunnan's I-O tables are structured across 42 industries, whereas the OECD compiles Myanmar's I-O tables with 45 industries. To harmonize the industrial classifications between these two data sources, both Yunnan and Myanmar's industries are reclassified and aggregated into 24 common sectors. This classification follows the industry definitions provided by the Ministry of Internal Affairs and Communications of Japan (2021). As a result, the I-O tables for both regions are reconstructed into a standardized 24×24 matrix, which enables consistent comparative analysis. Appendices 1 and 2 present the original industrial classifications of Yunnan in the Chinese MRIO tables and those of Myanmar in the OECD I-O tables, and the corresponding industries used in the two-region I-O tables.

Subsequently, this study constructs a two-region I-O table for Yunnan and Myanmar by integrating the respective regional I-O tables. The structure of the two-region I-O table[2] is illustrated in Figure 2. In constructing the two-region framework, core components such as intermediate inputs, value added, final demand, and foreign trade from each region's I-O table are directly utilized. Therefore, the only component to be estimated is the matrix of intermediate inputs traded between Yunnan and Myanmar, which represents the interregional economic linkages between the two regions.

The estimation of intermediate inputs traded between Yunnan and Myanmar is based on cross-border trade data collected from the MOC, Myanmar. As this border trade data is aggregated, it must be allocated across industries to construct the interregional trade matrix. To achieve this matrix, the study applies commodity-level trade ratios derived from detailed trade data between China and Myanmar, obtained from the WITS database. These ratios represent the relative share of each industry in the total trade volume and are used to disaggregate the aggregate border trade value into industry-specific flows. The trade ratio for each industry is calculated using the following formula:

$$\frac{\text{Import value of total commodity value in each industry}}{\text{Total import between China and Myanmar}} \times \text{Cross-border trade value.}$$

In this study, Myanmar's imports from Yunnan are treated as Yunnan's cross-border exports, while Yunnan's imports represent Myanmar's cross-border exports.

Figure 2 Non-competitive import type integrated I-O table of Yunnan and Myanmar

Industries	Intermediate demand						Total intermediate demand	Final demand	Foreign Trade		Regional trade with other provinces		Total demand
	Yunnan			Myanmar					Import	Export	Import	Export	
	1	2	3	1	2	3							
1 2 3	Yunnan (A^{YY})			Export to MMR (A^{YM})			YUN	YUN	YUN		YUN		YUN (X_i)
1 2 3	Import from MMR (A^{MY})			Myanmar (A^{MM})			MMR	MMR	MMR				MMR (X_i)
Total intermediate input													Total demand
Value added	YUN			MMR			TVA						
Total Supply	YUN (X_j)			MMR (X_j)			Total supply						

Source: Authors' drawing based on the two-regions-I-O table

In the next step, cross-border trade data are separated from each region's total foreign trade by industry. Specifically, Yunnan's foreign trade data are disaggregated into: (i) cross-border trade with Myanmar, and (ii) trade with other countries, including the remaining portion of trade with Myanmar which is not classified as cross-border. Similarly, Myanmar's I-O table is adjusted to distinguish cross-border trade with Yunnan from its trade with the rest of the world.

To estimate the intermediate inputs traded between Yunnan and Myanmar, the study applies the RAS[3)] method by utilizing the disaggregated cross-border import and export data. In this process, Myanmar's exports are considered part of Yunnan's intermediate inputs (A^{MY}), and vice versa, Yunnan's exports are treated as intermediate inputs for Myanmar (A^{YM}). After allocating the intermediate inputs, all components of the I-O table are integrated into the two-region I-O table (as shown in Figure 1). The rows and columns are adjusted to ensure balance between supply and demand by industry. Furthermore, in compiling the two-region I-O tables for 2012 and 2017, the study preserves the original structural ratios—such as value-added shares, intermediate input coefficients, and final demand composition—based on each region's I-O data. The integrated two-region I-O tables consist of 24 sectors including 11 manufacturing sectors, 10 service sectors, agriculture sector, mining sector and construction sector.

3.3 Analytical method: Backward and forward linkages

By using the constructed two-region I-O tables, this study analyzes the sectors which contribute the most to economic development of Yunnan and Myanmar. The analysis employs the backward linkages (BLs) and forward linkages (FLs) approaches.

Backward and forward linkages are fundamental I-O analytical tools that reflect inter-industry dependencies within and across regions. BLs are derived from the inverse matrix introduced by Leontief (1936) by employing a competitive input-output framework. The formula for the Leontief inverse is as follows: $L=[I-(I-\widehat{M})A]^{-1}=[b_{ij}]$, where I is the identity matrix, $\widehat{M}$ represents the diagonal matrix of import coefficients, and A denotes the matrix of input coefficients $[a_{ij}]=[x_{ij}/X_j]$, here, the intermediate input (x_{ij}) of sector j is divided by the total output of sector j. The BLs are calculated as the vertical sum of the column vectors of Leontief's inverse matrix. BLs can be derived as follows:

$$BL_j=\sum_{i=1}^{n} b_{ij} \tag{1}$$

Where n denotes the number of industries, the BLs can be further transformed into a normalized form. BLs indicate the total input requirements across industries needed to produce one unit of final demand in industry j, highlighting the degree of industry j's dependency on upstream sectors. In this approach, each industry's BL value is divided by the average of the vertical sums of the Leontief inverse matrix, as shown in Equation (2). This normalized BL index allows for comparison across industries by indicating the relative strength of each sector's demand-side contribution to the regional economy. A higher BL value suggests that the industry has stronger upstream linkages, meaning that a unit increase in its final demand will induce greater output in other industries by generating higher intermediate input demand. Thus, industries with high BLs are considered key sectors from a demand-side perspective, as their growth can stimulate broader economic activity through production chains.

$$\overline{BL_j}=\frac{\sum_{i=1}^{n} b_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} \tag{2}$$

In measuring the FLs, this study applies the Ghosh inverse matrix, denoted as, $G=[g_{ij}]$, which is proposed by Miller and Blair (2009). In the Ghosh model, the output coefficients are calculated using the formula: $[a_{ij}]=[x_{ij}/X_i]$. FLs can be derived from Equation (3).

$$FL_i=\sum_{j=1}^{n} g_{ij} \tag{3}$$

Then, this study transforms the FLs to normalized form by using Equations (4).

$$\overline{FL_i}=\frac{\sum_{j=1}^{n} g_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} g_{ij}} \tag{4}$$

The normalized FLs capture the supply-side importance of each industry by indicating how a unit increase in output from a specific sector leads to increased production in other industries through the provision of intermediate inputs. An industry with a high FL value

plays a key role in supporting the production activities of downstream sectors and is thus considered vital for supply-driven growth in the regional economy.

4. Results

4.1 Comparison of sectoral value-added contributions between Yunnan and Myanmar

This section examines the value-added (VA) contributions in Yunnan and Myanmar. The VA ratio is calculated as the ratio of value added to total output for each industry and reflects the share of income generated within a sector. The VA ratio highlights its role in employment generation and wealth creation. Leal-Ordonez (2017) states that the VA ratio captures the contribution of primary production factors, such as labor and capital, per unit of output. Table 1 presents a comparison of sectoral VA ratios for Yunnan and Myanmar in 2012 and 2017. The first column reports the aggregate VA ratios relative to total output for both years. Overall, Yunnan and Myanmar exhibit similar VA ratios of approximately 0.40, suggesting comparable input structures across the two economies. Between 2012 and 2017, Yunnan's VA ratio increased from 0.42 to 0.44, indicating an enhanced contribution to overall economic activity. In contrast, Myanmar's VA ratio shows no significant change between 2012 and 2017.

A more detailed sectoral examination reveals substantial changes in Yunnan's value-added ratios across several industries. Notable increases are observed in wood, paper, and furniture manufacturing (from 0.29 to 0.42); non-metallic mineral products (from 0.28 to 0.36); machinery and equipment manufacturing (from 0.22 to 0.35); electricity, heat, and water supply (from 0.29 to 0.53); finance and insurance (from 0.39 to 0.59); and wholesale and retail trade (from 0.24 to 0.72). In contrast, declines in value-added ratios are found in construction (from 0.53 to 0.23), transport and storage (from 0.74 to 0.53), and real estate (from 0.65 to 0.41). Except for these sectors, Yunnan's all manufacturing and service sectors show improved VA contributions which demonstrate the industrial development of Yunnan during 2012–2017.

In contrast, Myanmar's value-added (VA) ratios exhibit relatively little variation between 2012 and 2017. VA ratios in agriculture, mining, food processing, other manufacturing equipment, and education remain substantially lower than those observed in Yunnan. Despite being Myanmar's main export sectors, agricultural and mining products undergo limited domestic processing, which results in low value-added generation. This finding is consistent with Mao et al. (2021), who emphasize that Myanmar's agricultural trade reflects a low degree of value-added integration, characterized by exports of primary commodities and reliance on imports of processed agricultural products. These patterns indicate the need for Myanmar to strengthen its competitive advantage by upgrading production and

Table 1 Value-added contributions by sector of Yunnan and Myanmar

Industry	Yunnan		Myanmar	
	2012	2017	2012	2017
(1)	(2)	(3)	(4)	(5)
Total value-added to output ratios	0.42	0.44	0.44	0.43
Agriculture, hunting and forestry	0.62	0.62	0.47	0.47
Mining and washing of coal	0.42	0.45	0.37	0.37
Food products, beverages and tobacco	0.47	0.50	0.28	0.30
Textile industry	0.26	0.25	0.36	0.35
Wood, paper, timber and furniture	0.29	0.42	0.33	0.33
Chemical products	0.23	0.29	0.32	0.31
Manufacture of metal products	0.23	0.25	0.31	0.30
Manufacture of non-metal products	0.28	0.36	0.36	0.35
Machinery and equipment	0.22	0.35	0.34	0.34
Electrical machinery and equipment	0.19	0.21	0.31	0.32
Manufacture of transport equipment	0.23	0.25	0.37	0.37
Other manufacturing equipment	0.64	0.66	0.39	0.37
Electricity, heat and water supply	0.29	0.53	0.42	0.41
Construction	0.53	0.23	0.36	0.35
Wholesale and retail trades	0.24	0.72	0.51	0.50
Transport, storage and postal services	0.74	0.53	0.42	0.42
Information and communications	0.43	0.48	0.47	0.45
Finance and insurance	0.39	0.59	0.52	0.51
Real estate	0.65	0.41	0.60	0.59
Scientific research	0.33	0.43	0.51	0.50
Public administration	0.57	0.52	0.53	0.52
Education	0.82	0.77	0.60	0.58
Healthcare and social work	0.44	0.47	0.52	0.49
Other supplies including accommodation and catering	0.48	0.46	0.44	0.42

Source: Two-regions input-output tables constructed by authors

integrating more deeply into global value chains.

Reflecting its labor-intensive economic structure, Myanmar records slightly higher VA ratios than Yunnan in selected manufacturing sectors, including textiles, wood and paper products, chemical products, metal products, electrical machinery and equipment, and transport equipment manufacturing. However, VA ratios in these sectors do not show increase over the period 2012–2017. Moreover, export contributions of these products of Myanmar are insignificant and demand further improvement of industrialization.

In summary, the value-added analysis reveals clear sectoral differences in production structures between Yunnan and Myanmar. Yunnan shows evidence of industrial upgrading and expansion into higher value-added services, whereas Myanmar's economy remains relatively stable and concentrated in labor-intensive activities. This structural asymmetry shapes cross-border trade dependence and underscores the importance of targeted policies to enhance value-added creation in Myanmar and to strengthen trade integration between

two regions.

4.2 Backward and Forward linkages

4.2.1 Backward linkages

This section examines the contribution of each industry of Yunnan and Myanmar to regional economy from the demand side by using the backward linkages (BLs) approach. Calculation of BLs is explained in Section 3.3. BLs identify the sectors that contribute most to the output growth of other sectors through increased demand. In other words, a higher BL in a sector indicates that a one-unit increase in its output generates greater intermediate demand from other sectors and then stimulates their output growth. Larger BL values reflect a greater contribution to the regional economy. Table 2 [columns (2) to (5)] presents the BLs of Yunnan and Myanmar for 2012 and 2017. The results show that for both Yunnan and Myanmar, the sectoral BLs have no significant change between 2012 and 2017.

In Yunnan, all manufacturing sectors, except for food products and other manufacturing equipment, demonstrate their contributions to output growth. The magnitudes of these manufacturing BLs are relatively similar, which suggests that all manufacturing sectors play comparable roles as the primary demand-side drivers of regional economic growth. In contrast, agriculture, mining, construction, and all service sectors exhibit less contributions to output growth, apart from the construction sector in 2017. This finding aligns with Long (2020), who reports that during 1978–2019, the output share of Yunnan's primary industry decline, the secondary industry remains relatively stable, and the tertiary industry increases. Consistent with that trend, this study finds low contributions from Yunnan's agriculture and mining, alongside significant and stable contributions from manufacturing sectors in both years. Overall, BLs underscores the important role of manufacturing sectors as the key driver of Yunnan's output growth in 2012 and 2017. Zhu (2011) states that Yunnan government sets the industrial development policies to enhance the competitiveness of main industries including tobacco, mining, bio, power and tourism. However, in terms of BLs, mining and tobacco sectors show small production link with other industries which demonstrates their weak contribution to output growth.

In opposite with Yunnan's agriculture sector, Myanmar's agriculture, mining, and all manufacturing sectors, except for the manufacture of transport equipment, show contributions to output growth. This outcome is closely linked to Myanmar's economic reforms initiated after 2011, which dramatically improves Myanmar's economy to be the highest growth during 2011–2019, according to the World Development Indicators, World Bank.

The economic reform seems to spur the development of manufacturing, which emerges as a significant contributor to Myanmar's economy. Similarly, production and trade data from the Asian Development Bank[4] supports these results and indicate a decline in the output share of agriculture, alongside gradual increases in the shares of manufacturing and

Table 2 Backward and forward linkages of Yunnan and Myanmar for years 2012 and 2017

Sectors	Backward Linkages				Forward Linkages			
	Yunnan		Myanmar		Yunnan		Myanmar	
	2012	2017	2012	2017	2012	2017	2012	2017
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Agriculture, forestry, animal husbandry and fishery	0.79	0.80	1.03	1.05	0.92	1.00	1.31	1.33
Mining and washing of coal	0.95	0.95	1.05	1.15	1.39	1.40	1.14	1.11
Food products, beverages, and tobacco	0.90	0.88	1.23	1.22	0.82	0.88	1.01	0.97
Textile industry	1.06	1.06	1.16	1.11	1.18	0.96	0.83	0.88
Wood, paper, timber, and furniture	1.06	0.96	1.20	1.17	1.44	1.24	1.25	1.22
Chemical products	1.12	1.07	1.16	1.20	1.29	1.33	1.21	1.23
Manufacture of metal products	1.08	1.12	1.11	1.16	0.89	1.11	1.11	1.15
Manufacture of non-metallic mineral products	1.08	1.02	1.08	1.16	1.30	1.32	1.04	1.14
Machinery and equipment	1.08	1.02	1.10	1.08	1.18	1.01	0.55	0.62
Manufacture of electrical machinery and equipment	1.10	1.11	1.15	1.10	1.26	1.02	0.62	0.49
Manufacture of transport equipment	1.06	1.07	1.00	0.96	0.91	1.06	0.57	0.53
Other manufacturing equipment	0.77	0.78	1.11	1.07	1.34	1.27	0.78	0.75
Electricity, heat, and water supply	1.09	0.90	1.04	1.09	1.49	1.49	1.27	1.19
Construction	0.86	1.14	1.11	1.11	1.02	0.75	0.56	0.60
Wholesale and retail trade	1.12	0.73	0.97	0.98	0.70	1.04	1.09	1.10
Transportation	0.69	0.88	1.01	1.08	1.09	1.34	1.17	1.11
Information and communications	0.94	0.94	1.01	0.96	1.00	1.18	0.89	0.87
Finance and insurance	0.95	0.85	0.95	0.92	1.08	1.33	1.20	1.13
Real estate	0.75	0.99	0.88	0.88	1.12	1.31	0.72	0.72
Scientific research	1.00	0.96	0.97	0.96	1.13	1.16	1.06	0.84
Public administration	0.82	0.90	0.96	0.96	0.68	0.75	0.78	0.70
Education	0.63	0.69	0.91	0.90	0.68	0.67	0.59	0.55
Health care and social work	0.96	0.95	0.99	0.98	0.74	0.79	0.60	0.55
Other service and activities	0.89	0.93	1.09	1.05	1.31	1.11	0.68	0.66

Source: Authors' calculation based on integrated two-region I-O table of Yunnan-Myanmar

services in total output of Myanmar during 2010–2019.

During 2012–2017, the results of BLs confirm the role of manufacturing in driving Myanmar's economy. However, their contribution remains the same between 2012 and 2017. Moreover, despite the decline in agriculture's output share, as a historically primary economic driver of the country, this sector continues to play a dominant role in output growth on the demand side. Thus, the agriculture sector keeps its role in Myanmar's economic growth. In addition, transportation and other service sectors register large BLs, which indicate their importance to regional economic growth in both 2012 and 2017.

4.2.2 Forward linkages

Forward linkages (FLs) identify the sectors that contribute most to the output growth of other sectors on the supply side. In other words, a higher FL indicates that a one-unit increase in the output of a sector provides more intermediate input for other sectors, thereby fostering their output. The estimation of FLs is explained in detail in Section 3.3.

Table 2 [columns (6) to (9)] presents the FLs of Yunnan and Myanmar for 2012 and 2017. Yunnan's electricity, heat, and water sectors record the largest FLs in both years, which highlights their vital role in driving regional output growth. Moreover, Yunnan's mining, wood and paper products, chemical products, manufacture of non-metallic mineral products, machinery and equipment, manufacture of electrical machinery and equipment, and other manufacturing equipment sectors also have magnitudes of FLs greater than 1, which show the contribution of these sectors to Yunnan's economy.

Similarly, some service sectors including transportation, information and communications, finance and insurance, real estate, and scientific and research sectors, hold large FLs which express the contributions of these service sectors to Yunnan's economy on the supply side in both years 2012 and 2017. Overall, the FL analysis suggests that increasing production in these key sectors can generate spillover effects throughout the economy. Accordingly, industrial policies that strengthen the capacity and productivity of these sectors would be instrumental in enhancing regional economic growth.

In Myanmar, the agriculture sector is prominent in terms of FLs, which reflects its strong supply-side role in supporting other sectors' production. Alongside the agriculture sector, several manufacturing sectors: mining, wood and paper products, chemical products, manufacture of metal products, manufacture of non-metallic mineral products, demonstrate relatively larger contributions to output growth. In particular, the agriculture and mining sectors play a central role in Myanmar's economy, both as key suppliers to domestic industries and as major export contributors. Strengthening output growth in these sectors would therefore not only stimulate other sectors through supply-side linkages but also enhance export performance of Myanmar. In addition, the FL results highlight the importance of some service sectors including wholesale and retail trade, transportation, and finance and insurance, in supporting the output growth of other industries. These findings suggest that policies aimed at boosting the productivity and efficiency of both key manufacturing and service sectors could generate broad-based economic benefits for Myanmar.

Overall, the BL and FL analyses reveal that Yunnan's economy depends primarily on manufacturing sectors, while Myanmar's growth relies on both agriculture and some manufacturing sectors. In Yunnan, although agriculture makes a less contribution to output growth in terms of BLs and FLs, it accounts for roughly 40% of total exports, the largest export share among all sectors. Except for chemical products, most manufacturing sectors of Yunnan exhibit relatively low export capacity. This fact suggests that Yunnan should continue to develop its agriculture sector while enhancing the competitiveness of its manufacturing and service sectors. In Myanmar, both BL and FL results highlight the key contributions of agriculture, mining, and some manufacturing industries: particularly textiles, wood and paper products, and chemical products. From an export perspective, Myanmar remains heavily reliance on agriculture, mining, and textiles. These findings underscore the

vital role of these sectors in driving the country's economic growth.

Consistent with this result, Thwin et al. (2010) indicate the significant contribution of agriculture sectors to the GDP and export growth of Myanmar in year 2000–2001. Additionally, Thein and Inaba (2023) highlight that although Myanmar's economic structure has slightly changed during the economic reformation period 2010–2015, the economy still depends on agriculture, with its GDP share around 20.1%, significantly higher than those of Thailand (8.9%), Indonesia (13.3%), and Vietnam (15.5%) in 2019. Comparatively, both Yunnan and Myanmar demonstrate the role of manufacturing development in supporting regional economies during 2012 and 2017. However, in terms of exports, both economies remain predominantly dependent on agriculture. All manufacturing sectors in both regions play the same role in economic development and do not show a significant different economic contribution by sector.

5. Conclusion

This paper compiles integrated interregional input-output (I-O) tables for Yunnan and Myanmar for the years 2012 and 2017 to enable a more comprehensive assessment of the economic contributions of cross-border trade. The detailed procedures for data estimation and table integration are explained in Section 3.1. Prior to examining border trade linkages, the analysis investigates structural changes in both economies by evaluating value-added creation and sectoral contributions to output growth.

The value-added analysis reveals different production structures between Yunnan and Myanmar. Yunnan demonstrates strong progress in value-added creation, particularly in manufacturing sectors as well as in utilities. Despite declining value-added ratios in construction, transport and storage, and real estate, the overall expansion of manufacturing and service sectors indicates continued industrial upgrading in Yunnan during 2012–2017. In contrast, Myanmar exhibits comparatively weak value-added performance especially in agriculture sector and maintains an unchanged economic structure over the same period. This divergence underscores the need for targeted industrial policies in Myanmar to enhance domestic value-added creation and deepen productive integration with Yunnan.

The backward linkage analysis shows that manufacturing sectors in both regions play a central role in stimulating regional economic activity, while service sectors exhibit different economic impacts in 2012 and 2017. In Yunnan, agriculture and mining contribute relatively little to output growth, whereas Myanmar's growth is more strongly supported by primary industries combined with some manufacturing sectors. As a result, Yunnan's economic expansion is primarily manufacturing-driven, while Myanmar relies on a mixed growth pattern combining agriculture, mining, and limited manufacturing activities.

Forward linkage analysis further highlights the role of manufacturing in Yunnan's economic expansion, along with contributions from mining and some service sectors. On Myanmar's side, agriculture and mining, together with several manufacturing industries consistently support output growth. By contrast, only a limited number of service sectors demonstrates notable contributions to Myanmar's economy. Overall, the sectoral contribution patterns in both regions do not significantly change between 2012 and 2017 and suggest limited structural transformation during this period.

The above findings bring several important policy implications to both economies. First, Myanmar should prioritize industrial policies that promote value-added upgrading, particularly in manufacturing sectors with strong backward and forward linkages. Enhancing access to finance, improving industrial infrastructure, and fostering technology adoption, especially for small and medium-sized enterprises, would help strengthen domestic production capacity. Second, cross-border cooperation between Yunnan and Myanmar should move beyond trade in primary goods toward deeper production integration, including joint industrial zones, supply-chain linkages, and energy and logistics connectivity. Third, service-sector development in Myanmar, particularly in transportation, logistics, finance, and trade-related services, is essential to support manufacturing growth and facilitate cross-border economic integration. For Yunnan, policies that sustain manufacturing competitiveness while expanding high-value services can further reinforce its role as a regional production and trade hub. To achieve more balanced and sustainable regional development, strengthening value-added creation, promoting industrial diversification, and enhancing cross-border production linkages are critical for both economies.

This paper represents a preliminary stage in analyzing the economic impacts of cross-border trade relations using I-O analysis. While the integrated Yunnan-Myanmar I-O tables provide valuable insights into sectoral structures and industrial linkages, a more comprehensive assessment of regional economic integration requires further investigation. Especially, future research should examine trade integration between the two economies, including bilateral trade dependence, value-chain participation, and mutual spillover effects at the industrial level. Such analyses would enable more detailed and actionable policy recommendations related to border trade facilitation, industrial coordination, and taxation policies. These insights are important not only for policymakers in both governments, but also for manufacturers and traders operating on both sides of the border. In this regard, as a second stage, this study will extend the analysis to evaluate mutual economic contributions between Yunnan and Myanmar at industrial level.

Notes

1) Border trade data are obtained from the website of the Ministry of Commerce of Myanmar. The available statistics are reported on a quarterly and semi-annual basis and do not constitute

an annual time series. Accordingly, annual border trade volumes are estimated by aggregating the published quarterly and semi-annual data.

2) (A^{YY})=Yunnan's intermediate input, (A^{MY})=Intermediate input which imports from Myanmar to Yunnan, (A^{MM})=Myanmar's intermediate input, (A^{YM})=Intermediate input which imports from Yunnan to Myanmar, (X_j)=Output of each region by industry, and (X_i)=Demand of each region by industry.

3) The RAS method is commonly employed to balance the rows and columns of input-output tables. It adjusts the entries in the matrix by reallocating values across rows and columns in accordance with the original coefficient structure (Gretton and Cotterell, 1979).

4) Asian Development Bank, the Key Indicator Database https://kidb.adb.org/

References

Aseff, J. G., Espejo, J. and Morales Anaya, J. A. (1995). The importance of border trade: The case of Bolivia. Working Paper No. 01/95. Universidad Católica Boliviana. Instituto de Investigaciones Socio-Económicas (IISEC). La Paz.

Dan S. L. (2022). Conflict and Development in the Myanmar-China Border Region. Cross-Border Conflict: Evidence, Policy and Trends (XCEPT). Online.

Fredrich, K., Horst, W. and Su, F. (2004). Navigating the border: An analysis of the China-Myanmar timber trade, China and forest trade in the Asia-Pacific region: Implications for forest and livelihoods. Forest Trends. ISBN 1-932928-02-2.

Ge, Y., He, Y., Jiang, Y., and Yin, X. (2014). Border trade and regional integration. Review of Development Economics. 18(2): 300-312.

Gretton, P. and Cotterell, P. (1979). The RAS Method for Compiling Input-Output Tables. Theory and Methods. 58.

Hongkong Trade Development Council (2016). Belt and Road: Trade and Border Cooperation between Yunnan and Myanmar, HKTDC Research.

Kubo, K. (2016). Myanmar's cross-border trade with China: Beyond informal trade. IDE Discussion Paper No. 625. Institute of Developing Economies.

Kudo, T. and Mieno, F. (2007). Trade, Foreign Investment and Myanmar's Economic Development during the Transition to an Open Economy. IDE Discussion Paper No. 116. Institute of Developing Economies.

Jarreau, J. and Poncet, S. (2012). Export sophistication and economic growth: Evidence from China. Journal of Development Economics. 97(2): 281-292.

Leal-Ordonez J. C. (2017). Equivalence between input-output and value-added economies. Working Papers 2017-13. Banco de Mexico.

Leontief, W. W. (1936). Quantitative input and output relations in the economic system of the United States. Review of Economics and Statistics. 18: 105-125.

Liu, W. and Jin L. (2016). The problems existing in the China-Myanmar agricultural trade and some considerations. Indian Ocean Economic and Political Review. 2016(6).

Long, H. (2020). Research on the characteristics of industrial structure evolution in Yunnan Province, 2020 4th International Conference on Economics, Management Engineering and Education Technology (ICEMEET 2020), School of Business, Yuxi Normal University, Yuxi, 653100, Yunnan, China. DOI: 10.25236/icemeet.2020.110.

Lyu, H. H. (2024). Socio economic effects of border trade and sustainable development pathways. Journal of Trends in Financial and Economics. 1(2): 1-6.

Mao, P., Zhang, Y., Feng, L. and Kam P. S. (2021). China-Myanmar cross-border agricultural economic cooperation-Views from Myanmar. Advances in Economics, Business and Management Research. vol. 185. Proceedings of the 1st International Symposium on Innovative Management and Economics (ISIME 2021).

Miller, R. E. and Blair, P. D. (2009). Input-Output Analysis Foundations and Extensions, 2nd edn. Cambridge University. London

Ministry of Internal Affairs and Communications, Japan (2021). 2015 Input-Output Tables for Japan.

Poncet, S. (2006). Economic integration of Yunnan with the greater Mekong subregion. Asian Economic Journal. 20(3): 303-317.

Ratti R. and Reichman S. (1993). Europe on the move: Recent development in European communications and transport activity research. Chapter 6. Spatial effects of borders: An overview of traditional and new approaches to border region development. Avebury Ashgate Publishing Ltd.

Taguchi, H. and Oizumi, K. (2014). Trade integration of Yunnan and Guangxi with the greater Mekong sub-region revisited. China Economic Policy Review 3(1): 1-14.

Thein, E. E. and Inaba, K. (2023). Sources of Myanmar's economic growth during 2010-2015: input-output analysis. Journal of Economic Structures. 12(15).

Thwin, N. K. S., Yoshida, T. and Maeda, K. (2010). Industrial structure in Myanmar using a new estimated input-output table (2000-2001), Kyushu University Institutional Repositor. 55(2): 387-396.

Wang, J. (2018). SWOT analysis of China Myanmar industrial cooperation under the background of "One Belt And One Road". China Economic & Trade Herald. 000(020): 17-18.

Wen, G. Q., Wei, M., Lan, Z. B., Wen, Y. H., Deng, H. L. and Qin,. Z. L. (2019). Analysis of the current situation of agricultural science and technology development in Myanmar and international cooperation in agricultural science and technology between China and Myanmar. Journal of Southern Agriculture. 6: 1392-1398.

Xu, Y. and Zhang, L. (2016). Research on the border trade between Yunnan and Myanmar. The First International Symposium on Business Cooperation and Development in South-East and South Asia under B&R Initiative (ISBCD-16), Atlantis Press.

Zhu, Z. (2011). Yunnan's industrial development policy and intermediate goods trade with MRBCs, in intermediate goods Trade in Asia: Economic Deepening through FTAs/EPAs. edited by Mitsuhiro Kagami. BRC Research Report No. 5. Bangkok Research Center. IDE-JETRO, Bangkok.

Sources of Data

Asian Development Bank. Key Indicator Database.

Carbon Emission Accounts and Datasets for emerging economies (CEADs).

Ministry of Commerce, Myanmar, Border Trade Data.

National Statistics Bureau (2021). CEADS China Provincial-level MRIO Table for 2012.

Organization for Economic Co-operation and Development (OECD) Input-Output data.

World Development Indicators (WDI) dataset.

World Integrated Trade Solution (WITS) dataset.

Appendices

Appendix 1 Industrial classifications of Yunnan and Myanmar

Name of industries				
Yunnan (China MRIO)		Myanmar (OECD)		Two-region I-O table
(1)		(2)		(3)
Agriculture, Forestry, Animal Husbandry and Fishery	1	Agriculture, hunting, forestry	1	1. Agriculture, forestry, animal husbandry and fishery
Mining and washing of coal	2	Fishing and aquaculture	1	2. Mining and washing of coal
Extraction of petroleum and natural gas	2	Mining and quarrying, energy producing products	2	3. Food products, beverages, and tobacco
Mining and processing of metal ores	2	Mining and quarrying, non-energy producing products	2	4. Textile industry
Mining and processing of nonmetal and other ores	2	Mining support service activities	2	5. Wood, paper, timber, and furniture
Food and tobacco processing	3	Food products, beverages and tobacco	3	6. Chemical products
Textile industry	4	Textiles, textile products, leather and footwear	4	7. Manufacture of metal products
Manufacture of leather, fur, feather and related products	4	Wood and products of wood and cork	5	8. Manufacture of non-metallic mineral products
Processing timber and furniture	5	Paper products and printing	5	9. Machinery and equipment
Manufacture of paper, printing and articles for culture, education and sport activity	5	Coke and refined petroleum products	2	10. Manufacture of electrical machinery and equipment
Processing petroleum, coking and processing of nuclear fuel	2	Chemical and chemical products	6	11. Manufacture of transport equipment
Manufacture of chemical products	6	Pharmaceuticals, medicinal chemical and botanical products	6	12. Other manufacturing equipment
Manufacture of non-metallic mineral products	8	Rubber and plastics products	6	13. Electricity, heat, and water supply
Smelting and processing of metals	7	Other non-metallic mineral products	8	14. Construction
Manufacture of metal products	7	Basic metals	7	15. Wholesale and retail trade
Manufacture of general-purpose machinery	9	Fabricated metal products	7	16. Transportation
Manufacture of special purpose machinery	9	Computer, electronic and optical equipment	10	17. Information and communications
Manufacture of transport equipment	11	Electrical equipment	10	18. Finance and insurance
Manufacture of electrical machinery and equipment	10	Machinery and equipment, nec	9	19. Real estate
Manufacture of communication equipment, computers and other electronic equipment	10	Motor vehicles, trailers and semi-trailers	9	20. Scientific research
Manufacture of measuring instruments	12	Other transport equipment	11	21. Public administration

Note: Columns (1) and (2) present the original industrial classifications of Yunnan (Chinese MRIO tables) and Myanmar (OECD I-O tables). The number next to each industry indicates its corresponding industry classification in the integrated two-region I-O tables presented in Column (3).

Appendix 2 Industrial classifications of Yunnan and Myanmar (continued)

Name of industries				
Yunnan (China MRIO)		Myanmar (OECD)		Two-region I-O table
(1)		(2)		(3)
Other manufacturing	12	Manufacturing nec; repair and installation of machinery and equipment	12	22. Education
Comprehensive use of waste resources	12	Electricity, gas, steam and air conditioning supply	13	23. Health care and social work
Repair of metal products, machinery and equipment	13	Water supply; sewage, waste management and remediation activities	13	24. Other service and activities
Production and distribution of electric power and heat power	13	Construction	14	
Production and distribution of gas	13	Wholesale and retail trade; repair of motor vehicles	15	
Production and distribution of tap water	14	Land transport and transport via pipelines	16	
Construction	15	Water transport	16	
Wholesale and retail trades	16	Air transport	16	
Transport, storage, and postal services	17	Warehousing and support activities for transportation	16	
Accommodation and catering	24	Postal and courier activities	17	
Information transfer, software and information technology services	17	Accommodation and food service activities	24	
Finance	18	Publishing, audiovisual and broadcasting activities	17	
Real estate	19	Telecommunications	17	
Leasing and commercial services	20	IT and other information services	17	
Scientific research and polytechnic services	20	Financial and insurance activities	18	
Administration of water, environment, and public facilities	21	Real estate activities	19	
Resident, repair and other services	24	Professional, scientific and technical activities	20	
Education	22	Administrative and support services	21	
Health care and social work	23	Public administration and defense; compulsory social security	21	
Culture, sports, and entertainment	24	Education	22	
Public administration, social insurance, and social organizations	21	Human health and social work activities	23	
		Arts, entertainment and recreation	24	
		Other service activities	24	
		Activities of households	24	

Note: Columns (1) and (2) present the original industrial classifications of Yunnan (Chinese MRIO tables) and Myanmar (OECD I-O tables). The number next to each industry indicates its corresponding industry classification in the integrated two-region I-O tables presented in Column (3).