Benchmarking the National Logistics Costs: a Case of 49 Countries

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***Abstract*— Ratio of national logistics costs per gross domestic product (NLC/GDP) is considered as an important indicator for evaluating a nation's logistics efficiency. This study presents such ratios of 49 countries, which were calculated based on the same method and data sources. Such similar method and data sources enable a comparative analysis in this study. Robert Delaney's method, a method used to calculate the US's logistics costs per GDP, was employed to derive the ratio for each of 49 countries. Empirical data used the secondary data gathered from National Account of Asian Development Bank (ADB), an organization reports logistics costs-related data of the 49 countries under study. The main components of logistic costs, including (1) transportation costs, (2) warehousing costs, (3) inventory carrying costs, and (4) logistics administrative costs, were calculated to derive a ratio of NLC/GDP for each country. Results of a comparative analysis are reported based on two classifications, (1) a classification using the level of country development (developing versus developed countries) and (2) a classification based on income levels (low income, lower-middle income, upper-middle income, and high income countries). Results further revealed a NLC of each country that can be obviously comparable. As these ratios were calculated using a similar method and obtained data from similar sources, such a comparison is new to macro logistics literature. Policymakers may use the results in this study to develop a logistics development policy for their countries for use in improving and enhancing their national logistics capability. In addition, academia may employ the approach used in this study with a National Account's data to derive a NLC/GDP.**

Keywords—national logistics cost, gross domestic product, National Account data

I. INTRODUCTION

The current economic environment is more competitive, and governments acknowledge that globalization has increased its competitiveness. Businesses strive to create competitiveness to maintain profits and market shares. These phenomena urge nations and businesses to focus on supply chains and logistics. One main goal to enhance the efficiency of supply chains and logistics is to lower logistics costs.

In macro logistics literature, measurement of logistics costs has been paid a lot of attentions [1, 2]. Measurable logistics costs aids in formulating macro and strategic policy used to manage operation, investment, and resources related to logistics infrastructure projects [1]. Typically, monitoring national logistics performance uses lagging indicators. National-level logistics cost (NLC) calculation is thus more complex than firm-level logistics cost calculation. NLC is often reported by countries in terms of a proportion between their NLCs and GDPs (NLC/GDP) but different counties employed assumptions used to define their NLC/GDP differently [3]. In addition, different counties also use different data sources and calculation methods and it is challenging when comparing the NLC/GDP ratios derived from different countries [2].

The aim of this study is to provide an approach how to calculate NLC using secondary data sources obtained from National Account of Asian Development Bank (ADB). As the NLCs in this study were calculated based on similar data sources and method, a comparative analysis could be undertaken. The study, thus, contributes by providing an approach on how to calculate NLC/GDP based on similar secondary data sources that allow for a comparative analysis.

II. LITERATURE REVIEW

Given that there is no standardized calculation methodology for NLCs, the main challenge is about an identification of logistics cost components and a selection of suitable method used to calculate NLCs [3-5].

A. Components of Logistics Costs

The macro logistics literature suggests numerous components of logistics costs. For example, researchers have identified 40 cost components and concluded that there were five most common used: transportation cost, warehousing cost, inventory-carrying cost, logistics administration cost, and packaging cost [6]. However, a study has extensively reviewed the macro logistics literature and concluded four commonly used logistics costs components: transportation costs, warehousing costs, inventory carrying costs, and logistics administration costs [2].

B. Calculation Methods

There were many researchers proposing numerous calculation methods [2]. Heskett and colleague was the first to propose a calculation method based on macroeconomic theory (*hereafter* Heskett's method) [7]. Afterwards, CASS Logistics System Inc. followed Heskett's method and introduced the CASS method [8]. The CASS method later served as foundation for the latter four proposed approaches: (1) calculating NLC/GDP from macro-level data [9-11], (2) calculating firm-level logistics costs per sales [12, 13], (3) calculating firm-level logistics costs per sales and impute to NLC/GDP [14, 15], and (4) calculating NLC/GDP from macro- and micro-levels data [2]. Nevertheless, all of these four approaches were developed based on Heskett's method.

It can be concluded that Heskett's calculation method, or so-called the CASS method, has been a commonly used

calculation method in many countries such as the United States [4] and Thailand [2]. The CASS method can be adapted for both the national-level and the firm-level data sources. The method is considered as very flexible to be used in any context [12, 13]. Regarding logistics cost components, the CASS method outlines the basic concept for monitoring logistics activities by using the four cost components: transportation-related cost, inventory holding cost, warehouse-related cost, and administration cost [8]. The current study will use the CASS method to calculate NLCs using existing macro-level data obtained from the ADB's National Accounts data.

III. Methodology

A. Components of Logistics Cost in this Study

The CASS method requires logistics cost components consists of the following. Transportation cost (T) includes only freight transportation, not passenger transportation, and is defined as expenses incurred when (1) a seller pays a fee to a service provider or (2) a seller delivers a product to an end-customer by using their own transportation units. Warehousing cost (W) includes in-house warehousing costs (i.e., an expense paid by sellers) and outsourced warehousing costs (i.e., revenues of service providers). Inventory carrying cost (I) is the opportunity cost of money spent or monetary burden tied up in inventories. Logistics administration cost (A) consists of customer service cost, ordering cost, and purchasing cost. The CASS method suggests that one can infer that this cost will be equal to 10% of the sum of Transportation cost, Warehousing cost, and Inventory carrying cost.

B. Data used in calculation

Data used were obtained solely from the 53rd Annual Edition of 'Key Indicators for Asia and the Pacific 2022 report', which was prepared by the Asian Development Bank [16]. ADB provides the GDP data of 21 industrial sectors and the GDP at current market prices of 49 countries. The transportation and warehousing costs can be retrieved from the GDP value of the 'Transportation and Storage' sector in the 'National Accounts' table. The inventory carrying cost is the value of inventory of specific sectors, which were available only for six sectors including: 'Mining and Quarrying', 'Manufacturing', 'Electricity, Gas, Steam, and Air-conditioning Supply', 'Water Supply, Sewerage, Waste Management, and Remediation Activities', 'Construction', and 'Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles'. In the agricultural sector, one assumption in this study was that we assumed that there should be no inventory, as all commodities should be produced and immediately distributed. Similar to the service sector, there was no inventory cost, as services could not be stocked. The calculation formula is as follow:

$$NLC/GDP = (T\&W + I + A) \ / \ GDP \quad (1)$$

C. Comparative Analysis

A comparative analysis was carried out using two classification systems: the ADB's classification based on the level of country development [16] and the World Bank's classification based on income levels [17]. To determined an income level for each country, a gross national income (GNI) per capita data in U.S. dollar was used to convert a country' currency. The World Bank Atlas method, taken into account of exchange rate fluctuations [17], was employed in such a conversion.

IV. Findings

A. The ADB's Classification

Results from the calculations of NLC/GDP of 49 countries are presented in Table 1, and are classified based on the ADB's and the World Bank's classifications. The ADB's classification could be used to group countries into two types: the developing ADB member countries and the developed ADB member countries. The developed countries include Australia, Japan, and New Zealand. The term "developing Asia" refers to 46 developing ADB member countries, and could be further classified as five sub-regions of Asia and Pacific. These sub-regions include 'Central and West Asia', 'East Asia', 'South Asia', 'Southeast Asia', and 'the Pacific' [16].

TABLE I. Estimated NLC per GDP of 49 Countries (%)

Country	ADB		WB	2010	2015	2020	2021
Afghanistan	DG	CWA	L	18.80	25.11	9.32	NA.
Armenia	DG	CWA	UM	15.05	11.01	8.34	8.86
Australia	DD	DADB	H	8.47	7.80	7.25	6.98
Azerbaijan	DG	CWA	UM	22.75	18.79	19.83	20.38
Bangladesh	DG	SA	LM	17.01	15.22	12.80	12.74
Bhutan	DG	SA	LM	19.08	19.31	16.98	NA.
Brunei Darussalam	DG	SEA	H	5.87	5.89	5.66	5.62
Cambodia	DG	SEA	LM	16.73	15.48	14.09	15.28
China, People's Republic of	DG	EA	UM	8.55	7.28	6.65	6.86
Cook Islands	DG	P	UM	8.28	9.99	9.09	10.58
Fiji	DG	P	UM	9.21	11.56	5.25	NA.
Georgia	DG	CWA	UM	14.16	11.58	11.80	12.20
Hong Kong, China	DG	EA	H	10.43	8.75	6.26	NA.
India	DG	SA	LM	9.14	9.89	8.11	9.18
Indonesia	DG	SEA	LM	12.49	13.40	10.65	10.61
Japan	DD	DADB	H	6.34	6.28	5.24	NA.
Kazakhstan	DG	CWA	UM	18.36	18.05	16.43	16.64
Kiribati	DG	P	LM	10.87	9.63	10.73	NA.
Korea, Republic of	DG	EA	H	6.98	5.98	4.74	5.20
Kyrgyz Republic	DG	CWA	LM	18.13	17.75	13.40	13.97
Lao People's Democratic Republic	DG	SEA	LM	17.82	12.73	14.10	14.32
Malaysia	DG	SEA	UM	6.87	6.67	5.79	5.62
Maldives	DG	SA	UM	12.72	13.86	8.97	NA.
Marshall Islands	DG	P	UM	10.27	12.69	11.15	10.40
Micronesia, Federated States of	DG	P	LM	10.39	10.04	NA.	NA.
Mongolia	DG	EA	LM	17.70	15.08	12.74	12.10
Myanmar	DG	SEA	LM	24.32	24.15	NA.	NA.
Nauru	DG	P	H	10.56	19.31	NA.	NA.

COUNTRY	ADB		WB	2010	2015	2020	2021
Nepal	DG	SA	LM	13.55	10.27	9.31	5.97
New Zealand	DD	DADB	H	7.42	7.97	NA.	NA.
Niue	DG	P	UM	5.52	6.51	NA.	NA.
Pakistan	DG	CWA	LM	20.38	17.53	14.20	9.83
Palau	DG	P	UM	8.96	9.51	5.27	NA.
Papua New Guinea	DG	P	LM	8.43	7.10	6.76	6.66
Philippines	DG	SEA	LM	7.86	7.10	7.04	7.09
Samoa	DG	P	LM	8.46	8.56	6.03	5.76
Singapore	DG	SEA	H	11.81	10.73	9.05	9.37
Solomon Islands	DG	P	LM	10.11	8.38	8.37	NA.
Sri Lanka	DG	SA	LM	16.82	16.37	17.14	16.43
Taipei, China	DG	EA	UM	7.96	8.04	7.82	9.39
Tajikistan	DG	CWA	LM	26.95	24.69	18.13	19.46
Thailand	DG	SEA	UM	8.73	8.85	7.08	6.88
Timor-Leste	DG	SEA	LM	24.74	22.87	18.49	NA.
Tonga	DG	P	UM	5.98	7.88	6.80	NA.
Turkmenistan	DG	CWA	UM	10.51	13.22	NA.	NA.
Tuvalu	DG	P	UM	5.29	4.26	4.49	4.25
Uzbekistan	DG	CWA	LM	15.37	13.45	15.77	16.05
Vanuatu	DG	P	LM	8.08	4.41	NA.	NA.
Viet Nam	DG	SEA	LM	10.23	7.11	7.23	9.63

DG denotes developing country; DD denotes developed country;
P denotes the Pacific; SEA denotes Southeast Asia; SA denotes South Asia;
CWA denotes Central and West Asia; EA denotes East Asia;
DADB denotes developed ADB member country;
H denotes high income country; UM denotes upper-middle income country;
LM denotes lower-middle income country; L denotes low-income country.

Results regarding the ADB's classification show that the developed countries had NLCs ranging from 6.3% to 7.4% in 2019 and from 4.3% to 20.4% in 2021. A classification according to regions for the data of 2021 reveals insights as the followings.

- Central and West Asia: Armenia had the lowest NLC (8.86%) while Azerbaijan had the highest NLC (20.38%).
- East Asia: Republic of Korea had the lowest NLC (5.20%) while Mongolia had the highest NLC (12.10%).
- South Asia: Nepal had the lowest NLC (5.97%) while Sri Lanka had the highest NLC (16.43%).
- South East Asia: Brunei Darussalam and Malaysia had the lowest NLC (5.62%, 5.62%) while Cambodia had the highest NLC (15.28%).
- The Pacific: Tuvalu had the lowest NLC (4.25%) while Cook Islands had the highest NLC (10.58%).

B. The World Bank's Classification

The World Bank's classification suggested four groups of countries based on income levels: 'Low income', 'Lower-middle income', 'Upper-middle income', and 'High income'. Results reveal insights as the followings.

- The group of high-income countries: Republic of Korea had the lowest NLC (5.20%) while Singapore had the highest NLC (9.37%).
- The group of upper-middle income countries: Tuvalu had the lowest NLC (4.25%) while Azerbaijan had the highest NLC (20.38%).
- The group of lower-middle income countries: Samoa had the lowest NLC (5.76%) while Tajikistan had the highest NLC (19.46%).
- The group of low-income country only consists of Afghanistan which had the NLC of 9.32%.

V. DISCUSSIONS

NLCs are considered as a proper indicator indicating a country's past and future performances related to logistics efficiency [1]. It was observed that many developed and developing countries are striving to determine their NLCs [2]. The reason behind this is that most countries are looking forwards to improve their logistics efficiency and find ways to benchmark their countries against the others. A common way to benchmark logistics efficiency of nations is the World Bank's Logistics Performance Index or LPI [1]. However, LPIs provides a comparison of countries' trade logistics connectivity [1]. Many researchers, thus, suggested comparing NLC/GDP is a better way to reflect logistics efficiency from a domestic perspective [2, 4].

The findings in this study provide ratios of NLC/GDP classified based on either the level of country development or the country's income levels. This allows for a comparison between countries and for benchmarking one country against the others within a classified group. For example, Republic of Korea seemed to have the best logistics efficiency among many countries in East Asia and the group of high-income countries. This suggests that the country may serve as a best practice in logistics efficiency. Singapore, where its NLC was high for the group of high-income countries, may use Republic of Korea as a best practice in striving to improve the country to have a better level of logistics efficiency. A benchmarking can be undertaken not only within a group but also across the groups (i.e., regions or the income levels).

VI. CONCLUSION

This study demonstrated a calculation of NLC/GDP using an existing national account data. The ratios of NLC/GDP of 49 countries were derived and allowed for a comparative analysis. Such an analysis could be undertaken, as the calculation method and data sources used were similar.

This study contributes to the macro logistics literature by demonstrating the calculation of NLC/GDP using an existing national account data. The use of national account data and a comparative analysis of the derived ratios are new to the literature. Results further showed that a benchmarking can be undertaken. For practical uses, the calculation method and the use of national account data can serve as a starting point for researchers and policymakers who desire to calculate their country's NLC. An advantage of using the national account data is that researchers can save research costs and times to collect data, compared with ones gathering empirical data from actual logistics operations.

This study has some limitations. The transportation costs used in the calculation included both passenger and freight transportations. Ideally, transportation costs should exclude the passenger transportation, as it does not involve with logistics efficiency. The warehousing costs included only outsourcing activities due to a limitation of using national account data. Warehousing costs should also include the expenses related to owning warehouses. Lastly, the calculation adopted 10% constant factor as a proxy to impute the logistics administration costs. Different counties have different capabilities of logistics management and economic background, which can lead to different degrees of logistics administration costs.

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