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ORIGINAL ARTICLE

# A holistic analysis of national e-commerce and logistics development

**Tengfei Wang[1] · Jong Woo Kang[2] · Vincent F. Valentine[3]**

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## Abstract

The aim of this work is to support policymakers and civil society to better understand various international indicators related to e-commerce and logistics performance, such as the United Nations Conference on Trade and Development (UNCTAD)'s business-to-consumer index (B2C), the World Bank's logistics performance index (LPI) and the World Bank's trading across borders (TAB) indicators. A holistic approach is adopted herein to analyse these indicators, using a data envelopment analysis (DEA) methodology. In examining countries worldwide with a focus on the Asia-Pacific region as an example, findings from this analysis support the widely held belief that Singapore is on the frontier of e-commerce and logistics. More interestingly, the results show that some countries, such as Mongolia and Georgia, which do not rank high according to B2C, LPI or TAB, are also on the frontier. The interpretation of such results is that, given the national resources available, these countries, in theory, produce the best possible outputs (i.e. national e-commerce and logistics performance) with those resources. However, this also indicates that, given the available resources, it would be difficult for these countries to further improve the performance of logistics and e-commerce without long-term economic and social development. For those countries that score far below the frontier, this is indeed a blessing in disguise. It means these countries have the potential to further enhance their performance without the need of additional resources. This paper proposes that a holistic DEA approach should be used regularly to track how the position of the frontiers move over time and to assess the performance of countries in relation to the evolving frontiers.

**Keywords** e-commerce · Logistics performance index · Trading across borders · Business-to-consumer index · Data envelopment analysis · Efficiency

✉ Tengfei Wang
wangt@un.org

[1] United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand

[2] Asian Development Bank, Manila, Philippines

[3] United Nations Conference on Trade and Development, Geneva, Switzerland

## 1 Introduction

Various international indicators related to e-commerce, such as UNCTAD's business-to-consumer index, the logistics performance index and the World Bank's Doing Business (trading across borders), are useful in gauging the development of e-commerce and logistics in different countries worldwide. Despite the usefulness of these indicators, the intrinsic resources of a nation which underpin these indicators, such as wealth and human capacity, were not taken into consideration when they were developed. Furthermore, although these indicators measure interrelated aspects on e-commerce and logistics, there is a lack of holistic analysis. Consequently, questions can be asked as to whether these indicators can collectively pass coherent information to policymakers and the general public to spur change.

Therefore, this paper aims to support policymakers and civil society to better understand various international indicators related to e-commerce and logistics performance, such as the UNCTAD's B2C, the World Bank's LPI and the World Bank's TAB.

The key questions to explore in this paper include: (1) given the resources available to each country, which ones, worldwide, are on the forefront of production efficiency in terms of e-commerce and logistics development? And, (2) benchmarked by such a frontier, which countries have the potential for further improvement and to what extent?

To answer these questions, it is essential to understand the connection between these indicators and the underlining resources for producing such indicators, which is an important element in production theory. Production can be simply defined as a process by which inputs are combined, transformed and turned into outputs. On the one hand, the inputs can normally be generalized as natural resources such as land, human resources (labour) and man-made aids to further production such as tools and machinery (capital). Outputs, on the other, can be categorized into tangible products, including goods, and intangible products such as services. Each production unit is called a decision making unit (DMU) and, in this paper, will be taken as equivalent to a country.

Production theory examines how efficiently resources are used for production. In this connection, Pareto efficiency or Pareto optimality refers to a state of allocation of resources from which it is impossible to reallocate so as to make any one individual or preference criterion better off without making at least one individual or preference criterion worse off. The Pareto frontier is the set of all Pareto-efficient allocations.

To illustrate, Fig. 1 shows the production of four DMUs and the production frontier. In this case, it is assumed that every production unit uses the same resources to produce two outputs *Y1* and *Y2*. The production units C and D are on the production frontier and are economically efficient. In other words, given the resources, it is not possible to make one output better off without making another output worse off. In contrast, production units A and B are not economically efficient because they can expand their production to the frontier.

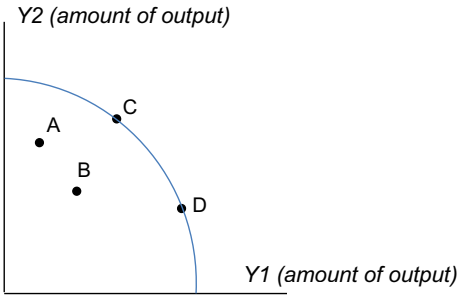


**Fig. 1** Production possibility frontier. *Source* Drawn by the authors

While the idea of a production frontier is rather straightforward, in reality, the frontier is unknown and can only be estimated. Also, when there are multiple inputs and multiple outputs, the estimation of the production frontier often becomes difficult and complicated. The nature of multiple inputs and multiple outputs of production lends itself to a methodology called data envelopment analysis (DEA), as elaborated in Sect. 2.

## 2 Data envelopment analysis (DEA)

The term DEA was first coined in 1978 (Charnes et al. 1978). In the ensuing decades, a phenomenal expansion of DEA in terms of its theory, methodology and applications ensued. DEA is widely acclaimed as a pivotal technique for measuring efficiency and production possibilities; objectives that are deemed to be one of the common interests of operational research and management science (Charnes et al. 1994).

The DEA-CCR model, derived from the early work by Charnes et al. (1978), has been most frequently used in literature and is used in this paper. The CCR model can be expressed by Eq. (1) through (4):

$$(\mathrm{FP}_k)\mathrm{Max} \quad U_k = \frac{\sum_{n=1}^{N} a_n y_{nk}}{\sum_{m=1}^{M} b_m x_{mk}} \tag{1}$$

subject to:

$$\frac{\sum_{n=1}^{N} a_n y_{nk}}{\sum_{m=1}^{M} b_m x_{mk}} \leq 1 \quad (k = 1, 2, \ldots, K) \tag{2}$$

$$a_n \geq 0 \quad (n = 1, 2, \ldots, N) \tag{3}$$

$$b_m \geq 0 \quad (m = 1, 2, \ldots, M) \tag{4}$$

Given the multiple inputs and multiple outputs, the CCR model measures the maximum efficiency of each DMU by solving the fractional programming (FP) objective function specified in Eqs. (1–4), where the input weights $a_1$, $a_2$, (step 3) … $a_N$ and output weights $b_1$, $b_2$, (step 4) … $b_M$ are parameters to be estimated. Constraint (2) reveals that the ratio of 'virtual output' $\sum_{n=1}^{N} a_n y_{nk}$ to 'virtual input' $\sum_{m=1}^{M} b_m x_{mk}$ cannot exceed 1 for each DMU.

A comprehensive literature review on DEA is provided by Emrouznejad and Yang (2018). Among the large number of DEA studies, it is useful to highlight a few publications which use a country or nation as a production unit for analysis. The most relevant paper was prepared by Rashidi and Cullinane (2019), who applied DEA to evaluate the sustainability of operational logistics performance within a sample of the Organisation for Economic Co-operation and Development (OECD) nations in comparison with the LPI. Elsewhere, Hsu et al. (2008) applied DEA to analyse economic efficiency of OECD and non-OECD countries. Stancíková and Skokan (2012) applied DEA to analyse the competitive potential of the European Union (EU) member states. Similarly, Hudec and Procházková (2013) applied DEA to measure the relative efficiency of knowledge innovation processes in EU countries. Munshi (2014) applied DEA to measure the national innovation system (NIS) in 20 emerging and developed countries.

## 3 Defining input and output variables

### 3.1 Output indicators

#### 3.1.1 Logistics performance index (LPI)

Developed by the World Bank, the LPI is a tool to help countries identify the challenges and opportunities they face in their performance in trade logistics. The LPI 2018 allows for comparisons across 160 countries. The LPI is based on a worldwide survey of operators (global freight forwarders and express carriers) providing feedback on the logistics 'friendliness' of the countries in which they operate and those with which they trade. The LPI consists of both qualitative and quantitative measures, such as customs performance, infrastructure quality and timeliness of shipments.

#### 3.1.2 Trading across borders (TAB)

The TAB indicators in this category record the time and cost associated with the logistical process of exporting and importing goods, covering three sets of procedures—documentary compliance, border compliance and domestic transport—within the overall process of exporting or importing a shipment of goods. The most recent round of data collection for the project was completed in May 2018. The data on trading across borders are gathered through a questionnaire administered to freight forwarders, customs brokers, port authorities and traders.

#### 3.1.3 UNCTAD business-to-consumer (B2C) e-commerce index

The index is calculated as the average of four indicators (i.e. each indicator carries the same weight), including (1) account ownership at a financial institution or with a mobile-money-service provider (% of population aged 15+), (2) individuals using the Internet (% of population), (3) postal reliability index and (4) secure Internet servers (per 1 million people).

### 3.2 Input indicators

There are many candidates for input indicators, such as gross domestic product (GDP) and volume of trade. The key question is whether there are indicators which have been widely agreed to measure the resources of a country. In this respect, the present paper adopts the indicators used by the United Nations for judging whether a country is a 'developing' or a 'least developed' country. These indicators are the following:

1. *Gross national income (GNI) per capita* GNI per capita provides information on the income status and the overall level of resources available to a country.
2. *Human assets index (HAI)* The HAI is a gauge of the level of human capital as measured by education and health. Low levels of human assets indicate major structural impediments to sustainable development, and a lower HAI represents lower development of human capital.
3. *Economic vulnerability index (EVI)* The EVI is a measure of structural vulnerability to economic and environmental shocks. High vulnerability indicates major structural impediments to sustainable development. A higher EVI represents a higher economic vulnerability.

A high value of GNI per capita and HAI is expected to lead to a high value of national e-commerce and logistics performance. The rationale is that high GNI per capita and HAI often mean that countries have a large amount of resources and human capacity to implement any e-commerce and logistics reform.

Conversely, a high EVI means the country has many obstacles and limited financial and human capacity to implement any e-commerce and logistics reform, and accordingly, this might lead to a low national e-commerce and logistics index. To apply the DEA-CCR model, the reciprocal value of EVI is used.

Among these three input variables, the definition of the GNI per capita is very straightforward. HAI and EVI, however, are highly aggregated indicators, representing a large number of different elements of national production (Figs. 2, 3). The authors opine that such highly aggregated indicators are suitable inputs when each unit for comparison is a complex DMU such as a country.

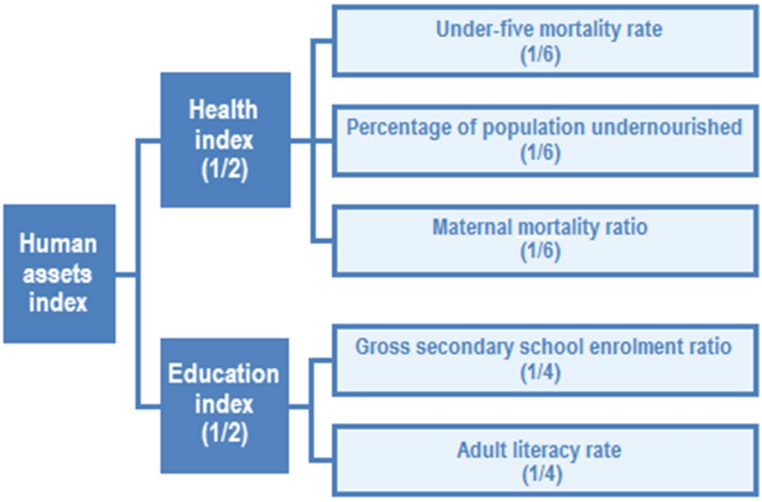


**Fig. 2** Human assets index (HAI) as input variable. *Source* United Nations, https://www.un.org/development/desa/dpad/least-developed-country-category/ldc-criteria.html

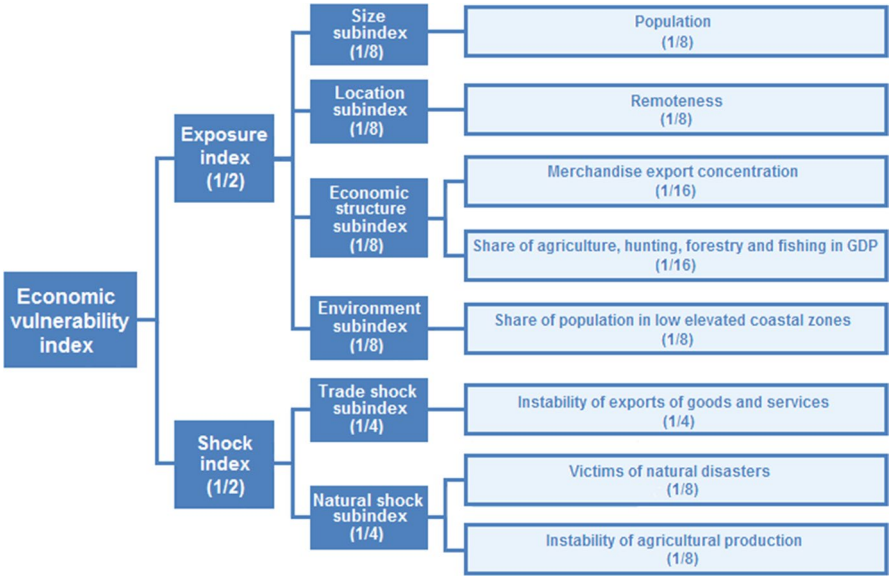


**Fig. 3** Economic vulnerability index (EVI) as input variable. *Source* United Nations, https://www.un.org/development/desa/dpad/least-developed-country-category/ldc-criteria.html

### 3.3 Dataset

Ideally, all countries covered by the B2C, LPI and TAB should be included in the analysis. However, not all data are available for all countries. Even for the countries

whose data are available for B2C, LPI and TAB, the OECD countries and some others, such as the Russian Federation, are not included in the analysis because the relevant input data on the HAI and the EVI are not available. Accordingly, the dataset covers 93 countries worldwide. More detailed information on the sample can be found in Table 1.

## 4 Results

The results from running the DEA-CCR model are presented in Table 1. On average, efficiency across countries is 82%, indicating that the average efficiency could be expanded further to reach the frontier.

Looking at the results of the analysis, few should be surprised by the result of Singapore being on the frontier, operating at full efficiency. Questions, however, may arise as to why some other countries, such as Mongolia or Mali, are also operating at full efficiency.

To answer these questions, we need to go back to the definition of efficiency: this looks not only at the outputs but also at the inputs. It is true that these countries do not rank highly in terms of the B2C, LPI and TAB indexes. However, the resources available for production in these countries, vis-à-vis many other countries, are also very scarce. Hence, their high levels of efficiency show that these countries are performing well, given the resources available to them. This also explains why a high B2C, LPI and TAB score does not necessarily mean a high level of efficiency, as shown in Fig. 4.

Figure 5 shows the efficiency estimates of the studied countries according to regional groupings. The average efficiency of the countries in Sub-Saharan Africa (89%) is the highest among the regions, indicating that, given their limited resources, these countries are performing close to the maximum level, which they can currently reach without increasing inputs. Such findings suggest that substantial international support on the input side will be useful in helping these countries to further enhance their e-commerce and logistics development—because the DEA results show that, in theory, these countries are exhausting their resources for their development in e-commerce and logistics. The average efficiency of the countries in the Middle East and North Africa (74%) is the lowest among the regions, indicating that, in theory, these countries can expand their e-commerce and logistics scores by 1.3 times to reach the frontier. The average efficiency of countries in East Asia, Europe and Central and South Asia ranges from 80% to 86%.

Figure 6 shows the efficiency estimates of the Asian-Pacific countries under study (other regions can be similarly analysed). It shows that Singapore, Mongolia, Malaysia and Georgia are fully efficient. The two largest economies in this group, namely China and India, achieve an efficiency of 82% and 85%, respectively. The bottom ten countries, namely Bangladesh, Cambodia, Kyrgyzstan, Pakistan, Afghanistan, Philippines, Indonesia, Sri Lanka, Myanmar and Uzbekistan, achieve an efficiency rate within the range of 60–80%, suggesting that there is substantial room for improvement in national e-commerce and logistics, given the resources available to these countries.

**Table 1** Input and output variables and efficiency of countries in e-commerce and logistics performance. *Source* Prepared by the authors

| Country | Efficiency (%) | Input variables | | | Output variables | | |
|---|---|---|---|---|---|---|---|
| | | EVI | HAI | GNI | LPI | TAB | B2C |
| Afghanistan | 73 | 39.3 | 48.4 | 633 | 1.95 | 30.63 | 21 |
| Algeria | 46 | 14.7 | 88.3 | 4902 | 2.45 | 38.43 | 36.3 |
| Angola | 66 | 36.8 | 52.5 | 4477 | 2.05 | 36.15 | 23.9 |
| Argentina | 65 | 24.3 | 98.6 | 13,157 | 2.89 | 65.36 | 48.8 |
| Armenia | 96 | 31.2 | 96.1 | 3988 | 2.61 | 89.22 | 60.1 |
| Bahrain | 89 | 34.9 | 98 | 22,779 | 2.93 | 77.77 | 62.1 |
| Bangladesh | 79 | 25.2 | 73.2 | 1274 | 2.58 | 31.76 | 46.3 |
| Benin | 86 | 34.3 | 49.8 | 882 | 2.75 | 68.94 | 20.1 |
| Bhutan | 95 | 36.3 | 72.9 | 2401 | 2.17 | 94.25 | 35.3 |
| Bolivia (Plurinational State of) | 75 | 32.5 | 84 | 2981 | 2.36 | 71.59 | 38.1 |
| Brazil | 76 | 21.5 | 96.1 | 10,319 | 2.99 | 69.85 | 63.6 |
| Cambodia | 78 | 34.8 | 68.9 | 1075 | 2.58 | 67.28 | 30.5 |
| Cameroon | 76 | 19.1 | 62.7 | 1464 | 2.6 | 15.99 | 40.3 |
| Chad | 100 | 52.4 | 22.1 | 921 | 2.42 | 40.12 | 7.4 |
| Chile | 89 | 26.6 | 98.5 | 14,336 | 3.32 | 80.56 | 70.4 |
| China | 82 | 21.8 | 95.2 | 7824 | 3.61 | 82.59 | 61.7 |
| Colombia | 70 | 22.4 | 95.6 | 7124 | 2.94 | 61.83 | 55.9 |
| Comoros | 100 | 52.4 | 49.4 | 1595 | 2.56 | 66.87 | 12.5 |
| Congo | 62 | 31.8 | 63.5 | 2180 | 2.49 | 19.68 | 14.3 |
| Costa Rica | 78 | 25.2 | 98.7 | 10,544 | 2.79 | 79.32 | 57.7 |
| Côte d'Ivoire | 90 | 16.7 | 45.6 | 1483 | 3.08 | 52.44 | 27.6 |
| Cyprus | 91 | 14.1 | 99.5 | 25,752 | 3.15 | 88.44 | 85 |
| Democratic Republic of the Congo | 97 | 27.2 | 41.9 | 481 | 2.43 | 3.45 | 11.7 |
| Djibouti | 83 | 36.3 | 58 | 1894 | 2.63 | 59.37 | 30.2 |
| Dominican Republic | 76 | 23.8 | 85.5 | 6256 | 2.66 | 83.51 | 45.4 |
| Ecuador | 68 | 28.2 | 94.2 | 5993 | 2.88 | 68.65 | 40 |
| Egypt | 49 | 17.9 | 86.1 | 3340 | 2.82 | 42.23 | 34.4 |
| El Salvador | 81 | 28.1 | 87.1 | 3851 | 2.58 | 89.76 | 42.1 |
| Gabon | 67 | 32.8 | 72.7 | 8001 | 2.16 | 43.94 | 38.9 |
| Georgia | 100 | 26.9 | 98.8 | 3894 | 2.44 | 90.03 | 72.3 |
| Ghana | 93 | 33.7 | 69.9 | 1481 | 2.57 | 54.84 | 48.8 |
| Guatemala | 65 | 24.2 | 78.2 | 3617 | 2.41 | 77.15 | 30.2 |
| Guinea | 81 | 30.2 | 39.5 | 678 | 2.2 | 47.82 | 11.4 |
| Haiti | 91 | 30.6 | 48 | 814 | 2.11 | 76.9 | 16.3 |
| Honduras | 71 | 29.5 | 82.9 | 2093 | 2.6 | 65.85 | 38.1 |
| India | 85 | 22.9 | 74.2 | 1591 | 3.18 | 77.46 | 51.5 |
| Indonesia | 71 | 24.2 | 90.4 | 3640 | 3.15 | 67.27 | 45.7 |
| Iran (Islamic Republic of) | 91 | 24.7 | 91 | 5813 | 2.85 | 66.2 | 70.9 |
| Iraq | 53 | 26.3 | 59.2 | 5427 | 2.18 | 25.33 | 24.6 |
| Israel | 89 | 20.1 | 99.3 | 37,420 | 3.31 | 82.85 | 84.7 |

**Table 1** (continued)

| Country | Efficiency (%) | Input variables | | | Output variables | | |
|---|---|---|---|---|---|---|---|
| | | EVI | HAI | GNI | LPI | TAB | B2C |
| Jamaica | 86 | 30.5 | 88.6 | 4747 | 2.52 | 61.54 | 59.8 |
| Jordan | 74 | 20.1 | 92.9 | 3893 | 2.69 | 79.03 | 55.9 |
| Kazakhstan | 86 | 27.5 | 99.7 | 10,633 | 2.81 | 70.36 | 68.1 |
| Kenya | 86 | 26.4 | 67 | 1316 | 2.81 | 68.06 | 46.2 |
| Kuwait | 68 | 26.7 | 97.2 | 41,537 | 2.86 | 54.24 | 65.2 |
| Kyrgyzstan | 76 | 31.3 | 95 | 1202 | 2.55 | 80.74 | 33.8 |
| Lao People's Democratic Republic | 90 | 33.7 | 72.8 | 1996 | 2.7 | 78.12 | 41.5 |
| Lebanon | 76 | 21.1 | 86 | 8131 | 2.72 | 57.9 | 61.3 |
| Lesotho | 100 | 42.0 | 61.6 | 1296 | 2.28 | 91.86 | 27.2 |
| Liberia | 100 | 53.2 | 37.2 | 431 | 2.23 | 27.77 | 15.6 |
| Libya | 72 | 37.6 | 96.8 | 6047 | 2.11 | 64.66 | 37.6 |
| Madagascar | 87 | 37.8 | 54.5 | 486 | 2.39 | 60.95 | 25.6 |
| Malawi | 100 | 47.1 | 52.5 | 331 | 2.59 | 65.29 | 22.3 |
| Malaysia | 100 | 21.4 | 91 | 10,432 | 3.22 | 88.47 | 80.8 |
| Mali | 100 | 36.8 | 43.1 | 801 | 2.59 | 73.3 | 23.9 |
| Mauritania | 83 | 39.9 | 46.9 | 1230 | 2.33 | 60.3 | 19.6 |
| Mauritius | 87 | 24.2 | 95.3 | 9808 | 2.73 | 81 | 66.9 |
| Mexico | 61 | 17.6 | 94.6 | 9882 | 3.05 | 82.09 | 44.1 |
| Mongolia | 100 | 39.0 | 91.7 | 3892 | 2.37 | 66.89 | 66.1 |
| Morocco | 80 | 16.3 | 77.9 | 3058 | 2.54 | 83.58 | 50.9 |
| Myanmar | 64 | 31.7 | 68.5 | 1255 | 2.3 | 47.67 | 27.4 |
| Nepal | 82 | 28.4 | 71.2 | 745 | 2.51 | 77.17 | 33.4 |
| Niger | 100 | 35.3 | 35.4 | 393 | 2.07 | 65.4 | 6.6 |
| Nigeria | 100 | 34.2 | 49.8 | 2770 | 2.53 | 23.08 | 54.7 |
| Oman | 79 | 27.1 | 97.1 | 17,133 | 3.2 | 79.39 | 57.2 |
| Pakistan | 74 | 21.9 | 56.7 | 1502 | 2.42 | 60.12 | 32.3 |
| Panama | 78 | 25.5 | 88.2 | 11,804 | 3.28 | 85.47 | 46.7 |
| Paraguay | 92 | 42.5 | 87.1 | 4260 | 2.78 | 65.1 | 41.7 |
| Peru | 66 | 24.7 | 94.7 | 6152 | 2.69 | 68.22 | 44.8 |
| Philippines | 71 | 25.1 | 89.9 | 3525 | 2.9 | 69.9 | 45.1 |
| Qatar | 80 | 28.5 | 96.7 | 75,074 | 3.47 | 71.51 | 63.7 |
| Rwanda | 100 | 36.4 | 55 | 707 | 2.97 | 74.98 | 32.7 |
| Saudi Arabia | 70 | 14.4 | 97.8 | 23,674 | 3.01 | 54.31 | 68.7 |
| Senegal | 87 | 33.4 | 57.1 | 1004 | 2.25 | 60.85 | 36.8 |
| Sierra Leone | 100 | 51.6 | 27.4 | 582 | 2.08 | 48.99 | 15.9 |
| Singapore | 100 | 30.5 | 98.9 | 53,504 | 4 | 89.57 | 95.2 |
| South Africa | 73 | 23.4 | 92.6 | 6099 | 3.38 | 59.64 | 52.9 |
| Sri Lanka | 70 | 25.0 | 91.9 | 3773 | 2.6 | 73.29 | 44.8 |
| Sudan | 96 | 49.2 | 53 | 1452 | 2.43 | 18.96 | 28.7 |
| Syrian Arab Republic | 60 | 33.6 | 79.8 | 1523 | 2.3 | 29.83 | 21.6 |
| Thailand | 95 | 23.7 | 95.9 | 5706 | 3.41 | 84.65 | 73.2 |

**Table 1** (continued)

| Country | Efficiency (%) | Input variables | | | Output variables | | |
|---|---|---|---|---|---|---|---|
| | | EVI | HAI | GNI | LPI | TAB | B2C |
| Togo | 82 | 28.3 | 61.8 | 555 | 2.45 | 63.66 | 29.6 |
| Trinidad and Tobago | 77 | 31.0 | 94 | 17,975 | 2.42 | 62.6 | 58 |
| Tunisia | 67 | 18.0 | 88.6 | 3882 | 2.57 | 70.5 | 51.7 |
| Turkey | 81 | 10.8 | 98.1 | 11,946 | 3.15 | 90.27 | 71.1 |
| Uganda | 100 | 31.7 | 50.2 | 661 | 2.58 | 66.73 | 41.5 |
| United Arab Emirates | 98 | 28.4 | 88 | 42,772 | 3.96 | 71.5 | 81.2 |
| Uruguay | 72 | 31.7 | 98 | 15,772 | 2.69 | 57.14 | 52.9 |
| Uzbekistan | 64 | 23.0 | 96.6 | 2247 | 2.58 | 49.79 | 48.2 |
| Venezuela (Bolivarian Republic of) | 56 | 23.5 | 92.1 | 10,278 | 2.23 | 7.93 | 49.8 |
| Vietnam | 92 | 30.1 | 89.3 | 1951 | 3.27 | 70.83 | 58 |
| Zambia | 83 | 40.5 | 58.6 | 1561 | 2.53 | 56.88 | 27 |
| Zimbabwe | 100 | 59.7 | 59.8 | 953 | 2.12 | 54.34 | 36.7 |

Reciprocal value of EVI used for calculating efficiency

## 5 Discussion and conclusions

Should a country rejoice as a result of its high efficiency according to the results from this DEA? The answer is that a country should not necessarily be content with a high efficiency rating. If a country ranks low in logistics and e-commerce indexes while its efficiency according to the DEA is high, it shows that the potential for the country to further enhance its performance with existing resources is very limited. This probably indicates that any further improvement of logistics and e-commerce will stem from economic and social activity. In contrast, if a country achieves a low efficiency rating according to the DEA, this also indicates that, given the resources available, a country has a real potential to enhance its logistics and e-commerce performance using existing resources. In a nutshell, if a country ranks low in logistics and e-commerce, a high or low efficiency score carries both good and bad news for the country.

To illustrate the benefits of the analysis, it can be seen that Uzbekistan ranks low with a 64% efficiency score. This immediately highlights to policymakers a need to look at the underlying data to understand how to achieve further gains by utilising existing resources. For Uzbekistan, its EVI rating is high, whereas its TAB is low. This alerts policymakers to examine the TAB dataset, whereupon it becomes evident that potential gains could be achieved by improving the time to export (documentary compliance), since this is currently rated at taking 96 hours. Other factors, such as time to cross the border and associated costs, are less of an issue. Should changes be made resulting in an improvement rating in the TAB, a time-series analysis will then serve to highlight Uzbekistan to other countries as a benchmark for possible best practice.

As a further step for this research, a live dataset tool could be created to test how a country's capacity potential could change, in comparison with other countries, if

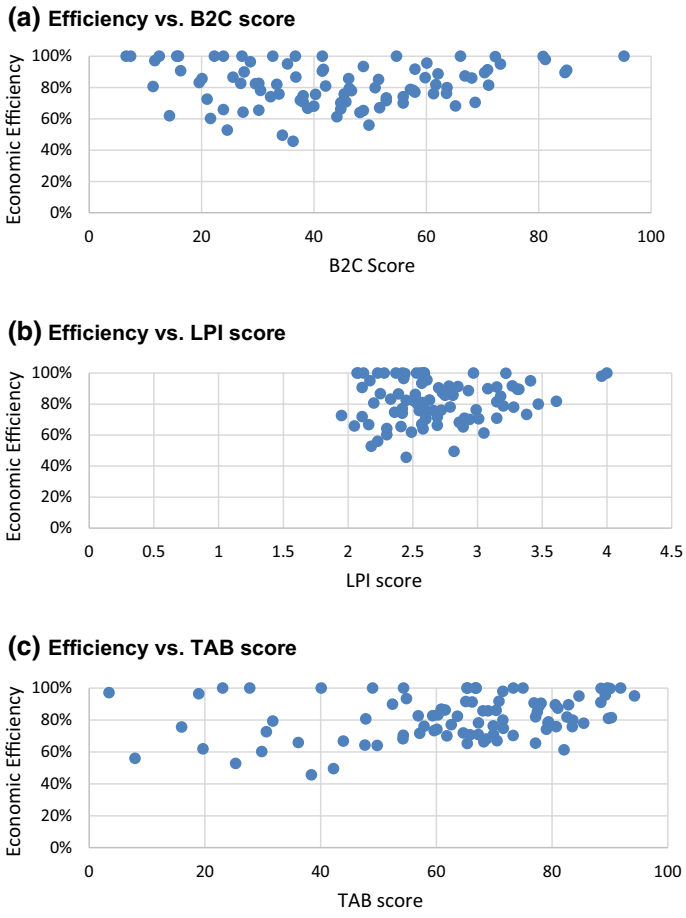


**Fig. 4** Efficiency in relation to B2C, LPI and TAB scores

one or more variables were improved. This could then serve as a key performance indicator for policymakers to achieve.

A few conclusions can be drawn from the analysis undertaken within this paper.

First, the methodology presented herein is meant to serve as a tool for policymakers and civil society to better understand a nation's potential. An economy's status needs to be checked against whether its resources are fully utilized to produce the best outputs (in e-commerce and logistics performance) or not. Similarly, a small economy should also track how far its production, which takes both outputs and inputs into consideration, lies from the production frontier.

Second, the most important part of this paper is the interpretation of the results from the DEA. The analysis shows that Singapore is on the frontier of e-commerce and logistics, and this corresponds with a widely held perception. What is more surprising is that some countries, such as Mongolia and Georgia, which do not rank

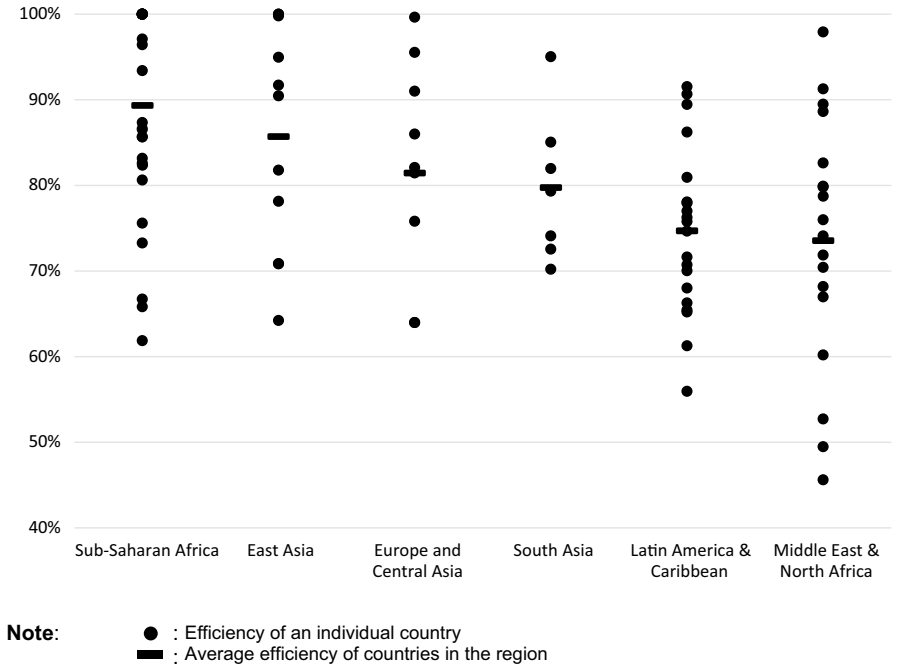


**Fig. 5** Efficiency of countries in e-commerce and logistics development according to the regions. *Source* Authors' calculations

high according to B2C, LPI or TAB, are also on the frontier. The interpretation of such results is that, given the national resources available, these countries, in theory, have produced the best outputs (i.e. national e-commerce and logistics performance). However, this also indicates that, given the available resources, further improvement of the performance of logistics and e-commerce would be difficult and would have to rely upon the economic and social development of the countries in the long term. For those countries which score far below the frontier, this could indeed be seen as a blessing in disguise. This means that, given the resources available, these countries have the potential to further enhance their performance.

Going forward, there are a few areas which can be further investigated.

First, it will be useful to expand the dataset to cover all OECD countries and other countries which are not covered in this study, when data for these countries become available.

Second, repeat studies should be carried out when new B2C, LPI and TAB indicators are published. A panel data analysis could also be undertaken to investigate how the production frontier evolves and how the performance of countries benchmarked by the frontier moves over time.

Third, this paper presents how efficient a country is according to DEA. This serves as the first step for any further analysis of the underlying reasons for the (in)efficiency of each country. Such further analysis would be grounded within the specific context of a country. In this connection, national researchers are

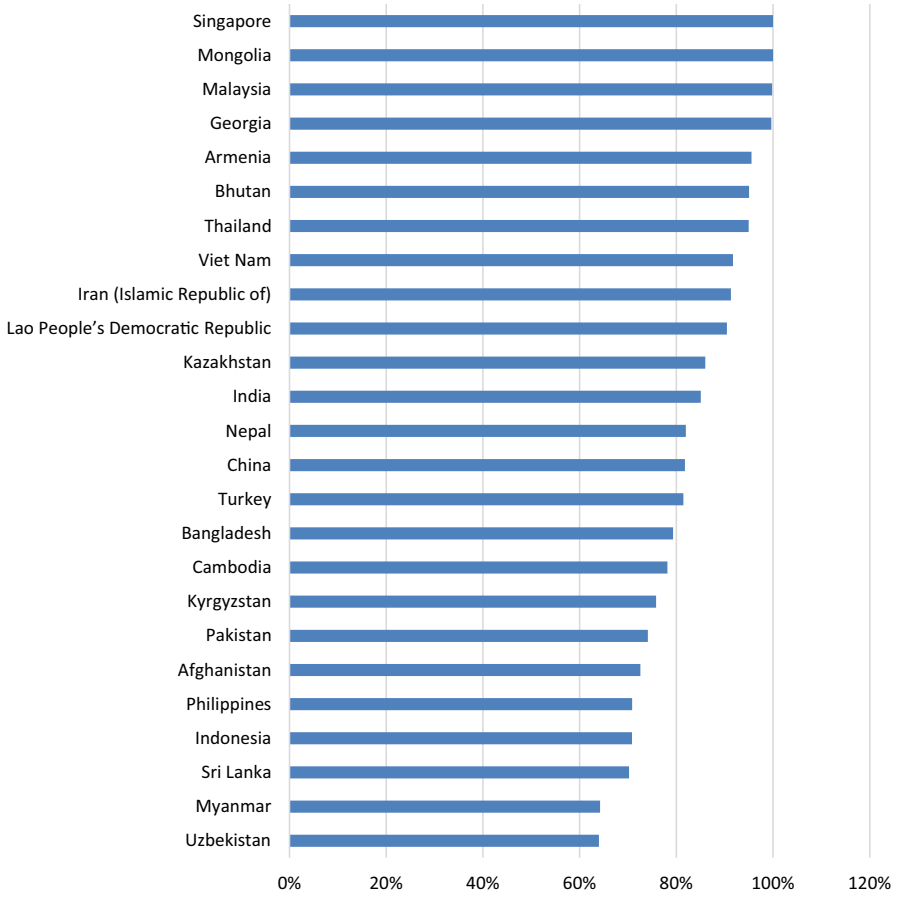


**Fig. 6** Efficiency of countries in e-commerce and logistics development, Asia and the Pacific countries. *Source* Authors' calculations

encouraged to utilize this paper as a reference to carry out further analysis. Results from national analysis may shed light on common and different reasons behind the (in)efficiencies of countries and identify relevant policy recommendations.

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