

The LPI methodology

Because logistics has many dimensions, measuring and summarizing performance across countries is challenging. Examining the time and costs associated with logistics processes—port processing, customs clearance, transport, and the like—is a good start, and in many cases this information is readily available. But even when complete, this information cannot be easily aggregated into a single, consistent cross-country dataset, because of structural differences in countries' supply chains. Even more important, many critical elements of good logistics—such as process transparency and service quality, predictability, and reliability—cannot be assessed using only time and cost information.

Constructing the international LPI

The first part of the LPI survey (questions 10–15) provides the raw data for the international LPI. Each survey respondent rates eight overseas markets on six core components of logistics performance. The eight countries are chosen based on the most important export and import markets of the country where the respondent is located, on random selection, and—for landlocked countries—on neighboring countries that form part of the land bridge connecting them with international markets. The method used to select the group of countries rated by each respondent varies by the characteristics of the country where the respondent is located (table A5.1).

Respondents take the survey online. The web engine for 2014 is the same as the new engine put in place in 2012. It incorporates the Uniform Sampling Randomized (USR) approach to gain the most possible responses from underrepresented countries. Because the survey

engine relies heavily on a specialized country selection methodology for survey respondents based on high trade volume between countries, the USR can help countries with lower trade volumes rise to the top during country selection.

The 2014 survey engine builds a set of countries for the survey respondents that are subject to the rule set (see table A5.1). After 200 surveys, the USR is introduced into the engine's process for country selection. For each new survey respondent, the USR solicits a response from a country chosen at random but with non-uniform probability—with weights chosen to evolve the sampling toward uniform probability. Specifically, a country i is chosen with a probability $(N-n_i) / 2N$, where n_i is the sample size of country i so far, and N is the total sample size.

The international LPI is a summary indicator of logistics sector performance, combining data on six core performance components into a single aggregate measure. Some respondents did not provide information for all six components, so interpolation is used to fill in missing values. The missing values are replaced with the country mean response for each question, adjusted by the respondent's average deviation from the country mean in the answered questions.

The six core components are:

- *The efficiency of customs and border clearance*, rated from “very low” (1) to “very high” (5) in survey question 10.
- *The quality of trade and transport infrastructure*, rated from “very low” (1) to “very high” (5) in survey question 11.
- *The ease of arranging competitively priced shipments*, rated from “very difficult” (1) to “very easy” (5) in survey question 12.

- *The competence and quality of logistics services*, rated from “very low” (1) to “very high” (5) in survey question 13.
- *The ability to track and trace consignments*, rated from “very low” (1) to “very high” (5) in survey question 14.
- *The frequency with which shipments reach consignees within scheduled or expected delivery times*, rated from “hardly ever” (1) to “nearly always” (5) in survey question 15.

The LPI is constructed from these six indicators using principal component analysis (PCA), a standard statistical technique used to reduce the dimensionality of a dataset. In the LPI, the inputs for PCA are country scores on questions 10–15, averaged across all respondents providing data on a given overseas market. Scores are normalized by subtracting the sample mean and dividing by the standard deviation before conducting PCA. The output from PCA is a single indicator—the LPI—that is a weighted average of those scores. The weights are chosen to maximize the percentage of variation in the LPI’s original six indicators that is accounted for by the summary indicator.

Full details of the PCA procedure are in tables A5.2 and A5.3. The first line of table A5.2 shows that the first (principal) eigenvalue of the correlation matrix of the six core indicators is greater than one—and much larger than any other eigenvalue. Standard statistical tests, such as the Kaiser Criterion and the eigenvalue scree plot, suggest that a single principal component be retained to summarize the underlying data. This principal component is the international LPI. Table A5.2 shows that the international LPI accounts for 92 percent of the variation in the six components.

To construct the international LPI, normalized scores for each of the six original indicators are multiplied by their component loadings (table A5.3) and then summed. The component loadings represent the weight given to each original indicator in constructing the international LPI. Since the loadings are similar for all six, the international LPI is close to a simple average of the indicators. Although PCA is re-run for each version of the LPI, the weights remain very steady from year to year. There is thus a high degree of comparability across the various LPI editions.

Table A5.1 Methodology for selecting country groups for survey respondents

	Respondents from low-income countries	Respondents from middle-income countries	Respondents from high-income countries
Respondents from coastal countries	Five most important export partner countries + Three most important partner countries	Three most important export partner countries + The most important import partner country + Four countries randomly, one from each country group: a. Africa b. East, South, and Central Asia c. Latin America d. Europe less Central Asia and OECD	Two countries randomly from a list of five most important export partner countries and five most important import partner countries + Four countries randomly, one from each country group: a. Africa b. East, South, and Central Asia c. Latin America d. Europe less Central Asia and OECD
Respondents from landlocked countries	Four most important export partner countries + Two most important import partner countries + Two land-bridge countries	Three most important export partner countries + The most important import partner country + Two land-bridge countries + Two countries randomly, one from each country group: a. Africa, East, South, and Central Asia, and Latin America b. Europe less Central Asia and OECD	Two countries randomly from the combined country groups a, b, c, and d

Source: Logistics Performance Index 2014.

Constructing the confidence intervals

To account for the sampling error created by the LPI's survey-based methodology, LPI scores are presented with approximate 80 percent confidence intervals. These intervals make it possible to provide upper and lower bounds for a country's LPI score and rank. To determine whether a change in score or a difference between two scores is statistically significant, confidence intervals must be examined carefully. For example, a statistically significant improvement in a country's performance should not be concluded unless the lower bound of the country's 2014 LPI score exceeds the upper bound of its 2012 score.

Despite being the most comprehensive data source for country logistics and trade facilitation, the LPI has two important limitations. First, the experience of international freight forwarders might not represent the broader logistics environment in poor countries, which often rely on traditional operators. And the international and traditional operators might differ in their interactions with government agencies—and in their service levels. Second, for landlocked countries and small island states, the LPI might reflect access problems outside the country assessed, such as transit difficulties. The low rating of a landlocked country might not adequately reflect its trade facilitation efforts, which depend on the workings of complex international transit systems. Landlocked countries cannot eliminate transit inefficiencies with domestic reforms.

To calculate the confidence interval, the standard error of LPI scores across all respondents is estimated for a country. The upper and lower bounds of the confidence interval are then

$$LPI \pm \frac{t_{(0.1, N-1)} S}{\sqrt{N}}$$

where *LPI* is a country's LPI score, *N* is the number of survey respondents for that country, *s* is the estimated standard error of each country's LPI score, and *t* is Student's

Table A5.2 Results of principal component analysis for the international LPI

Component	Eigenvalue	Difference	Variance proportion	
			Individual	Cumulative
1	5.45	5.25	0.91	0.91
2	0.20	0.04	0.03	0.94
3	0.16	0.06	0.03	0.97
4	0.10	0.06	0.02	0.98
5	0.05	0.00	0.01	0.99
6	0.05	na	0.01	1.00

na is not applicable.
Source: Authors' analysis.

Table A5.3 Component loadings for the international LPI

Component	Weight
Customs	0.40
Infrastructure	0.42
International shipments	0.40
Logistics quality and competence	0.42
Tracking and tracing	0.41
Timeliness	0.40

Source: Authors' analysis.

t-distribution. As a result of this approach, confidence intervals and low-high ranges for scores and ranks are larger for small markets with few respondents, since these estimates are less certain.

The high and low scores are used to calculate upper and lower bounds on country ranks. The upper bound is the LPI rank a country would receive if its LPI score were at the upper bound of the confidence interval rather than at the center. The lower bound is the LPI rank a country would receive if its LPI score were at the lower bound of the confidence interval rather than at the center. In both cases the scores of all other countries are kept constant.

The average confidence interval on the 1–5 scale is 0.23, or about 8 percent of the average country's LPI score. Because of the bunching of LPI scores in the middle of the distribution, the confidence interval translates into an average of 20 rank places, using upper and lower rank bounds as calculated above. Caution must be taken when interpreting small differences in LPI scores and rankings.

Constructing the domestic LPI database

The second part of the LPI survey instrument is the domestic LPI, in which respondents provide qualitative and quantitative information on the logistics environment in the country where they work.

Questions 17–22 ask respondents to choose one of five performance categories. In question 17, for example, they can describe port charges in their country as “very high,” “high,” “average,” “low,” or “very low.” As in the international LPI, these options are coded from 1 (worst) to 5 (best). Appendix 2 displays country averages of the percentage of respondents rating each aspect of the logistics environment as 1–2 or 4–5.

With a few exceptions, questions 23–34 ask respondents for quantitative information

on their countries’ international supply chains, offering choices in a dropdown menu. When a response indicates a single value, the answer is coded as the logarithm of that value. When a response indicates a range, the answer is coded as the logarithm of the midpoint of that range. For example, export distance can be indicated as less than 50 kilometers, 50–100 kilometers, 100–500 kilometers, and so forth—so a response of 50–100 kilometers is coded as $\log(75)$. Full details of the coding matrix are available on request.

Country scores are produced by exponentiating the average of responses in logarithms across all respondents for a given country. This method is equivalent to taking a geometric average in levels. Scores for regions, income groups, and LPI quintiles are simple averages of the relevant country scores.