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# **Survey of literature on Measuring Logistics cost: A Developing Country's Perspective<sup>1</sup>**

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## **Abstract**

In today's world, economic climate changes more quickly, and countries realize that globalization has made the world smaller and more competitive. Also, customers seek products and services that can respond to their specific needs and firms make effort to create competitive advantages to keep their profit and market share. All of the above trends lead firms and countries to focus on efficient logistics system. In this context, almost all developed economies and a few emerging economies estimate national logistics cost on a regular basis to understand the efficiency of their logistics system. This paper makes an attempt to survey the literature on logistics cost estimation with special emphasis from the perspective of a developing country like India where estimation is a challenge due to limitation of data.

## ***Key words:***

Logistics cost, transportation cost, supply and use table

## ***JEL Classification Code***

D57, E23, P44

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## Introduction

Over time and across the industries, both at micro and macro level, logistics have always played a crucial role. Historically, logistics planning used to be strategically one of the most important factors for winning a war (Daniela & Ovidiu, 2014). In fact, the term 'logistics' comes from a French word 'logistique', believed to be popularized by a 19<sup>th</sup> century military officer and writer Antoine-Henri Jomini, who defined it in his book 'The Art of War'. Nowadays, in the world of globalization, logistics' strategic importance plays its role in the trade war. In simple layman terms, 'logistics' is basically the distribution of products and services from the point of origin to the point of consumption. Even though, the term is broadly understood but its definition is rather blurred. Of the many available definitions, perhaps the most commonly used is that given by the 'Council of Supply Chain Management Professionals'. It defines it as: "that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements."

On the macroeconomic scale, the logistics costs are an important factor in the competitiveness of a nation. Given the acceleration in the logistic activities over the last few decades and the increasing competition among different nations, the importance of a unified and reliable way to measure the logistics costs is crucial. Most of the developed countries compute logistic costs on a regular basis, and use performance indicators for logistic activities to measure their efficiency level. Thus, measuring national logistics costs is essential to know where we stand vis-à-vis our competing countries. Equally important is to identify the factors where there is scope to reduce costs. These are two essential steps a nation has introspect if one has to reduce the costs, which thereby increase the competitiveness of the nation.

It should also be noted that that the magnitude of the logistics cost is dependent on the structure of the economy. Broadly speaking, the amount of logistics costs vary significantly across industries, and according to Farahani et.al (2009), the costs are higher in manufacturing industries like chemicals, metals, and food. For instance, in some industries like food manufacturing, logistics costs can be as high as 30% of the price of the product. It is thus very important for a competitive working of a company to get regular and transparent information on the costs of all the different logistics processes, so as to improve company's performance.

On the other hand, cross-country studies by Armstrong & Associates (October 2017) suggests that supply chain management capabilities differ from country to country due to two main reasons: (1) Information flow and controls, and (2) Physical limitations. As Table 1 indicates, the biggest economies dominate in terms of infrastructure. Even though, India is ranked 2nd in roadways globally, however very few of Indian roadways have the modern four lane highways. In the railways too, India ranks 5th globally, but different gauges make railcar interchanges impossible, and hence disrupt the freight flows. These inefficiencies and limitations are important factors for higher logistics costs in India. Another challenge in India is large government bureaucracy. However according to the report, with the implementation of the goods and the services tax (GST) regime, the supply chain efficiencies have increased and transit times have been reduced by around 30 per cent.

Also, according to the 2008 Survey of the Indian Third-Party Logistics (3PL) Service Providers (Mitra, 2009), even though Indian 3PL industry is growing at a rate of 20 per cent, it is still far behind the North American 3PL industry in terms of global reach and amount of services offered. Indian 3PL industry is in its early stages of development, and is currently struggling from issues

like lack of awareness among the shippers, lack of infrastructure, cumbersome documentation and tax system.

**Table 1 Global Transportation Infrastructure**

Country	Ranked by 2016 GDP Size* (US\$ Billions)	Roadways Rank	Roadways km	Railways Rank	Railways km	Waterways Rank	Waterways km	Pipelines Gas km
U.S.	18,569.1	1	6,585,610	1	293,564	5	41,009	1,984,321
China	11,218.3	3	4,577,300	2	124,000	1	110,000	70,000
Japan	4,938.6	6	1,218,772	11	27,311	44	1,770	4,456
Germany	3,466.6	12	645,000	6	43,468	18	7,467	26,985
U.K.	2,629.2	18	394,428	16	16,837	31	3,200	28,603
France	2,463.2	8	1,028,446	9	29,640	Not Ranked	8,501	15,322
India	2,256.4	2	4,699,024	5	68,525	9	14,500	13,581
Italy	1,850.7	15	487,700	14	20,182	36	2,400	20,223
Brazil	1,798.6	4	1,580,964	10	29,850	3	50,000	17,312
Canada	1,529.2	7	1,042,300	4	77,932	77	636	110,000**
South Korea	1,411.3	46	99,025	52	3,874	50	1,600	2,216
Australia	1,259.0	9	823,217	7	36,968	42	2,000	30,054
Spain	1,232.6	11	683,175	17	16,102	63	1,000	10,481
Mexico	1,046.0	20	377,660	18	15,389	33	2,900	18,074
Indonesia	932.4	14	496,607	27	8,159	7	21,579	11,702

\*International Monetary Fund, World Economic Outlook Database, Gross Domestic Product, Current Prices

\*\*Includes gas and liquid petroleum

Source: Armstrong & Associates (October 2017)

It must be noted that the cost metrics of logistics cost in the literature differs across studies. By and large, there are three main metrics to access the logistics cost: (a) percentage of gross domestic product (GDP), (b) percentage of sales or turnover, and (c) absolute costs. However, most of the studies report logistics cost as a percentage of GDP in order to make the results for different countries more comparable.

The question remains whether there is a difference between logistics cost quoted as a per cent of turnover or per cent of GDP. In general, it must be said that these are not wholly equivalent. The difference between them may relate, for example, to including the value of export, which may have an effect especially on questionnaire-based results. GDP excludes the exportation, but it can be assumed that companies include it in turnover when assessing their logistics costs as a percentage of it. The issue is not as relevant in statistics-based and case study approaches, which are based

on mathematical modeling and may utilize national statistics data (e.g. GDP). However, the general practice is to report logistics cost as a percentage of GDP in the literature.

The plan of the rest of the paper is as follows: section 2 deals with the definition of the logistics costs, following which section 3 discuss various approaches to identify logistic costs. In section 4, we reports cross-country estimates of logistics costs.

## **1. Defining Logistics Costs**

At the outset, it is important to understand the elements that determine logistics cost. According to Sopple (2007), the functions of logistics process are as follows: order processing, inventory management, warehousing, transportation, material handling and storage, logistical packaging, and information. But, the weights of different factors in the overall cost vary significantly across countries and industries, and thus, the efficient use of resources and cutting down of logistics cost depends on the logistics management. M. Christopher (2005) defines it as “the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders.”

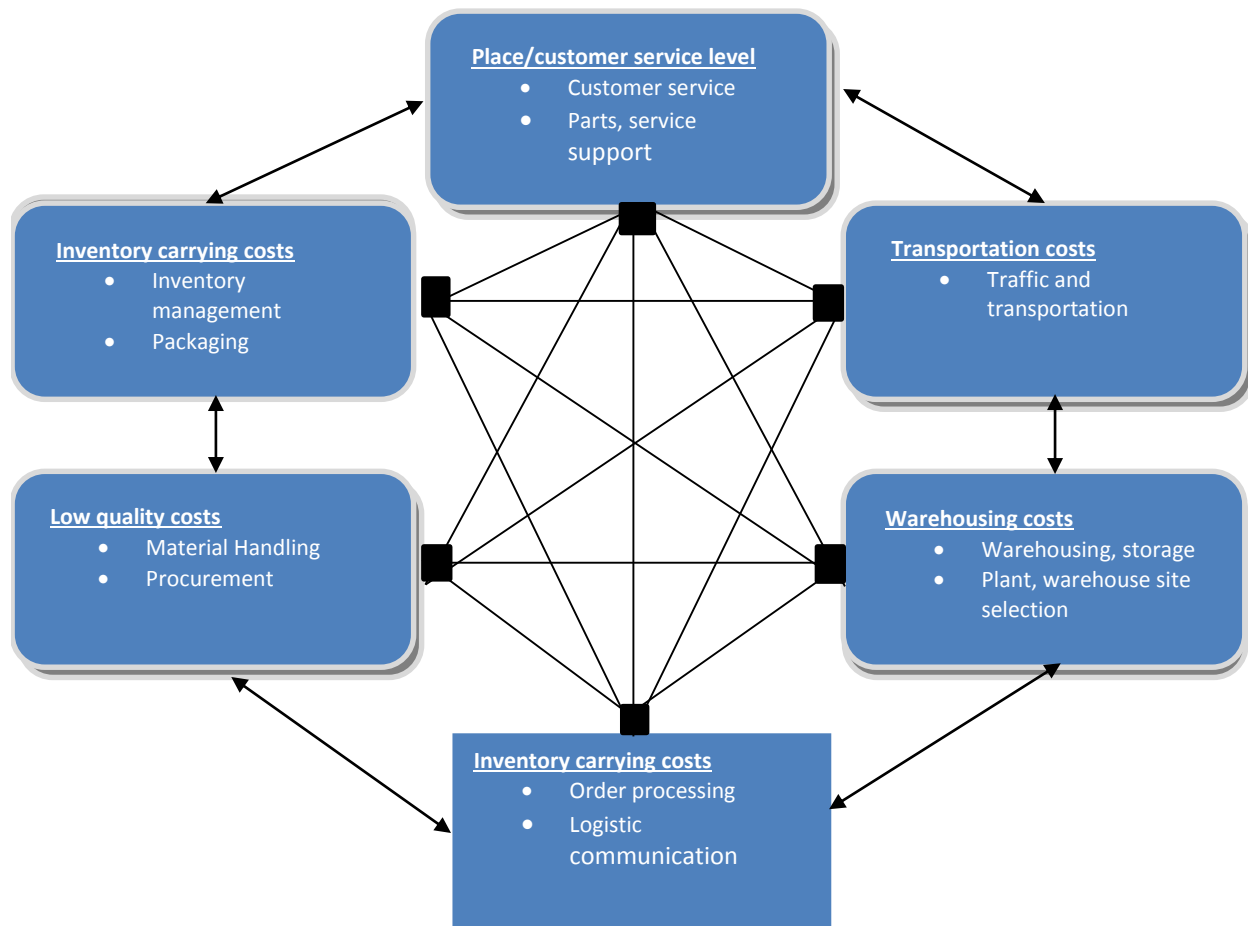
No doubt, there are various complexities in assessing the logistics cost. The primary reason is that the logistics involves many different and complex processes, and getting information about every stage of the process from transportation to depreciation of capital involves a great challenge (Farahani et.al. 2009). At the micro level, the choices made by the firms both strategic and operational may lead to lack of information about the logistics costs (Pohlem, klammer & Cokins, 2009). Also, nowadays, increasing number of companies is outsourcing its logistics operations. According to Langley (2008), around 81% of the international transportation and warehousing is outsourced. It becomes even more cumbersome to estimate the logistics cost if the companies outsource logistics bundled with other services, because then it becomes difficult to separate out the cost of individual functions (Rantasila, 2012). Another very subtle issue in aggregating and accurately measuring the logistics cost at the macro level comes from the fact that there is no common definition of supply chain management that the companies adhere to, and thus, when these companies calculate the logistics cost, their methods vary across firms and industries (Pohlen et.al., 2009). Another important issue in macro-level estimation of logistics cost is the unavailability of sufficient data, and then the reliability of the available data.

With this introduction, we now survey on how previous literature have dealt with the concept of logistics costs, and the methodologies that have been used to address the issue. In what follows, we review several scientific papers, studies, handbooks, and few textbooks.

Let us begin with the concept of ‘total cost’ developed by Lambert, Grant, Stock, and Ellram (2006). The concept basically says that if the management of any company focuses only on some particular cost group, then that may increase the other costs, thus making an adverse impact on the total costs. Lambert et.al (2006) divides logistics costs into six groups. Figure 1 describes the inter-connection between these costs. The first group is ‘customer service’, and it looks at the cost trade-off of the cost of lost sales and returned goods. This may make up a large part of the total logistics costs, but are not always necessarily included as part of the logistics cost. The second group constitutes the transportation cost. It is irrefutably one of the most important, essential,

and a large part of total logistics costs. The authors further divide this group into product- related and market- related factors. Product related factors are easiness and density of handling the products, and market related factors are modes of available transport, location of markets etc. The third and fourth group consists of warehousing and inventory-carrying costs. The warehousing costs include costs of storage, setting up and locating warehouses. Inventory –carrying costs include capital-opportunity costs, inventory service costs, and other risk costs. The fifth cost group include costs that are due to the production and procurement that varies with order size and frequency. The last group includes order processing and information systems costs.

**Figure 1 Interconnections between the six cost groups (Lambert, 2006)**



Unlike Lambert et.al. (2006), Sopple (2007) looks at only three-level breakdown of logistics cost namely, transportation, storage, and inventory. In a similar vein, Rushton, Croucher, and Baker (2006) in the *Handbook of Logistics and Distribution Management* divides cost components into four groups: transportation, inventory carrying, storage and warehousing costs, and the administration costs. On the other hand, Ayers (2006) consider a fifth component consisting of purchased material and associated labor as a separate group.

In a marked departure, Kivinen and Lukka (2002) examined the services required in a logistics management system through stake-holders interaction. Based on their interactions, they created a logistics cost classification consisting of 12 processes: warehousing, manufacturing,

transportation, customer service, procurement, quality control, reverse logistics, recycling logistics, logistics technology, packaging, consultancy, and value-added services.

Table 2 provides a summary of list of logistics cost components based on the literature review of some of the important publications including questionnaire-based surveys, statistics-based studies, and scientific articles. As Table 2 indicates, we can see that the 5 most common logistic cost components are: transportation costs, warehousing costs, inventory carrying costs, administration costs, and packaging costs. In appendix, the full references of these studies encompassing scientific articles, questionnaire-based surveys, and statistics-based studies are given in Tables A1-A3 for the benefit of the readers.

**Table 2 Count of Logistic cost components in the literature**

<b>Logistic Cost Component</b>	<b>Literature &amp; Scientific Articles</b>	<b>Questionnaire based Surveys</b>	<b>Statistics based studies</b>	<b>Total Count</b>
Transportation costs	15	12	11	38
Warehousing costs	12	12	7	31
Inventory carrying costs	11	7	9	27
Administration costs	5	11	10	26
Packaging costs	6	3	3	12
Other costs	1	5	1	7
Customer service	3	2	1	6
Order processing/information	4		2	6
Insurance	2	2	1	5
Handling	1		3	4
Risk and damage	2	1		3
Tied capital costs	2	1		3
Communication	1		1	2
Customs	1	1		2
Indirect logistics costs	1	1		2
Associated labor	1			1
Capital costs of goods in transit	1			1
Consultancy	1			1
Cost of damage during transit	1			1
Fixed costs	1			1
Logistics technology	1			1
Lot quantity	1			1
Manufacturing	1			1
Procurement	1			1
Purchased materials	1			1
Quality control	1			1
Recycling logistics	1			1
Reverse logistics	1			1
Stock-out costs	1			1

**Table 2 Count of Logistic cost components in the literature**

<b>Logistic Cost Component</b>	<b>Literature &amp; Scientific Articles</b>	<b>Questionnaire based Surveys</b>	<b>Statistics based studies</b>	<b>Total Count</b>
Trade costs	1			1
Value-added services	1			1
Cost of commodities space movement	1			1
Design, restructure and option cost	1			1
Forecasting	1			1
Permission losses	1			1
Procurement	1			1
Substance consumption	1			1
Returned goods	1			1
Wages, bonus, allowance	1			1
Depreciation		1		1

Source: Authors' compilation

### **3 Approaches to measure Logistics cost**

As noted earlier, cost components directly related to the physical flow of goods are easily perceived as a part of total logistics costs, and are thus referred in the literature as direct costs. Logistics processes also generate functional costs such as for administration, which is not confined to logistics activities. Identifying and measuring these costs is considerably more difficult than measuring direct costs.

Although the most appropriate method for determining costs varies depending on the type of industry, there are still some rather well-established general identification techniques. One option is to position them in a fourfold table according to certain dimensions: direct versus indirect costs, and overhead costs vs. activity-related costs (Table 3). This approach has been adopted, for example, in Finland's State of Logistics 2006, 2009, 2010 and 2012 surveys and in the 2000 study on the State of Logistics in the Baltic Sea Region.

In sum, logistics costs would involve estimation of all these components of costs, either from published official/private sources or from primary surveys using structured questionnaire or from stake-holders interactions.



**Table 3: Logistics Costs of Positioning**

<p><b><i>Indirect function related costs</i></b></p> <p>Packaging material</p> <p>Packaging costs</p> <p>Costs of logistics equipment, premises &amp; capital</p> <p>Administration costs</p> <p>Indirect log. related U-hardware, software and maintenance costs</p> <p>Other costs of logistics supporting functions</p>	<p><b><i>Indirect overhead costs</i></b></p> <p>Costs of lost sales</p> <p>Costs of customer service level</p> <p>Costs of non-marketable goods</p> <p>Other logistics related trade-off costs</p>	<p>Indirect logistics costs</p>
<p><b><i>Direct function related costs</i></b></p> <p>Transportation costs</p> <p>Cargo handling</p> <p>Warehousing</p> <p>Custom clearance logistics</p> <p>Documentation costs</p> <p>Direct log. related IT-hardware software and maintenance costs</p> <p>Other direct activity related costs</p>	<p><b><i>Direct overhead costs</i></b></p> <p>Value of time</p> <p>Inventory carrying</p> <p>Other operation costs related to logistics</p>	<p>Direct Logistics Costs</p>
<p>Function related costs</p>	<p>Alternative or overhead costs</p>	

Source: Authors' compilation.

To recapitulate, logistics is considered to be the part of the supply chain process that deals with the transportation, warehousing, inventory carrying and administration & management of physical products/services between the point of production and the point of delivery to the final consumer. This excludes the cost of passenger transport and the cost of transport, storage, packaging, handling etc. of mail and luggage, as well as the storage and transport tasks which occur during the production process. By definition, such costs imply the direct financial cost of performing logistics tasks that will be reflected in national accounts, up to the point where the final consumer purchases the product. Moreover, it includes costs of imported and exported goods movement, storage, etc. from the point where it passes through a border control point.

Moving on, we now study the different methodologies that have been used by the previous studies to examine and estimate the logistics cost at the macro level. At the global scale, World Bank has developed the 'Logistics Performance Index (LPI)' which ranks countries qualitatively on various logistics indicators. However, this indicator does not provide any quantitative estimate of the logistics cost of any country.

According to Rantasila (2012), most of the methods used to measure logistic cost at the micro level cannot be directly used to access the logistic cost at the macro level. The previous published studies have adapted different methods based on the reliability and availability of the data. Rantasila provides three alternate methodologies that can be availed to do macro level logistics cost study:

- (1) To collect empirical data directly from respondents using questionnaires (survey method);
- (2) To estimate logistics cost using existing data from different statistical sources and/or create a model based on data collated from primary/secondary sources. The modelling approach can be an econometric, analytic, or simulation type; and
- (3) Employ case study methods.

As discussed above, we can classify research methodologies in previous literature in three categories: survey-based studies, statistical studies, and case studies. Statistical studies use statistical models and data like national accounting statistics to derive the level of logistics cost. The survey-based studies on the other hand relies on the information collated from structured/semi-structured questionnaires which provides the estimates of logistics cost from the perspective key-stakeholders of the industries. Typically, questionnaires are canvassed to key persons (chief operating officers) in industries with a view to solicit logistics cost of their respective industries. These responses are then aggregated by suitable weighing scheme to arrive at the logistics cost of a country. Another subtle difference between survey and statistical studies is in the approach taken. The statistical studies usually approach the issue from the supply side, whereas the survey-based studies approach it from the demand side of supply chain (Rantasila, 2012). On the other hand, the case studies typically address the issue at a micro level or for a specific industry.

It must be noted that the earliest attempt to measure the macro level logistic costs was made by Heskett, Glaskowsky, and Nocholas way back in 1973. They classified the logistic cost as a sum of four activities: transportation, inventory, warehousing, and order processing. They adopted a modelling approach for their estimation purpose which has undergone several refinements. Bowersox (1998) refined their previous model and introduced the Artificial Neural Network (ANN) model for logistic cost assessment. The model is based on biological emulation of the nervous system, and uses five input variables: geographic region variables, economic variables, income level variables, transportation variables, and country size variables. These input variables enter the Neural Network Model, to give output as the national level logistic cost. Bowersox et al. (2005) presented the logistic cost as percentage of GDP for 24 select countries. Even though the study does not provide individual cost components of the logistics costs, it still made an important contribution in estimating global level logistic cost.

By and large, a variant of this model has been adopted by Armstrong & Associates Inc. to provide estimates of logistics costs of all the major and emerging economics of the world. While this is indeed a commendable effort, caveats need to be emphasized. The neural model is estimated based on observed data of input variables (economy, infrastructure related variables for countries, which are readily available from in World Bank database) and output (here logistics cost as

percentage of GDP) variables of select developed countries. Typically, estimates of output variables (here logistics cost as percentage of GDP) of developed countries are available from alternative methods. So, one estimate a neural model for the control countries, which are basically the developed economies. Once the neural model is estimated for the control countries, the input variables for any country are put in the model to estimate the logistics cost as a percentage of GDP for the corresponding country. But for developing economies like India, where transaction costs are quite high in terms of costs and time, quality of physical infrastructure is inefficient, application of neural model estimated from developed economies data to assess logistics cost of India may provide erroneous result.

Coming to the methodology (2) mentioned above where estimates are based on primary/secondary data, the literature on logistics suggests two approaches to estimate logistics cost: the top-down and bottom-up approach. The top-down approach disaggregates data published in national accounts to a level that reflects transport, storage and other components of logistics cost as defined earlier. This method of calculating logistic cost is referred to as the disaggregated approach. The bottom-up approach computes logistics cost by aggregating detailed transport and warehousing data and relating it to the specific products. This method is referred to as the aggregated approach.

Most of the developed countries adopt the latter approach to estimate logistic cost. This approach is more data intensive. However, as the logistic sector is more organized in the developed countries, the respective industry collates these data for their own use and the governments of the respective countries also maintain such database.

Because of the scarcity of data, developing countries use the former approach to arrive at logistic cost. This needs to be supplemented with survey for the following reason:

- Compiling of national accounts statistics at a disaggregated level depends on various parametric estimates from survey data, which are not up-to-date. For this reason, surveys are undertaken to derive up-to-date estimate of elements of logistics cost.
- Some elements of logistics may not be available from national accounts statistics. For this reason, one may need to undertake survey. This is particularly true of the following components namely, administration and management cost of distribution.

Some of the countries (example South Africa) adopt a hybrid approach (top down and bottom-up approach) which has the following advantages over other commonly applied methods:

- a) Aggregated and disaggregated approaches are entirely independent in their methods of analysis and source of data. This not only allows for logical checks, but it also allows the assessment of the propensity to outsource logistics tasks.
- b) The aggregated approach builds up the cost of logistics from its most detailed input elements. This is in contrast to the methods commonly used to extrapolate cost data based on sample surveys. The validity of data could be verified at the primary source before any aggregation takes place.
- c) The aggregate approach can be undertaken in a MS Excel spreadsheet platform. So, one can undertake sensitivity analyses by varying the parameters of the model (viz. mode of transport, cost per ton km, packaging cost, etc.)
- d) The model focuses research on the refinement of individual input elements. It would even be possible to add more layers for the analysis of a particular industry in more detail.

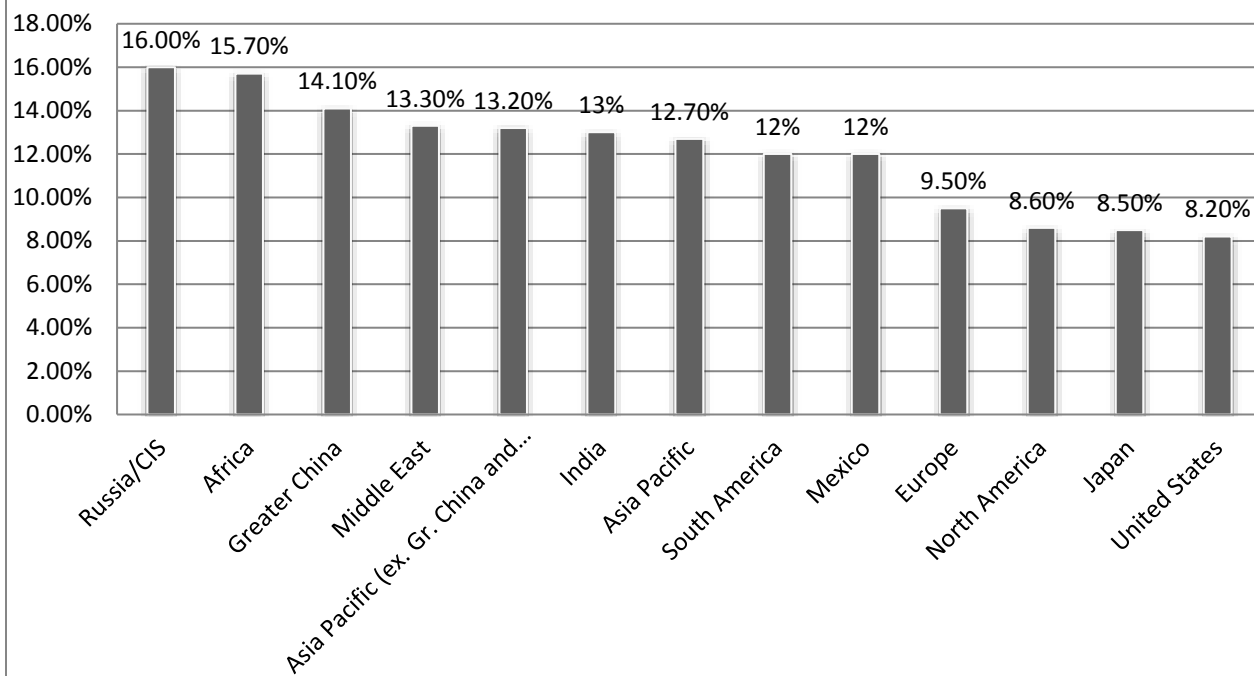
#### **4. Review of Cross-country Logistics cost**

We now start with statistics-based studies, and look at some single country and multi- country studies on logistics cost estimation. For Canada and United States, we look at the logistic costs studies that were done in 2005, when Industry Canada initiated a project for assessing the costs. The study included the following publications: Industry Canada – Logistics Cost and Agility Assessment Tool, SCM and KPI Analysis – A Canada / United States Perspective and State of Logistics: The Canadian Report 2008. The methodology is based on the models drawn upon the data collected from the Bureau of Economic Analysis (US) and Statistics Canada. A three-level breakdown of logistics costs classifying costs as internal, inventory, and outsourced is used. In contrast to the commonly applied method of ‘activity-based grouping’, this method is somewhat ambiguous.

For Europe, the total logistics cost were measured by Klaus and Kille in 2007. For this, they used two approaches. The first one uses data on freight tonnages transported by road, which is used to extrapolate all up and downstream functions. Measurements of road transport sector in Germany, with some changes to adjust for the national differences, it is possible to measure the size of the complete European road system, and hence the total logistics market. The other approach is to use national economy’s data on value-creating activities. For the 2007 and 2011 study, transportation costs have the largest logistics costs component, followed by warehousing and inventory costs for the Europe.

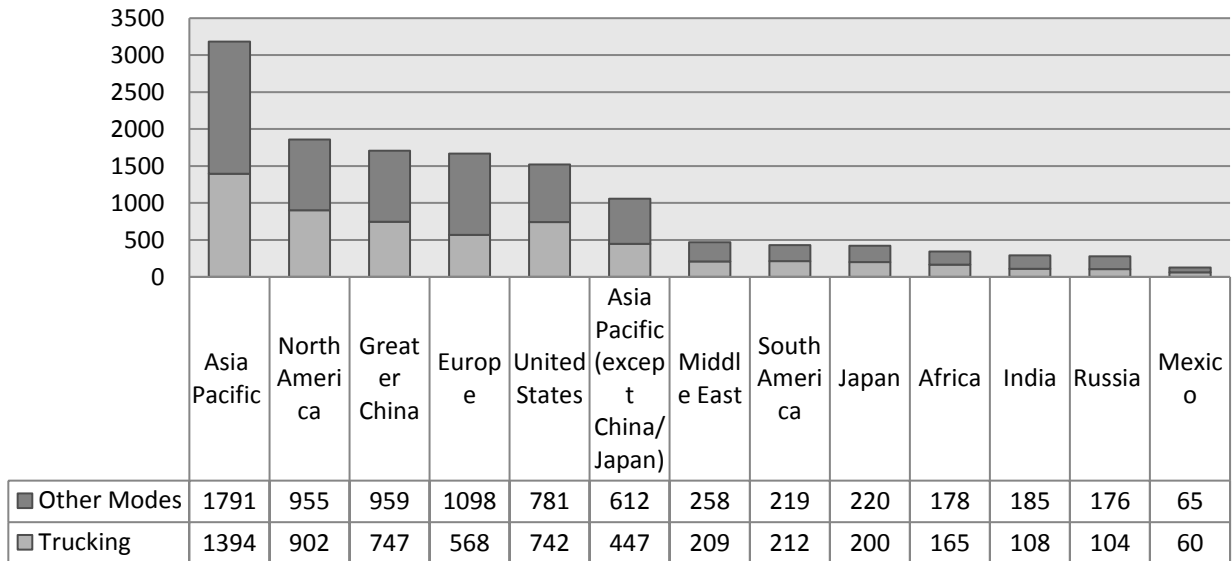
As per the Armstrong & Associates report (2017), for 2016, globally, in terms of logistics costs as a percentage of GDP, we can see that for the developing countries, the costs lie in the range of 11-15 per cent (Fig. 2)

**Figure 2 Logistics Costs for Key Regions and Countries as a % of GDP, year 2016**

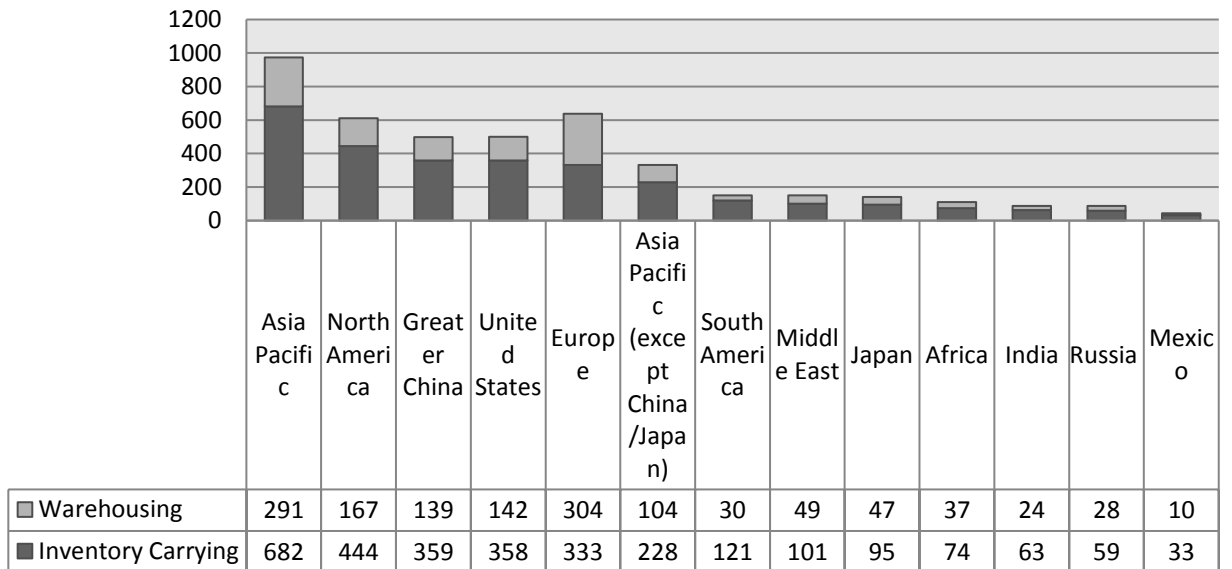


In Fig. 3 and Fig. 4, using the Armstrong & Associates report (2017), we have described the logistics costs of transportation (in particular trucking costs), inventory carrying costs, and warehousing costs of the key global regions for the year 2016. From Fig. 3, we can see that road transport/trucking is a major component of logistics costs, and other modes of transport like air and sea are secondary in terms of logistics costs. Fig. 4 confirms the global pattern that after transportation costs, Inventory carrying are second in order, followed by the warehousing costs.

**Figure 3 Trucking and Total Logistics Costs for Key Regions and Countries, 2016 (US\$ Billions)**



**Figure 4 Inventory Carrying and Warehousing Costs for Key Regions and Countries, 2016 (US\$ Billions)**



In the context of India, there have been no attempt to estimate logistics cost by the official statistical organization. However, private bodies have computed logistics cost, which are widely quoted to stress the point that India is a nation of high logistics cost. The notable among them are the estimates computed by Armstrong & Associates report (2017). For India, the logistic costs numbers for the year 2016 were: US \$108 billion for the highway-based trucking transportation, US \$63 billion in the inventory carrying costs, and US \$24 billion in the warehousing costs. Overall, the logistic cost turns out to be 13 per cent of GDP for the year 2016. This estimate is based on their neural model, the weaknesses of the same has already been pointed out earlier. Besides this, AVALON consulting firm undertook an exercise to estimate logistics costs of India

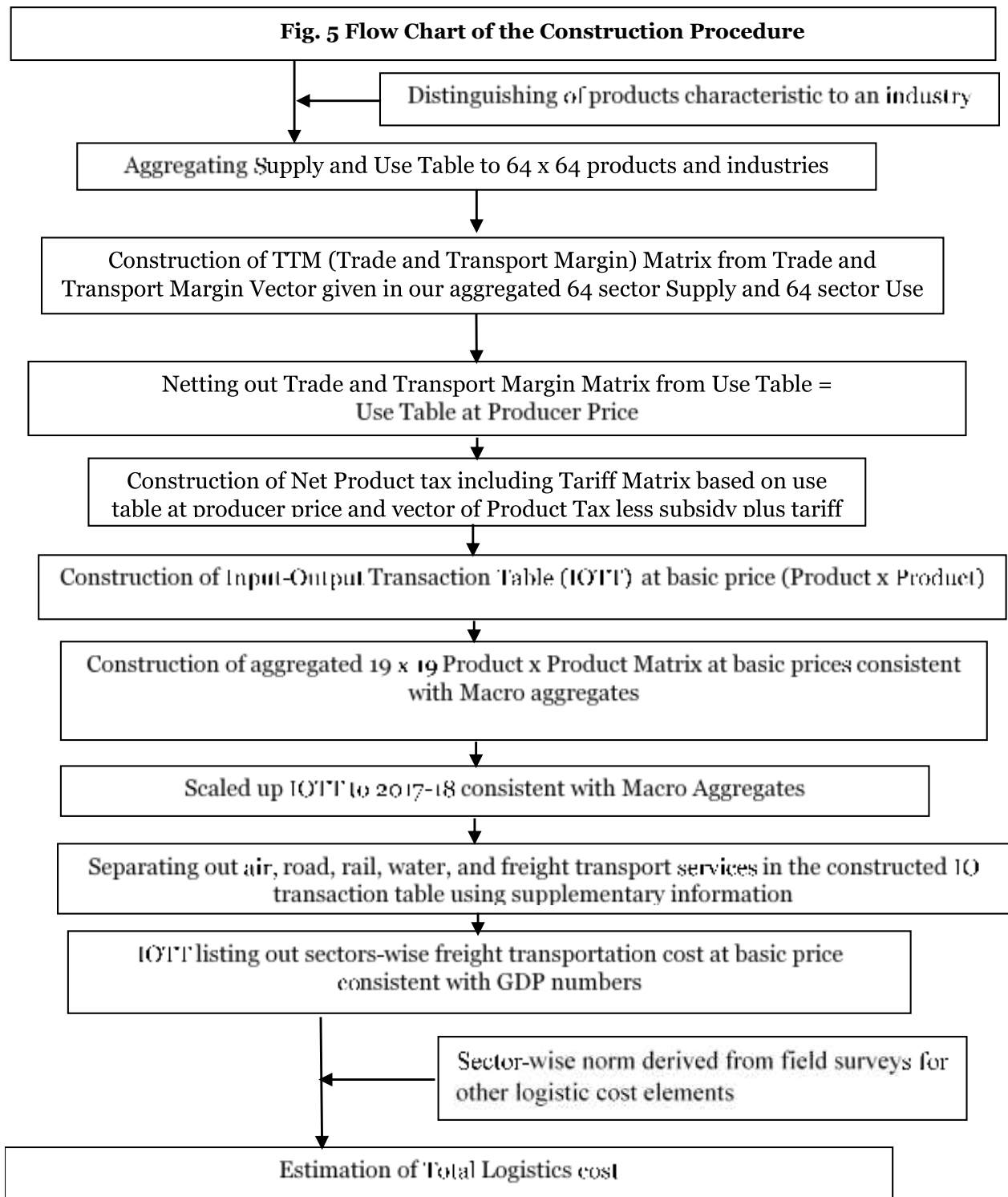
for Confederation of Indian Industries (CII). According to their report, the logistics cost for India is estimated to be 10.9 per cent of the gross value added (GVA) in 2015. The same has adopted a questionnaire based approach to estimate logistics cost of India. Basically, the stake-holders in major industries are asked to report their assessment of logistics cost as per cent of gross value added. These are then weighed to arrive at an estimate of logistic cost for India taking into account the sectoral contribution to the economy.

Recently, an attempt has been made by Pratap, Gupta, Malik and Pohit (2019) to quantify the logistics cost of India for the year 2017-18. In their paper, they have attempted to capture following logistics cost element in their estimation procedure:

- (i) Transportation Cost
- (ii) Other Logistics cost element
  - a. Material Handling
  - b. Warehousing
  - c. Administration cost
  - d. Cost of Logistics Equipment
  - e. Documentation
  - f. Insurance cost
  - g. IT - Hardware & Software Cost
  - h. Logistics System Management
  - i. Marketing cost
  - j. Packaging Costs
  - k. Speed Money
  - l. Software & Maintenance

The supply and use table (SUT) table has been the fulcrum of their estimation procedure. As the authors argue, any estimate of logistics cost derived from same would be consistent with GDP estimates derived from NAS as these portray the circular flows of goods and services in the economy.

In India, CSO released India's first SUT for 2012-13. These tables have been compiled at a level of disaggregation of 140 products and 66 industries. The authors have used these SUTs to prepare the symmetrical 64x64 input-output transaction table (IOTT) by making use of the industry technology and standard methodology suggested in the handbook of input-output published by the United Nations, 1999 (see the flow chart in Fig. 5). Since the input-output table derived from SUT would correspond to base year of SUT i.e. 2012-2013, there is the need to adjust the same for the reference year 2017-18 using the macro aggregates viz., GVA at basic price, net product tax including tariff and components of GDP expenditure. The input-output table of a country provides the cost structure of each sector of the economy by the principal inputs (goods and services), value added (returns to factors of production) and indirect taxes paid to the Government. Since transportation is a principal input in the production process, IO table typically provides estimates of such costs. However other cost elements are not usually shown as separate entry in an IO table, but rather are subsumed under service sector. The authors have attempted to cull out these costs using supplementary information from survey data. According to their findings, the total logistics cost of India turns out to be 8.81 per cent of GVA at basic price for the year 2017-18. This amounts to about 8.6 percent of GDPMP for the same year.







## Appendix

**Table A1: Cost components in literature and scientific articles combined components**

Publication (Year)	Bigoli 2010	Sople 2007	Ayers 2006	Lambert 2006	Rushton 2006	Kivinen 2004	Coyle 1998	Dimitrov 2001	Banomyong	Creazza 2010	Choi 2009	Jensen 2007	Dianwei 2006	Bowersox 2007	Zeng 2003	Bjornland 2001	NOU 1988
Transportation costs	√	√	√	√	√	√	√	√	√	√	√	√			√	√	√
Inventory carrying costs	√	√	√	√	√	√	√	√	√	√		√			√		
Warehousing costs	√	√	√	√	√	√	√		√		√	√			√		√
Packaging costs			√		√	√	√		√						√		
Administration costs					√		√				√	√			√		
Customer service				√		√			√								
Risk and damage																√	√
Insurance																√	√
Tied capital costs																√	√
Order processing/information	√			√					√	√							
Associated labor			√														
Capital costs of goods in transit	√																
Communication								√									
Consultancy						√											
Cost of damage during transit	√																
Fixed costs							√										
Logistics technology						√											
Lot quantity				√													
Manufacturing						√											
Procurement						√											
Purchased materials			√														
Quality control						√											
Recycling logistics						√											
Reverse logistics						√											
Stock-out costs	√																
Trade costs								√									
Value-added services						√											
Cost of commodities space movement													√				
Customs															√		
Design, restructure and option cost													√				
Forecasting									√								
Handling										√							
Indirect logistics costs												√					
Other costs													√				
Permission losses													√				
Procurement									√								
Substance consumption													√				
Returned goods									√								
Wages, bonus, allowance													√				

Source: Measuring Logistics Costs, Karri Rantasila (2013))

**Table A2: Cost components in Statistics-based studies**

Study (year of publication)	S- Africa (2011)	CSCMP (2011)	CFLP (2011)	Switzerland (2011)	Korea (2010)	Netherlands (2009)	Thailand (2009)	Canada (2008)	KPMG (2008)	Klaus (2010)	Morocco (2006)	Vinnova (2005)	COUNT
Scope (Multi/Single country)	S	S	S	S	S	S	S	M	S	M	S	S	
Cost components													
Transportation	√	√	√	√	√	√	√		√	√	√	√	11
Administration	√	√	√		√	√	√		√	√	√	√	10
Inventory-carrying	√	√			√	√	√	√		√	√	√	9
Warehousing	√			√		√			√	√	√	√	7
Cargo handling				√	√						√		3
Transport pack.			√		√						√		3
Communication											√		1
Customer service											√		1
Documentation											√		1
Equipment											√		1
Information					√								1
Insurance											√		1
Internal logistics costs								√					1
Internal services											√		1
Obsolescence											√		1
Outsourced logistics costs								√					1
Order processing										√			1
Other logistics				√									1
Plan/management						√							1
R&D											√		1
Shipper related		√											1

Source: Measuring Logistics Costs, Karri Rantasila (2013)

**Table A3: Cost components in Questionnaire-based studies**

Study (year of publication)	SCI (2011)	Davis (2010)	Finland (2010)	GMA (2010)	TOI (2010)	ELA (2009)	Norway (2000)	Aslog (2000)	Straube (2008)	Colombia (2008)	PwC (2008)	Japan (2007)	Baltic (2007)	TF 2003 (ind.)	TF 2003 (ref.)	COUNT
Scope (Multi/Single country)	S	M	S	M	S	M	S	S	M	S	S	S	M	S	S	
Cost components																
Transportation		√	√	√	√	√	√	√	√			√	√	√	√	12
Warehousing		√	√		√	√	√	√	√		√	√	√	√	√	12
Administration		√	√		√	√	√	√	√		√		√	√	√	11
Inventory carrying		√	√			√	√		√				√	√		7
Other logistics			√	√								√	√	√		5
Transport pack.			√		√		√									3
Insurance					√						√					2
Obsolescence					√		√									2
Customer serv./order entry		√							√							2
Appraisal												√				1
Cost of capital					√											1
Customs											√					1
Damages											√					1
Depreciation							√									1
Delivery											√					1
Distribution centers				√												1
Management/overhead				√												1
Other indirect log. costs							√									1
Shipper related											√					1

Source: Measuring Logistics Costs, Karri Rantasila (2013)

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