Quantifying Macro Logistics Cost of India

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Research

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Abstract

Globalisation has opened up economic opportunities for developing countries in the form of outflow of value-added services, low-cost raw materials , human resource skills, improved market access for their exports, efficiency gains in their economies through technology transfer and spill-over, and resource re-allocations. Consequently, various developing countries, including India, have increasingly begun to position themselves for greater participation in regional and global markets. It goes without saying that India needs to build its capacity for establishing linkages with global and regional markets for deriving the optimal benefits of engaging with the globalised world. This, in turn, depends on the creation of an efficient logistics system. For this purpose, most of the developed and emerging countries estimate logistics costs on a regular basis, and use performance indicators to measure the efficiency levels of logistics activities.

Till now, no attempt has been made to estimate logistics cost of India by the official statistical organisation. Two estimate of logistics cost computed by private bodies are usually quoted when one refers to Indian estimate. However, the methodology of the two needs serious introspection. In this context, this paper makes an attempt to estimate logistics cost of India.

1. Introduction

Unlike China, manufacturing sector has never been the driving force behind India's high growth trajectory (Mohan, 2017). It is often argued that the high logistics cost in India is a significant bottleneck for manufacturing sector's growth. Several reasons are cited for the high logistics cost in India. These include an unfavourable policy regime, lack of a multimodal transport system and the consequent heavy reliance on road transport, fragmented storage infrastructure, the presence of multiple stakeholders in the entire transport and storage value chain, poor quality of road and port infrastructure, and the absence of technology intervention in storage/transportation and distribution activities. The high logistics cost inevitably has an adverse effect on the country's competiveness in the globalised world.

While everybody understand the need for keeping logistics cost on the lower side, no serious effort has been made in India to quantify the same. In this context, an effort has been made to quantify the logistics cost of India. However before we attempt to quantify the cost, several issues need to be sorted. Firstly, what are the elements that should be considered in quantifying the logistics cost. Secondly, what approaches are adopted by the different researchers' world-wide to estimate logistics cost in general and whether the same can be replicated in the Indian context. Thirdly, what approach has been adopted by other studies in estimating logistic cost of India?

In practice, the logistics costs is measured in terms of a country's currency unit, or as share of country's gross domestic product (GDP), or as share of sales or turnover of an industry. It is customary to report it as a percentage of GDP for cross country comparison.

The plan of the rest of the paper is as follows. The next section provides a brief review of the literature on estimation of logistics cost and approach adopted by the different researchers. The lacunas are also discussed in this section. The emphasis of the literature survey is primarily on the studies that addresses the logistics cost of the nation (country) as this is the focal theme of this paper. The subsequent section describes the methodology adopted by the authors to estimate the logistics cost of India. Finally, Sect. 4 describes the results.

2. Review Of Literature: Estimating Logistics Cost

It must be pointed out that there is no standard nomenclature on what elements should be considered for quantifying logistics costs. In the literature, the following functions– order processing, inventory management, warehousing, transportation, material handling and storage, logistical packaging, and information– are generally considered the core components of logistics process and thereby should be into account while measuring logistics costs (Sopple, 2007).

Table 1 provides a summary of list of logistics cost components based on the literature review of some of the important publications. The list encompassed two dominant approaches namely, questionnaire-based surveys, and statistics-based studies. As Table 1 indicates, we can see that the five most common logistic cost components are: transportation costs, warehousing costs, inventory carrying costs, administration costs, and packaging costs.

Table 1
Count of Logistic cost components in the literature

Logistic Cost Components	Questionnaire based Surveys	Statistics based studies	Total Count
Transportation costs	12	11	23
Warehousing costs	12	7	19
Inventory carrying costs	7	9	16
Administration costs	11	10	21
Packaging costs	3	3	6
Other costs	5	1	6
Customer service	2	1	3
Order processing/information		2	2
Insurance	2	1	3
Handling		3	3
Risk and damage	1		1
Tied capital costs	1		1
Communication		1	1
Customs	1		1
Indirect logistics costs	1		1
Source: Compiled from Pohit et al (2019).			

With regard to the approaches to measure the logistic cost at the macro level, the literature proposes two principal ways (Rantasila, 2013):

1. Collate empirical data on elements of logistics cost through survey from respondents (survey method);
2. Use secondary data to derive logistics cost.

In the first approach, the information on logistics costs are collated from key-stakeholders of the industries using structured/semi-structured questionnaires. Generally questionnaires are canvassed to key persons (chief operating officers) in industries. The macro logistics cost of a country is subsequently derived by aggregated these costs by a suitable weighing scheme reflecting sectoral contributions in the economy.

In the second approach, attempts are made to use published macroeconomics data from national account statistics or other sources to quantify the logistics cost. This is usually complemented with primary surveys to quantify those costs which are usually not reflected as separate entries in macroeconomic data of a country. Some of the authors using this approach have also taken recourse to economic model to strengthen their estimates.

The following caveats however apply to both these methods. By and large, the logistics process involves multiple agents. So, collating information from multiple agents is always a difficult proposition (Farahani et.al. 2009). Of late, companies are increasingly outsourcing their logistics operations to third parties along with other complementary service activities. In such situation, identifying individual logistics function/activity is not an easy task (Rantasila, 2013).

Of course, second methodology can be applied in two ways: the top-down or bottom-up approach. In the top-down approach, data published in national accounts is disaggregated to a level that reflects transport, storage and other major components of logistics cost as defined earlier. In the bottom-up approach, the detailed cost data on transport, warehousing and other components of logistics activities are aggregated across products to arrive at logistics cost.

The latter approach is usually applied in most of the developed countries. It is a more data intensive process. The organized logistic sector in the developed countries generally collates these data for their own use and the governments of the respective countries also maintain such database. On the other hand, the logistics sector is by and large unorganized in a developing country. Such detailed data are not maintained by government or the logistics sector. Hence, the developing countries use the former approach in combination with surveys to arrive at logistic cost (Pohit et al, 2019).

The first notable attempt to measure logistic cost considered only four activities: transportation, inventory, warehousing, and order processing (Heskett, Glaskowsky, and Nocholas, 1973). This a model based approach, which has seen several transformation in their methodology. Currently, this adopts Artificial Neural Network (ANN) modelling framework for logistic cost assessment (Bowersox, 1998). The model uses five input variables namely, geographic region variables, economic variables, income level variables, transportation variables, and country size variables and provide as output the national level logistic cost as percentage of GDP for 24 select countries (Bowersox et al., 2005).

Armstrong & Associates Inc. has followed a similar approach to provide estimates of logistics costs of all the major and emerging economics of the world. Though these estimates may act as yardstick for respective countries to focus on their logistics inefficiencies, the drawback of this framework needs to be

bear in mind. The estimation of the parameters of their neural model rests on observed data of input variables (economy, infrastructure related variables for countries, which are readily available from in World Bank database) and output variables (here logistics cost as percentage of GDP) of select developed countries derived from alternative methods (for instance bottom-up approach). Having estimated the parameters of the model using developed countries' data, one estimates the logistics cost as a percentage of GDP of any country by feeding the values of the input variables for the corresponding country.

The reliability of estimates of logistics cost derived in this fashion for a developing economy like India may be questioned on several counts. The prevalence of high transaction cost in terms of bribes/speed money at each stage of logistics operations in a country like India is a fact (Pohit, 2016). If one uses data of developed countries to estimate the model where transaction cost is absent or negligible, the parameters may not reflect a developing country's perspective. The unpredictability of delivery schedule in India is also a fact due to poor quality of physical infrastructure. This is absent in developed country where predictability of delivery schedule is the hall mark of the logistics system.

The Central Statistical Organization, official body of the Government of India has made no attempt to measure logistics cost. This does not preclude private industrial bodies to compute logistics cost, which are found to be high by global standard. In absence of official estimates, these are widely quoted by the logistics players to stress the point that India is a nation of high logistics cost. Implicitly, these estimates are used by the stakeholders to extract higher tax incentives for the sector.

Among the published estimates, the notable one is the estimate provided by Armstrong & Associates report (2017). According to their estimates, India's logistics cost amounted to 13 per cent of GDP in 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) using a questionnaire based survey method. The senior management in the major industries were asked to report their assessment of logistics cost as per cent of gross value added. India's overall logistics cost is then estimated by weighing the sectoral cost with the sectoral shares of the respective industries in the economy. The exercise was done for the year 2015 and their estimate turned out to be 10.9 per cent of the gross value added (GVA). The weakness of this approach is the small size of sample focusing mainly on industries and extrapolating the estimates for non-coverage sectors based on other information.

In the light of the above discussion, we have laid out below our approach to quantifying the logistics cost of India.

3. Methodological Framework For Estimating India's Logistics Cost

As noted earlier, there is no standard world-wide nomenclature that defines logistics cost. Broadly speaking, the following are considered to be the core elements of logistics costs namely, handling and loading/unloading costs, packaging cost, insurance cost, transportation cost and management and administration costs. However surveying the literature on measurement of logistics cost, we have included a few additional logistics costs components for measuring the total logistics cost of India as indicated in Table 2. Note that we have incorporated the speed money (i.e. bribes) as part of the logistic cost as it is very much embedded in India's transportation system.

Table 2
Logistics Cost Components

Transportation
Other Logistics cost element
Material Handling
Warehousing
Administration cost
Cost of Logistics Equipment
Documentation
Insurance cost
IT - Hardware & Software Cost
Logistics System Management
Marketing cost
Packaging Costs
Speed Money
Software & Maintenance
Source: Authors' compilation

At the outset, India's National Accounts Statistics (NAS) published by Central Statistical Organisation (CSO), Government of India provide the national (macroeconomic) estimates of GDP, the balance of payments, national production, input costs, consumption, investment and other fundamental attributes of the national economy. To be specific, the cost estimates are more explicitly depicted in supply and use table (SUT), published by CSO which are also consistent with national accounts statistics. Nonetheless, the logistics cost estimates cannot be directly estimated from SUT as (a) the unit of analysis in

SUT or NAS is an establishment and (b) logistics operation transcend multiple industries/sectors and its costs are embedded in SUT/NAS but are not readily apparent as they are not shown in SUT/NAS as an independent entity.

The SUT table has been the fulcrum of our estimation of logistics costs as it is consistent with GDP estimates derived from NAS. The SUTs provide the statistical framework to include three major approaches to measure GDP, namely, production, income and expenditure, and hence enables the balanced estimate of GDP both at current prices and constant prices. In fact, these two tables detail the circular flows of goods and services in the economy.

The SUTs depicts, in matrices form, where the products come from and how they are used. Their main use is to act as an integration framework for balancing the national accounts, by recording how the supplies of different kinds of goods and services originate from domestic industries and imports and how those supplies are distributed between various intermediate or final uses (consumption, investment, exports).

The Supply Table and Use Table of India are product X industry matrices but their entries are different. In the Supply Table, each column presents the values of products (kept in rows) produced by an industry or the products supplied by industries to the economy distinguishing the domestic supply from foreign supply (imports). These are at basic prices. The total supply of each product at the purchaser's price has been obtained by adding taxes less subsidies on products and trade and transport margins.

On the other hand, a Use Table shows the use of the product (a good or service and kept in rows) by the type of use (kept in columns), that is, as intermediate consumption, gross capital formation, and exports. They are all at purchaser's price.

For balancing the two tables and finally bringing them to an analysis, it is essential that both the tables are brought to the same valuation prices.

The SUT for the year 2012-13 prepared by CSO is starting of our computation exercise. These tables consider 140 products and 66 industries. We made an effort of aggregating 140 products characteristics to 64 industries (see Appendix Table A1). The criterion of any product, to be the characteristics product(s) of an industry or in other words, any industry to be a producer of single or more products, is based on specialisation and coverage ratios based on supply matrix. The specialisation and coverage ratios are share matrices respectively in column totals and row totals. This provides us a mapping between 140 products and 64 industries.

The square SUT of 64 × 64 size is used for further converting into uniform input output (IO) table of 64 × 64 sectors 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. 1). The input-output table of a country implicitly estimates 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. IO tables generally tabulates transportation cost as the same is a principal input in the production process. However other cost elements are not usually shown as separate entry in an IO table, but rather are subsumed under service sector. Our purpose is to cull out these costs using supplementary information from survey data.

The next step involved in construction of IO table is the construction of trade and transport matrix (TTM). The TTMs matrix needs to be distinguished for both margin and non-margin manufacturing sectors. The services sector have no margin in TTMs matrix. The margin sectors are the following: railway transport, land transport, air transport, water transport, supporting and auxiliary transport activities. Each of the margin sector comprises of both passenger and freight segment. The values for non-margin sectors in TTM matrix is apportioned directly by using row shares of total use at purchaser's prices from TTM vector as provided in supply table. However, the entries for margin sectors are not direct and are based on sum of value of all non-margin entries in a column.

The sum total of the column value is further apportioned using a share of individual margin commodity vis–a-vis row sum of all the margin commodities together. The cell entries for margin sectors in TTMs are placed as negative values. We netted out TTM matrix from use table and further arrived at use table at producer prices. Similarly, we constructed matrix for net product tax including tariffs by similarly allocating net product tax including tariffs column. A point worth noting here is that the computing of net product matrix is straight unlike TTM matrix. We have taken out net product tax matrix from use table at producer prices, which further resulted into use table by product and industry dimensions. The table is subsequently transformed into use table at product x product and brought into import column into from supply table. This resulted into a 64–64 IO transaction table, 2012-13 at basic prices.

The 64 × 64 IO transaction table is further aggregated to 17 × 17 IO transaction table. The detailed mapping is given in Table 3.

The 17 sector uniform IO table is further scaled up to the year 2017-18 using latest national account statistics. The consistency of IO table hence prepared for 2017-18 is further checked for both income and expenditure side. The freight transport services which comprises of 72.45 per cent of total (passenger and freight) transport services are used for constructing a sector for freight transport services. The remaining passenger services are clubbed into other services. Finally, the share total intermediate use by freight transport services as GVA basic prices as well as GVA market prices is used to enumerate the freight cost.

Table 3
Concordance Between SUT 64 products 17 Products

Sl. No	Products	Aggregation of SUT 64 Products
1	Agriculture and Allied	1–4
2	Mining and Quarrying	5–10
3	Food, Beverage and Tobacco products	11–16
4	Textiles, Wearing Apparels and Leather Products	17–19
5	Ferrous & Non Ferrous Metal, and Metal Products	20–22
6	Consumer Electronics, Electronic Components, including Computer Peripherals	23–24
7	Machinery and Equipment	26–28
8	Chemical Rubber, Plastic Products including Petroleum Products	29–30,32
9	Drugs and Medicines	31
10	Cement	0.28137* 33
11	Other Non-Metallic Minerals Products	0.71863* 33
12	Wood & Wood Products	34
13	Other Manufacturing	25,35–38
14	Construction and Construction services	39
15	Electricity, Gas and Water Supply	40–42
16	Freight Transport Services	0.7245*(43–47)
17	Other Services	0.2755*(43–47), 48–64

Note: See Appendix Table A1 for description of SUT 64 products.

Source: Authors' compilation.

The updated input-output transaction table has been reported for 17 products. (See Appendix Table A5 for IOTT table). The aggregated constructed IO transaction table provides freight transportation for all sectors of the economy.

As mentioned earlier, we have computed sector-wise norm of other logistic cost elements given in Table 2 relative to transportation cost from survey data. These norms have been applied to cull out other logistics cost element from each sector's service input cost. The other logistic cost element are principally services activities which any industry/sector needs for production activities. So, they are accounted in IO transaction table under service input cost element. Summing up sector-wise logistics cost (freight transportation cost, freight material handling cost, and other logistic cost element) across sectors provides India's total logistics costs.

4. Results

Table 4 shows our estimates of the logistics cost for the year 2017-18. As this table shows, the total logistics cost turns out to be 8.87 per cent of GVA at basic prices. As Table 4 shows, there are variation across sectors depending on the nature of the products (low value or high products, bulk or non-bulk commodities). It is generally observed that low value items or bulk items have higher logistics costs.

It must be noted the logistics cost displayed above is in no way an indicator of the contribution of the logistics sector to the economy. The number estimated above only reflects the logistics cost to the economy in the year 2017-18.

Table 4
Logistic cost of India, 2017-18

Sl. No.	Sectors	Transport Cost	Total Logistics Cost	GVA at Basic Price	Logistics Cost as Per cent of GVA
		Rs Crores	Rs Crores	Rs Crores	Per cent
1	Agriculture and Allied	265765	528615	2447239	21.60
2	Mining and Quarrying	35113	42136	377628	11.16
3	Food, Beverage and Tobacco products	28677	56890	462892	12.29
4	Textiles, Wearing Apparels and Leather Products	14879	29487	372665	7.91
5	Ferrous & Non Ferrous Metal, and Metal Products	39121	58681	380694	15.41
6	Consumer electronics, Electronic Components, incl. Computer etc.	1010	2040	48644	4.19
7	Machinery and Equipment	49643	97109	540177	17.98
8	Chemical Rubber, Plastic Product incl. Petroleum Products	30944	56490	662244	8.53
9	Drugs and Medicines	1489	2951	98679	2.99
10	Cement	2966	5873	45295	12.97
11	Other Non-Metallic Minerals Products	5487	10873	115686	9.40
12	Wood & Wood Product	1072	2112	37636	5.61
13	Other Manufacturing	6110	12446	223606	5.57
14	Construction	82304	123456	1530234	8.07
15	Electricity, Gas and Water Supply	5947	8920	445792	2.00
16	Other services	191773	287659	7156601	4.02
	Aggregate	762300	1325738	14945714	8.87
Source: Authors' computations					

List Of Abbreviations

- GDP Gross domestic product
- ANN Artificial Neural Network
- CII Confederation of Indian Industries
- GVA Gross value added
- NAS National Accounts Statistics
- CSO Central Statistical Organisation
- SUT Supply and use table
- IO Input output
- TTM Trade and transport matrix

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The principal data for the paper has been shared. The primary survey data is not shared as our organization policy.

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Authors' contributions

All the authors have equally contributed to the paper.

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Conflict of Interest Statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Figures

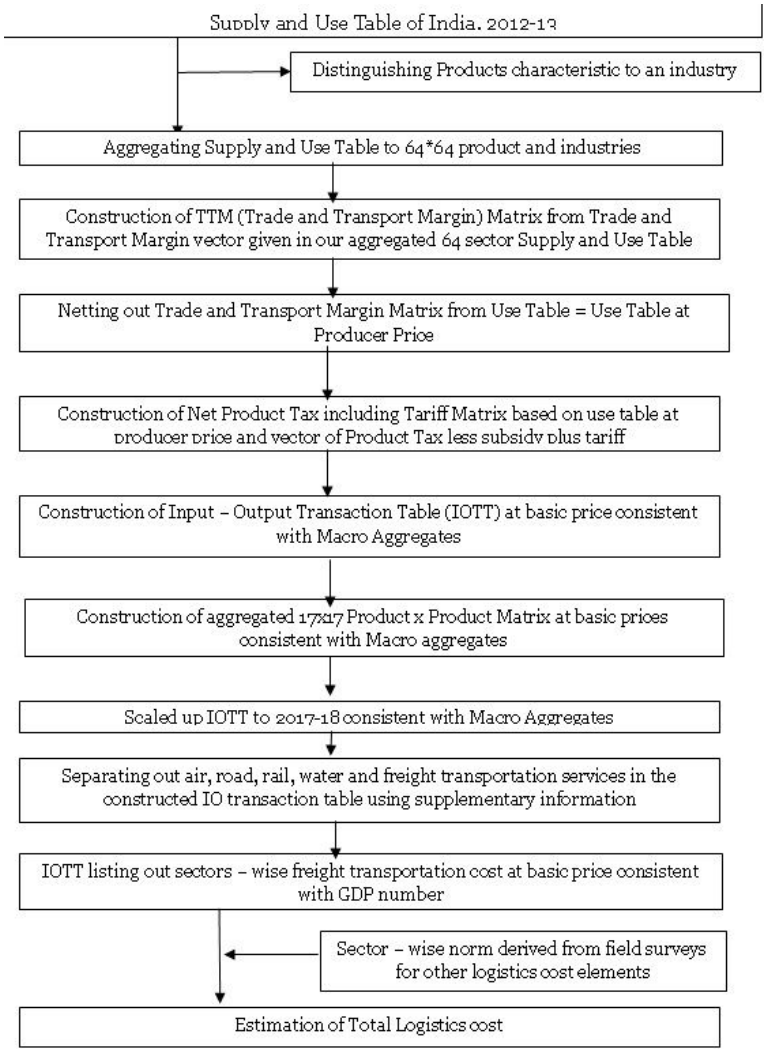

Figure 1

Flow Chart of the Construction Procedure

Supplementary Files

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