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Transportation Cost and Trade Competitiveness: Empirical Evidence from India

Prabir De* and
Bhisma Rout**

Abstract: India has been witnessing a sharp rise in merchandise trade and showing greater trade interdependence on a large variety of goods, particularly in intermediate and capital goods. However, higher transportation costs continue to impede India's trade. Costlier transportation prohibits trade in India and taxes the trade in the way tariff does. This paper provides sufficient evidence to ascertain that variations in ad-valorem transportation costs strongly influence trade flows in India. Another conclusion of this paper is that transportation cost is relatively more important than tariff in enhancing India's merchandise trade. Reduction in transportation costs should therefore get utmost priority while formulating policy for India's infrastructure development and trade facilitation since the fall in transportation costs, as an outcome of improved infrastructure, will stimulate trade. The challenge for India is thus to identify improvements in trade facilitation, logistics services and related infrastructure that can be achieved in the short-to-medium term and that would have a significant impact on trade competitiveness of India.

1. Introduction

The last few decades have seen significant changes in economic integration. A growing number of researchers have started to reveal a long list of trade barriers that affect economic integration process.[1] These barriers, as listed by Anderson and van Wincoop, broadly are

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> "The 170 percent of 'representative' trade costs in industrialized countries breaks down into 21 percent transportation costs, 44 percent border related trade barriers and 55 percent retail and wholesale distribution costs." (Anderson and van Wincoop, 2004, p. 69)

On the other, a good number of studies have indicated that the benefits of trade liberalisation have been so far remained limited, since a large part of developing world and LDCs have failed to manage the rising trade transportation costs, both inland and international (Wilson *et al*, 2003; WTO, 2004). Another set of theoretical and empirical literature has shown that poor infrastructure and narrow trade facilitation measures have negatively affected country's trade and income.[2]

This vast literature has formed the basis for much of the policy advice offered to developing countries and LDCs on trade facilitation. Its thrust has been on trade and transport facilitation steps, which are needed in order to reduce transportation costs in general, and to eliminate border delays, enhance trade efficiency, effect technological upgradation at borders and train human resources for dealing with external trade in particular. What matters is that in a highly competitive world economy, transportation cost is a significant determinant of country's trade competitiveness.

The reasons for making study of trade costs in case of India relevant for trade policy makers include: on one hand, India's import is growing at increasing rate, where higher trade costs push up the landed price of imports, ceteris paribus, and, on the other, India's trade covers an increasingly large volume of intermediate goods and raw materials, where expensive imports, resulting from higher trade costs, escalate the cost of production. Therefore, understanding the trade transportation costs will help evaluate the required transportation services and trade facilitation in the era of globalisation.

One of the objectives of this paper is therefore to understand the magnitude of trade transportation costs of India's merchandise trade.[3] How is India doing in reducing trade costs? Which barriers matter most– tariff or transport cost? How the estimates of freight rates look like across countries? By estimating the trade transportation costs for India's merchandise

trade with its major trading partners at commodity levels and by using some direct and indirect evidences on trade barriers, this paper provides empirical evidence to show that an important impediment for trade expansion in India is high trade transportation costs. We report evidence that the lower transportation cost is not only crucial for expanding India's trade but also a decisive factor in integrating the economies engaged in trade. The remaining part of the paper is organised as follows.

Section 2 provides the data and methodology. Section 3 presents an overview of how goods are transferred across international border. Since international transportation costs depend, to a great extent, on the ocean freight rates, our next task is to understand the relative importance of freight rates, which we deal in Section 4. Section 5 provides an illustration of composition of transportation costs in India. The aforesaid discussion is finally wrapped up with a formal assessment of the relationship between trade costs elements and trade flows in Section 6. We attempt to measure the impact of trade costs on trade flow in a comparative static framework. Econometric results are presented and discussed in this section, followed by conclusions in Section 7.

2. Definition, Data and Methodology

In general, an exporter or importer incurs trade costs at all phases of the export or import process, starting from obtaining information about market conditions in any given foreign market to ending with receipt of the final payment. One part of trade costs is trader-specific and depends upon a trader's operational efficiency. The magnitude of trade costs elements diminishes with an increase in the efficiency level of the trader, under the prevailing framework of any economy. The other part of trade costs is specific to the trading environment and is incurred by the traders due to in-built inefficiencies in the trading environment. It includes institutional bottlenecks (transport, regulatory and other logistics infrastructure), information asymmetry and administrative power that give rise to rent-seeking activities by government officials at various stages of transaction. This may cost traders (or their country) time and money including demurrage charges, making transactions more expensive.

In broad terms, trade costs include all costs incurred in getting a merchandise to a final user other than the cost of producing it, such as transportation costs (both freight costs and time costs), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, local distribution costs (wholesale and retail) and so forth.[4] This means two things. First, trade cost is measured as a mark-up between export and import prices, where this mark-up roughly indicates the relative costs of transfer of goods from one country to another. Second, trade costs are reported in terms of their ad-valorem tax equivalent.

Trade costs are generally quite large, even aside from trade policy barriers and even between apparently highly integrated economies. While explaining trade costs, Anderson and van Wincoop (2004) cited the example of Mattel's Barbie doll, which was discussed in Feenstra (1998). Feenstra indicated that the production costs for the doll were US$ 1, while it sold for about US$ 10 in the United States. The cost of transportation, marketing, wholesaling and retailing represent an ad-valorem tax equivalent of 900 percent. Anderson and van Wincoop (2004) commented: "Tax equivalent of representative trade costs for rich countries is 170 percent. This includes all transport, border-related and local distribution costs from foreign producer to final user in the domestic country. Trade costs are richly linked to economic policy. Direct policy instruments (tariffs, the tariff equivalents of quotas and trade barriers associated with the exchange rate system) are less important than other policies (transport infrastructure investment, law enforcement and related property rights institutions, informational institutions, regulation, language)."

Direct evidence on border costs shows that tariff barriers are now low in most countries, on average (trade-weighted) less than 5 percent for rich countries, and with a few exceptions are on average between 10 and 20 percent for developing countries.[5] While the world has witnessed a drastic fall in tariffs over the last two decades, a whole lot of barriers remain which penalise trade. Some among them are termed as 'soft' barriers and others as 'hard' barriers. One set of such 'soft' barriers are dealt with trade and business facilitation measures, and the 'hard' set of barriers, which are often cited as physical or infrastructure barriers, are dealt with transport

facilitation measures. For our understanding, the costs appearing from these barriers may be termed as trade costs.

High trade costs are an obstacle to trade and impede the realization of gains from trade liberalisation. Most of the studies on trade costs show that integration is the result of reduced costs of transportation in particular and other infrastructure services in general.[6] The supply constraints are the primary factors that have limited the ability of many developing countries and LDCs to exploit trade opportunities arising from trade liberalisation. Realization of optimal gain from trade, therefore, depends not only on tariff liberalisation but also on the quality of infrastructure and related services associated with trading across borders.

The cost of international transportation is a crucial determinant of a country's trade competitiveness. Doubling of a country's transportation costs leads to a drop in its trade by 80 percent or even more (Limao and Veneables, 2001). Shipping costs, the major element of transportation costs, represent a greater burden than tariffs.[7] The effective rate of protection provided by the international transport costs in many cases was found to be higher than that provided by tariffs.[8] For example, fuel surcharge on sea freight increased from US$ 455/FEU in January 2007 to US$ 1130/FEU in July 2008 in Asia.[9] High energy costs translate directly into higher shipping costs. It is noted in Rubin and Tal (2008) that at US$ 150 per barrel, the tariff-equivalent rates is 11 per cent, going back to the average tariff rates of the 1970s. Therefore, shipping costs represent a more binding constraint to greater participation in international trade than tariffs and other trade barriers. Complimentary trade policies focusing inland and international transport costs have, therefore, gained immense importance in enhancing international trade and integration.[10]

In this paper, we attempt to assess the impact of trade costs (barriers to trade) on trade flows. We are interested to understand how changes in major trade costs components affect changes in India's import demand. Therefore, we first estimate the impact of transport costs and other barriers to import, controlling for other variables. We deal with only those barriers (components of trade costs), which are imposed by policy

(e.g. transportation costs and tariff rates). To attain this objective, we first aggregate the freight rates by partner countries, which help us to estimate the ad-valorem transportation cost.

Aggregated Freight Rates

The cost of transportation of merchandise from one country to another is a combination of two major components: inland and international transportation costs. Understanding the unit freight rate in two legs of the journey – inland and international - will help us to know the variation in cost of transportation across commodities in India.

We first derive the freight rate, which is a weighted average of all commodity groups across India's major trading partners for both international and inland shipments of a container from abroad to India. We use equations (1) and (2) to estimate the country-wise freight rate (weighted average) per container for both inland and international shipment.

$$F_{ij} = \frac{\sum_k Q_{ij}^k f_{ij}^k}{\sum_k Q_{ij}^k} \quad \text{..... (1)}$$

$$F_i = 1/n\,(F_{ij}) \quad \text{.....(2)}$$

where, F_i represents the weighted average freight rate per container of country i (India), which is averaged over all commodity groups across all trading partners of country i, F_{ij} denotes the weighted average freight rate per container for country i for import of commodity k from country j, Q^k_{ij} stands for import of commodity k in TEU by country i from country j, f^k_{ij} represents freight rate per TEU of import of commodity k by country i from country j, k is the commodity group traded (at 4-digit HS) between partners i and j, and n is number of bilateral trading partners of i. We collect f^k_{ij} for inland and international shipment separately. F_i is estimated from 4-digit HS for imports of country i from its partner for the years 1996 and 2006.[11]

Estimated Ad-valorem Transportation Costs

We attempt to measure the ad-valorem transportation cost for a shipment of a container from partner (exporting) countries to India.[12] The ad-valorem (trade-weighted) transportation costs provide us US$ transport cost per US$ of import. We use equation (3) to estimate commodity distribution of ad-valorem transportation cost (*AdvTC*) for import of country i (India) from country j.

$$AdvTC_i^k = \frac{\sum_l Q_{ij}^k f_{ij}^k}{\sum_l M_{ij}^k} * 100 \quad \text{..... (3)}$$

where $AdvTC^k_i$ represents ad-valorem transportation costs respectively for country i (India) for commodity k, Q^k_{ij} stands for import of commodity group k in weight (here, in TEU) by country i from country j, f^k_{ij} represents inland freight rate per TEU for import of commodity k by country i from country j, M^k_{ij} stands for import of commodity group k in value (here, in US$) by country i from country j, k is the commodity group traded at 4-digit HS. The transport costs are estimated for k commodity group for imports of country i from its partner for the years 1996 and 2006. Here, the ad-valorem transportation cost is estimated as percentage of total import.

Weight-Value Ratio

To evaluate the transportation needs, it is useful to compare the trade growth in relation to transport costs. We calculate weight-value ratio of India for its international trade with the help of equation (4).[13]

$$w_{it} = \sum_k S_{ikt} w_k \quad \text{.....(4)}$$

where w_k is the median weight/value ratio for each HS 4 digit commodity k in imports (exports) for the year 2006, S_{ikt} is the share of product k in the trade bundle of country i at time t, and w_{it} is the aggregate weight-value ratio for country i's imports for the year t. We report the weight-value ratio (measured in kg per 100 US$) for India's imports.

Commodity-wise fright rates for inland and international shipments were collected from Maersk Sealand (2008),[14] whereas country's imports at 4-digit HS were collected from COMTRADE (UN, 2008).[15]

The Model

In order to explore the impact of trade costs on trade flows, the following constant elasticity of substitution (CES) equation is considered.

$$U_i = \left(\sum_j \lambda_j x^{1/\theta} \right)^{\theta} \quad \text{.....(5)}$$

where, i and j are importing and exporting countries, respectively, $\theta = \sigma / (1- \sigma)$. We treat λ is a quality shifter specific to exporter j, or, in other words, it represents the number of unique varieties being produced by exporter j.

We write the import demand for a product is as follows.

$$q_{ij} = E_i \left(\frac{\lambda_j}{p_j} \right)^{\sigma} t_{ij}^{-\sigma} \quad \text{.....(6)}$$

where q_{ij} is value of import of i from j, t is trade cost component, E is real expenditures on a product (expenditures divided by the price level), which we do not observe but proxy it by country's GDP.[16] Similarly, λ/p are not really observable due to poor quality of measures of p, and also contaminated by quality differences.[17] We want prices net of quality differences and quality itself, but we can not observe those. We want to control for a demand shifter that is exporter specific – India is different from China, certainly in its size and probably in the quality of the products it makes so we want to keep that out. Therefore, we have to omit those things we can not observe. We take care this in following ways.

First, we take a log and use a vector of importer and exporter fixed effects, and we get equations (7).

$$\ln q_{ij} = \ln E_i + \sigma \ln \left(\frac{\lambda_j}{p_j} \right) - \sigma \ln t_{ij} \quad \text{.....(7)}$$

Second, we replace t_{ij} by ad-valorem transportation cost. We write the trade cost vector as follows.

$$\begin{aligned} t_{ij} &= TAR_{ij} f_{ij} \\ &= TAR_{ij} (F_{ij} / V_{ij}) \end{aligned} \quad \text{..... (8)}$$

where f_{ij} is the ad-valorem equivalent of the transport cost, F_{ij} is the freight cost in TEU and V_{ij} is the import value per TEU. Since our purpose is to assess the impact of trade cost components on trade over time, we consider two cross-section years, namely, 1996 and 2006. We rewrite the equation (6) as follows.

$$\frac{q_{ij2006}}{q_{ij1996}} = \frac{E_{i2006} \left(\frac{\lambda_{j2006}}{p_{j2006}} \right)^{\sigma} t_{ij2006}^{-\sigma}}{E_{i1996} \left(\frac{\lambda_{j1996}}{p_{j1996}} \right)^{\sigma} t_{ij1996}^{-\sigma}} \quad \text{.....(9)}$$

By taking log, we get

$$\ln \frac{q_{ij2006}}{q_{ij1996}} = \ln \left(\frac{E_{i2006}}{E_{i1996}} \right) + \sigma \ln \left(\frac{\frac{\lambda_{j2006}}{p_{j2006}}}{\frac{\lambda_{j1996}}{p_{j1996}}} \right) - \sigma \ln \left(\frac{t_{ij2006}}{t_{ij1996}} \right) \text{..... (10)}$$

We incorporate exporter fixed effects to take care expenditures or the quality or the price parameters, and rewrite it as follows.

$$\ln \frac{q_{ij2006}}{q_{ij1996}} = \alpha + A_j - \sigma \ln \left(\frac{t_{ij2006}}{t_{ij1996}} \right) \quad \text{.....(11)}$$

Now, we substitute the trade costs elements by tariff (TAR_{ij}) and transport cost (TC_{ij}), and rewrite the equation (10) as follows.

$$\ln \frac{q_{ij2006}}{q_{ij1996}} = \alpha + A_j - \sigma \ln\left(\frac{TAR_{ij2006}}{TAR_{ij1996}}\right) - \sigma \ln\left(\frac{TC_{ij2006}}{TC_{ij1996}}\right) + \varepsilon_{ij} \text{ ..... (12)}$$

where, i and j are importing (India) and exporting (India's partner) countries. Tariff represents weighted applied rate whereas transport cost is taken at ad-valorem equivalent. The parameters to be estimated are denoted by α and σ, and e_{ij} is the error term.

The model considered here uses data for the years 1996 and 2006 at 4-digit HS for India's imports from 24 major trade partners. The model considers data at the bilateral level for all the variables for their individual partners. By taking tariffs and transport costs, we cover a major portion of trade costs. Bilateral trade, transport costs, and tariffs are estimated from 4-digit HS for the years 1996 and 2006.[18] While bilateral trade was collected from UN COMTRADE (UN, 2008), tariff (applied) was sourced from WITS (World Bank, 2008).

3. How Goods Move in India

About 23 percent of world trade by value occurs between countries that share a land border and this proportion has been nearly constant over recent decades, though it varies significantly across continents (Hummels, 2007). For India, between 1 and 5 percent of trade by value is with land-neighbouring countries (De, 2008c). For trade with nonadjacent partners, nearly all merchandise trade moves by using ocean and air modes. Bulk commodities like oil and petroleum products, minerals and grains are shipped almost exclusively via ocean cargo. Bulk cargoes constitute the majority of international trade when measured in terms of weight, but are a much smaller and shrinking share of trade when measured in value terms. Manufactured goods are the largest and most rapidly growing portion of world trade. Table 1 reports worldwide data on ocean and air shipping and non-bulk-traded goods.

Table 1: India's Trade of Non-bulk Goods*

Year	Trade Volume			Share in Total Trade		Annual Growth#	
	Ocean (MT)	Air (MT)	Total (MT)	Ocean (%)	Air (%)	Ocean (%)	Air (%)
1981-82	2.16	0.07	2.24	96.65	3.35	15.28	1.21
1991-92	6.72	0.07	6.79	98.90	1.10	-12.74	-26.09
2000-01	32.34	0.10	32.44	99.69	0.31	16.06	0.91
2001-02	37.25	0.10	37.35	99.74	0.26	15.18	-3.65
2002-03	43.69	0.10	43.80	99.76	0.24	17.29	6.31
2003-04	51.04	0.10	51.13	99.81	0.19	16.80	-5.86
2004-05	54.79	0.11	54.90	99.80	0.20	7.36	14.75
2005-06	62.01	0.11	62.12	99.82	0.18	13.17	0.03
2006-07	73.49	0.12	73.61	99.84	0.16	18.52	5.99
Annualised growth rates (%) for India							
1981-2006	15.85	2.54					
1981-1990	15.88	3.90					
1991-2006	15.83	1.77					
2000-2006	14.91	2.64					
Annualised growth rates (%) for World**							
1951-2004	4.43	11.72					
1975 -2004	3.82	8.35					

Notes: *Both export and import. #Year to year. ^MT stands for Million tonnes
Sources: 1. Calculated based on Ministry of Shipping, *Basic Port Statistics of India*, various issues, and Ministry of Civil Aviation, *Aviation Statistics of India,* various issues.
** Taken from Table 1B of Hummles (2007).

Air shipments in India, which used to share about 3.35 percent of total tons in 1981, represent less than one percent of total tons shipped, but are growing at 2.54 percent per annum, much less than world air shipment growth. Compared to air, ocean shipments grew rapidly. The relative growth of ocean shipping is even more apparent in terms of tonnages shipped, with 15.85 per annum growth rates going back to 1981.

Contrary to popular belief, India has witnessed a scenario which is just opposite of the world trend in terms of weights. Air shipping has become the fastest growing mode of transportation in world, whereas the ocean

shipping is the prime mode of international trade transportation in India. Whilst the share of ocean shipping in country's merchandise trade increased from 96.65 percent in 1981-82 to 99.84 percent in 2006-07, the share of air shipping in India's total trade, in contrast, decreased from 3.35 percent in 1981-82 to 0.16 percent in 2006-07.

Why has air transport grown so rapidly in world? A major factor has been a sharp decline in the relative cost of air shipping. Hummels (2007) commented: "a dollar of traded merchandise weighs much less today than in previous years". Putting it differently, a fall in the weight/value ratio of trade leads to more air transport. In contrast, why has ocean transport grown rapidly in India? One reason could be that India trades more in heaviest goods with nonadjacent partners which travel via ocean only.

In general, air shipping is yet to make any substantial foray in India. Therefore, when ocean shipping is the prevalent mode of transportation in India, investigating both explicit and implicit costs of transportation would be very useful in order to understand the economic importance of transportation costs. We look at this perspective by examining (i) transportation costs relative to other known barriers to trade, like tariffs; (ii) transportation costs relative to the value of the goods being moved, and (iii) the extent to which transportation costs alter relative prices and trade flows.

4. Relative Importance of Ocean Freight

Containerization in ocean transportation has changed the composition of freight rates, where freight (ocean) cost is one of the major components of international transportation costs.[19] It has an impact on trade equivalent same as tariffs.[20] Freight costs vary across regions, where inefficient transport services could be the potential element for freight costs differentials resulting in longer time of delivery. Inefficient transport services are reflected in higher freight costs and longer time for delivery. Table 2 provides a comparison of levels of freight rates across countries for India's imports for the years 2006 and 1996 and the corresponding growth rates.[21] Following observations are worth noting.

Table 2: India's Imports by Partners and Ocean Freight Rate

Origin (Exporter)	Distance# (km)	Import Weight (MT)	Share* (%)	Ocean Freight Rate (US$/TEU)		Annual Rate of Change in Ocean Freight (%)
	2006	2006	2006	2006	1996	1996-2006
China	3775	5.03	9.52	2289	1104	10.73
Nepal	799	3.98	7.53	350	202	7.33
Indonesia	4993	3.58	6.78	2546	911	17.96
Russia	4331	3.25	6.15	4390	3288	3.35
UAE	2316	2.93	5.55	1672	890	8.79
USA	12040	2.85	5.40	6522	3550	8.37
Canada	11325	2.75	5.20	7634	3209	13.79
Jordan	3955	2.37	4.48	2902	1187	14.45
Morocco	7769	2.20	4.16	3187	1870	7.04
Australia	10348	1.85	3.50	4398	2785	5.79
Malaysia	3839	1.69	3.19	1877	741	15.35
Iran	2540	1.65	3.12	1870	882	11.20
Thailand	2916	1.58	3.00	1881	1011	8.61
Korea	4681	1.52	2.88	2310	1178	9.61
Saudi Arabia	3050	1.48	2.79	3843	2091	8.38
Argentina	15791	1.32	2.49	8220	6938	1.85
Ukraine	5254	1.24	2.34	3882	2812	3.81
Japan	5835	1.18	2.23	2668	1131	13.60
Germany	5773	1.12	2.12	3809	1890	10.15
Singapore	4147	0.90	1.70	2230	1204	8.52
UK	6707	0.87	1.65	3103	1676	8.51
Qatar	2568	0.87	1.65	2090	998	10.94
Myanmar	2342	0.84	1.60	990	556	7.81
South Africa	7998	0.81	1.54	5400	2090	15.84
Egypt	4426	0.71	1.34	3054	2139	4.28
France	6581	0.67	1.26	3872	1987	9.49
Italy	5904	0.58	1.09	4016	2866	4.01
Bangladesh	1424	0.54	1.02	800	560	4.29
Kuwait	3835	0.52	0.99	2198	1882	1.68
Netherlands	6350	0.45	0.84	3987	1967	10.27
Belgium	6408	0.43	0.82	3876	2003	9.35
Brazil	14231	0.43	0.81	7023	5320	3.20
Sri Lanka	2433	0.39	0.75	490	210	13.33
Oman	1941	0.27	0.51	2871	1926	4.91

Notes: 1. Rates are collected for shipment of a 20' container (TEU) between the major container ports of origin and India. Rates are quarterly averaged for 1996 and 2006. 2. Rates include container handling charges, documentation fees, government taxes and levies, etc. of both the trading partners. For details of ocean freight components, please refer De (2007a). #Capital-to-capital distance, sourced from http://www.wcrl.ars.usda.gov/cec/java/lat-long.htm

Sources: Calculated based on Maersk Sealand (2008) for ocean freight, and UNCOMTRADE Database (UN, 2008) for import.

First, ocean freight co-varies with distance. Among India's major trading partners reported in Table 1, ocean freights from countries located in North and South America are very expensive. For example, import of a loaded container from Argentina costs about US$ 8220 per TEU. Quite expectedly, cost of import (in terms of ocean freight) from South Asian countries is much less.

Second, ocean freight rates have been rising almost across the board. Growth rates of these rates vary from country to country, but it is comparatively low in case of adjacent countries. When a longer period is considered, as between 1996 and 2006, the ocean freight rates for importing a container to India increased by an average of 2 – 18 percent per annum. Whilst import of a loaded container from Kuwait increased by only 2 percent since 1996, the same from Indonesia increased by about 18 percent.

Table 3 provides the composition and structure of ocean freight for 2006. About 66 percent of total shipping costs for movement of cargo between origin and destination countries were charged by shipping lines as base ocean freight, and 34 percent as auxiliary shipping charges,[22] such as container handling charges and government duties, among others. The extent of auxiliary shipping charges is very wide and covers several components, such as peak season surcharge, congestion surcharge, Bunker Adjustment Factor (BAF), Yen Appreciation Surcharge (YAS), Fuel Adjustment Factor (FAF), delivery order, etc. All these make shipping between countries quite costly. For example, an exporter had to pay on an average US$ 46 per TEU towards BAF in 2006, which was imposed by the shipping lines as fuel surcharge, and US$ 38 per TEU on an average as YAS for cargoes going to Japan. In many cases auxiliary shipping charges often overtake base ocean freight. In some studies, it was found that the auxiliary charges between the two countries were higher than the base ocean freight.[23] Ports serving the coast of Japan imposed comparatively higher auxiliary shipping charges, and the volume of average auxiliary shipping charges in India is found to be very high. One obvious reason is that India's major container ports are highly congested, where port authorities find it easy to impose peak season surcharge and congestion surcharge on the serving shipping lines and thus net short term gains. Their bottomlines improve, but Indian ports appear as very expensive.[24]

Table 3: Components of Ocean Freight in 2006

Freight components	Collected by	Rate (%)*
(a) Mandatory charges		
Base ocean freight between origin and destination	Shipping company	65.67
Container handling charge at origin	Terminal or port operator	12.00
Container handling charge at destination	Terminal or port operator	11.00
Carrier security charge	Shipping company	0.82
Documentation fee at origin	Shipping company	2.11
Documentation fee at destination	Shipping company	1.42
Government and port duties	Terminal or port operator	2.04
(b) Optional charges		
Wharfage	Terminal or port operator	0.53
Container cleaning charge	Shipping company	0.16
Peak season surcharge	Shipping company	0.69
Congestion surcharge	Shipping company	0.89
Bunker Adjustment Factor (BAF)	Shipping company	0.58
Yen Appreciation Surcharge (YAS)	Shipping company	0.63
Fuel Adjustment Factors (FAF)	Shipping company	0.58
Delivery order	Shipping company	0.64
EDI charge	Terminal or port operator	0.24
	Total	100.00

Notes: *Average charges, calculated based on shipping rates provided by the Maersk Sealand for the year 2006 for import of a container vessel.

The auxiliary shipping charges are increasingly becoming critical to India's trade. These high charges are offsetting the gains arising from trade liberalisation, and making the merchandise trade costlier. A major part of these charges like documentation fees, government taxes and levies, etc. are the 'soft' barriers to trade and very much explicit in the system. Traders (exporters and importers) hardly have any control on them. While some of these charges, such as the terminal handling charges, are market driven, government duties and levies (similar to tariffs) are very much *ad hoc*. And these charges are relatively high among for ports in India and also in most of the countries located in Northeast and Southeast Asia, where the volume of two-way trade is also very high. The disappointing part is that despite

technological advances, the cost of movement of goods across countries in Asia has not come down. Venables (2006) observed: "Technical change in shipping is no longer faster than technical change in goods shipped, so freight rates relative to shipment value are no longer falling". The net result is that differences across countries and regions in ocean freight rates affect the trade very much in the way high tariff does.

5. Relative Importance of Transportation Costs

We have argued in the previous section that ocean freight, a major component of international transportation costs, is quite disperse and moving unevenly in case of India's imports. In this section we examine the level and variation of freight rates at disaggregated commodity levels. We deal with this analysis as follows: first, we aggregate the freight rates and its composition, and second, we estimate the transportation costs in order to understand its relative importance in trade flows.

In general, the trade volume in India has been rising very rapidly. A majority of India's import in goods is intermediate goods, feeding the country's production or import demand when variations in trade costs could be crucial for the country's international competitiveness in manufactures. Reduction in trade costs is therefore likely to help India get its goods to markets more quickly and cheaply.

However, the problem gets multiplied when one attempts to measure 'price' and 'non-price' barriers to trade.[25] Hummels (1999) commented: "Beginning with tariffs and proceeding to international and domestic transportation costs, time, and information, it is not difficult to understand a credible impact of trade costs on international trade. However, the difficulty lies in directly measuring acceptable indicators of cross-country differentials in 'price' and 'non-price' factors in general, which are traditionally seen as two major determinants of cross-country variations in trade costs." Absence of compatible quantitative information on elements of trade costs restricts researchers from venturing into trade and transportation costs study for the continent. India does not compile information on import and export by transport modes and commodity groups as is done in the US.[26] As a result,

researchers rely on proxy of transport costs, and sometime on indirectly measured non-price factors while assessing barriers to trade flows.

Aggregated Freight Rates

The cost of transportation of merchandise from one country to another is a combination of two major components: inland and international transportation costs. Understanding the unit freight rate will help us to know the variation in cost of transportation across India's partner countries.

We first derive country-wise freight rate, which is a weighted average of all commodity groups across all trading partners for both international and inland shipments of a container to India. We use equation (1) to aggregate

Table 4: India's Imports: Aggregated Freight Rates by Country in 2006

Origin (Exporter)	Freight Rate* (US$/TEU)
Australia	5180.00
Bangladesh	1582.00
Belgium	4658.00
Brazil	7805.00
China	3071.22
Egypt	3836.00
France	4654.00
Germany	4591.00
Indonesia	3327.64
Iran	2652.00
Italy	4798.00
Japan	3449.96
Malaysia	2659.37
Myanmar	1772.00
Nepal	430.00
Netherlands	4769.00
Korea	3092.44
Singapore	3012.00
South Africa	6182.00
Sri Lanka	1272.00
Thailand	2663.34
UAE	2454.00
UK	3885.00
USA	7304.00

*Trade weighted

the country-wise import freight rate (weighted average) per container for ocean shipment. Table 4 provides aggregated freight (F_i) per container for the year 2006. Following are the major observations.

First, the aggregated import freight rate varies across countries. The import freight rate per container is highest (US$ 7805 per TEU in 2006) in case of importing from Brazil, and lowest in case of Nepal (US$ 430 per TEU in 2006). Table 4 shows that cost of ocean freight is much higher when imported from nonadjacent countries. Because the heaviest goods travel via ocean, trade weighted ocean freight of import of iron and steel is much higher than that of electrical and electronics.

Second, the variation in ocean freight across countries and commodities presumably has much to do with terminal handling charges (THC) and auxiliary shipping charges. On an average, auxiliary shipping charges are much higher than THC across commodities and countries. They are exceptionally high in India. Quite naturally, imports of manufactures like electronics, and office and telecom equipment, which come in containers and have relatively high shares in total imports, cost more in India than the traditional commodities. Why the international freight per container is so expensive in case of India? Perhaps, it is due to the high terminal handling charges, US$ 795 per TEU, and auxiliary shipping charges, US$ 1408 per TEU, [27] at Indian ports.

Third, the combined incidence of THC and auxiliary shipping charges is higher in case of high-value manufactures such as electronic integrated circuits, office and telecom equipment, and electrical and electronics items than traditional commodities and mining and forest products. These are the items which crucially determine India's trade competitiveness.

Estimated Ad-valorem Transportation Costs

Transportation cost in ad-valorem terms is the cost of shipping relative to the value of the good. This is equivalent to the percentage change in the delivered price as a result of paying for transportation. Here, we measure the ad-valorem transportation cost for import of a container to India using the equation (3).[28] Table 5(a, b) provides evidence on the level and

Table 5(a): India's Imports: Estimated Ad-valorem Transportation Costs in 2006

Origin (Exporter)	Adv. Transport Cost* (%)
Australia	72.73
Bangladesh	31.56
Belgium	22.20
Brazil	50.95
China	8.78
Egypt	46.25
France	7.92
Germany	7.02
Indonesia	46.41
Iran	34.08
Italy	8.73
Japan	8.88
Malaysia	16.33
Nepal	4.34
Netherlands	17.63
Korea	9.36
Singapore	6.21
South Africa	68.24
Sri Lanka	8.54
Thailand	8.65
UAE	20.13
UK	13.91
USA	31.25

Note: *Trade weighted

Table 5(b): India's Imports: Estimated Ad-valorem Transportation Costs by Major Commodity Groups in 2006

Commodity groups	Adv. Transport Cost* (%)
Agriculture and food products	48.30
Chemical	38.78
Electrical and electronics	1.21
Iron and Steel	34.85
Leather	4.81
Machinery and mechanical appliances	2.06
Metal	13.15
Paper and Pulp	82.61
Rubber and plastics	15.22
Textile and clothing	10.77
Transport	5.56

Note: *Trade weighted

distribution of ad-valorem transportation costs by commodity and countries for the year 2006. Following broad features appear.

First, the ad-valorem transportation costs vary across commodities and countries. The ad-valorem transportation cost for import of all goods is lowest in case of Nepal (4.34 percent in 2006) and highest in case of Australia (72.73 percent in 2006). Cost of shipping (relative to the value of the good) is thus comparatively lower in case of India's import from adjacent countries.

Second, transportation costs are lower for manufactured goods, than for traditional commodities. Paper and pulp, and agriculture and food products incur the highest transportation costs.

Third, the transportation costs for imports of high-end manufactures such as electrical and electronics, office and telecom equipment, and electronic integrated circuits in India is comparatively low.

The Weight to Value Ratio of Trade and Transport Cost

The changing composition of India's trade has become an important issue. The weight-value ratio of a product is the major determinant of the transportation expenses a country faces (Hummels and Skiba, 2004).[29] For example, the cost of transportation of heavier goods would certainly be higher than lighter goods. If a country (or a region) is a net importer of weights, it will be having a net deficit in transportation costs.[30] We calculate weight-value ratio for India with the help of Brooks and Hummels (2008). Since India's major import partners are nonadjacent, it would be worthwhile to understand the relationship between transport cost and weight-value ratio, which will help us evaluate the transportation needs in India more prominently. We estimate the weight-value (measured in kg per 100 US$) for India's import with the help of equation 4. The results are reported in Table 6(a, b). Following observations are worth noting.

First, import of weights from China is very prominent. The WV ratio of 7.76 indicates that India's import of weights per 100 US$ from China is highest among its all trading partners. USA and Indonesia come next.

Table 6(a): India's Imports: Estimated Weight-Value Ratio by Country in 2006

Origin (Exporter)	W-V Ratio (Kg/100 US$)
Australia	2.82
Bangladesh	0.75
Belgium	0.65
Brazil	0.62
China	7.76
Egypt	0.32
France	1.24
Germany	1.92
Indonesia	5.22
Iran	1.67
Italy	0.81
Japan	1.94
Malaysia	2.45
Myanmar	1.25
Nepal	0.52
Netherlands	0.72
Korea	2.27
Singapore	1.40
South Africa	1.20
Sri Lanka	0.54
Thailand	0.92
UAE	2.19
UK	1.49
USA	7.62

Table 6(b): India's Imports: Estimated Weight-Value Ratio by Major Commodity Groups in 2006

Commodity group	W-V Ratio (Kg/100 US$)
Agriculture and food products	10.74
Chemical	14.41
Electrical and electronics	0.85
Iron and Steel	10.45
Leather	0.07
Machinery and mechanical appliances	1.45
Metal	2.25
Paper and Pulp	3.49
Rubber and plastics	2.23
Textile and clothing	0.74
Transport	1.61

Second, India's imports are comparatively heavy in agriculture and food products, iron and steel, and chemical, which are basically heavier raw materials and intermediate products used as inputs for production. In other words, India is importer of weights in semi-finished goods and raw materials. Therefore, heavier is the good, larger the transportation cost.

India, therefore, imports comparatively larger weights, implying high transport congestion and subsequently high ad-valorem transportation costs due to its inadequate and poor quality of infrastructure services.

6. Assessing Barriers to Trade in India

The model considered here uses import data for the years 1996 and 2006. The model considers data at the bilateral level for all the variables for India's individual partners. By taking transportation costs and tariff, we cover a major portion of trade costs. Before estimating the models, we obtained a matrix of correlation coefficients to rule out any possibility of multicollinearity problems.[31]

The log-linear type equation has been estimated using both OLS and GLS regressions. The random effect has turned out to be the proper model fitting for the data, as per the Hausman (1978) specification test.[32]

Table 7 reports OLS and GLS estimates of equation (12). We expect that the tariff and ad-valorem transport cost variables are negatively correlated with the volume of imports. Variables being in natural logarithms, estimated coefficients show CES elasticity. The elasticity is useful both as an indicator of the effect of trade barriers on trade volumes. The model performs well as most of the variables do have expected signs.

The econometric evidence seems to strengthen the existing linkage of trade costs and trade flows: higher the transportation costs between each pair of partners, less they trade. In our case, it is seen that a 10 percent fall in transportation costs has the effect of increasing country's import by about 5 percent (in models 3 and 4). Although as per the specification tests, random effect turned out to be the appropriate model, we have run the fixed effects estimation as well and compared between the OLS and GLS R^2. We could see that a marginal improvement in overall goodness of fit of the GLS

Table 7: Non-linear Least Squares Estimates of Import Demand

	OLS[1]		GLS[2]	
	Model 1	Model 2	Model 3	Model 4
Transport cost (ad-valorem equivalent)	-0.508 (-4.770)*	-0.528 (-5.110)*	-0.514 [-4.940]*	-0.530 [-5.250]*
Tariff (weighted applied)	-0.144 (-0.870)		-0.126 [-0.790]	
R^2	0.569	0.556	0.571	0.559
Wald χ^2			27.74	27.55
Prob>χ^2			0.00	0.00
No of observations	24	24	24	24

Notes: 1. Fixed effect. 2. Random effect. *Significant at 1% level. Here, t-values are given in first bracket, whereas z-values are given in third bracket. Country fixed effects are included in the model.

estimation (57.1 percent in model 3), compared to OLS (56.9 percent in model 1). The REMs report values of Wald $\chi 2$. The reported $\chi 2$ value of 27.74 in model 3 is highly significant with the probability>$\chi 2$ (=0.0000). Taken jointly, our model shows almost a perfect fit.

The estimated model explains about 57 percent of the variations in direction of trade flows. The most interesting result is the strong influence that changes in ad-valorem transportation cost had on changes in trade: higher the transportation cost between each pair of partners, less they trade. In other words, the estimated elasticity indicates that a 10 percent rise in ad-valorem transportation cost lowers import by 5 percent in India.

The estimated models also indicate that tariff does not influence the trade flow since all its estimated coefficients have appeared as statistically insignificant. Perhaps, there were not much significant changes in applied tariffs between 1996 and 2006. The insignificance of tariff is of the fact that both transportation cost and tariff work in same direction with trade flow and hence tariff has been overshadowed by transportation cost in the regression models in Table 7. Omitted variable bias could be the plausible reasons for insignificance of transit time.

From the estimated elasticities and their significance level, it can be concluded that transportation cost is more important than tariff, ceteris paribus, in enhancing India's trade. This also directly indicates that there is a huge infrastructure bottleneck within India in general. This calls for immediate attention in order to enhance India's trade flows.

The estimates also seem to show that the size of the effects does not vary widely. The usual caveat is that R^2 reported in the Table 7 indicate that the equation (12) explain only half of the variation in trade flows. Perhaps the inappropriateness of the structural model or omitted variable bias could be the plausible reasons for such a fit.

7. Concluding Remarks

The analysis carried out in this paper provides sufficient evidence to emphasize that variations in transportation costs have significant influence on India's import. The bottom-line is costlier transportation prohibits trade and taxes the trade in the way tariff does. High transportation cost is also disincentives to national and regional transport and production networks. There are two major advancement of this study: First, we introduce bilateral ocean freight that we believe have an impact on trade. Second, we introduce ad-valorem equivalent of transportation costs at bilateral level, which are largely ignored in the empirical literature in the context of India.

Barriers reduce trade. This is the conclusion of a series of papers, including this one, that examine trade-reducing effects of trade costs. One of the conclusions of this paper is that transportation cost is more important than tariff, ceteris paribus, in enhancing India's import demand.

Reduction in transportation costs should therefore get priority attention while formulating policy for India's infrastructure development and trade facilitation since the fall in transportation costs, as an outcome of improved infrastructure and trade facilitation, will stimulate trade. The challenge for India is thus to identify improvements in trade facilitation, logistics services and related infrastructure that can be achieved in the short-to-medium term and that would have a significant impact on trade competitiveness of India.

Endnotes

1 Refer, for example, Anderson and van Wincoop (2004), Hummels (2007).

2 See, Limao and Veneables (2001), Wilson *et al*, (2003), Nordås and Piermartini (2004), Francois and Manchin (2006), Brooks and Menon (2008), to mention a few.

3 This paper builds upon the literature carried out on this subject earlier and in particular De (2006a, 2007, 2008a, 2008b, 2009a, 2009b). It has two distinct methodological improvements over other studies. First, we have estimated the ad-valorem transportation costs for India's trade. Second, the model is tested at a large cross-section pooled data for the years 1996 and 2006, taken at 4-digit HS level.

4 See, Anderson and van Wincoop (2004) for a detailed discussion on trade costs. Also see, Khan (2008).

5 Based on WTO (2006a, 2007)

6 A growing literature in this regard has documented the impact of trade costs on the volume of trade. Some seminal studies carried out on this topic in recent years are Hummels (1999; 2007), Limao and Venables (2001) and Anderson and van Wincoop (2004).

7 For a shipment of goods across border, transport costs refer to two major elements - international transport costs, which count costs associated with the shipment of goods from one country and to another, and the inland (domestic) transport costs, which consider costs of inland transportation of merchandise in both exporting and importing countries.

8 For example, according to World Bank (2001), 168 out of 216 US trading partner, transport costs barriers outweighed tariff barriers. For the majority of Sub-Saharan African countries, Latin America and Caribbean, and a large part of Asia, transport cost incidence for exports is five times higher than tariff cost incidence.

9 Quoted in The Economist, August, 2008

10 See, for example, WTO (2008), which has observed that transport costs outweigh tariffs in trade, and rising shipping costs hurt manufacturing in developing world.

11 See the Appendix 1 which provides the non-bulk commodity classification for *k* commodity groups, adopted in this paper. In general, COMTRADE does not provide trade weight at 2-digit HS. It comes from 4-digit HS only. So, we have to classify the commodity groups at 4-digit HS. This classification of commodity groups follows WTO's classification, which was reported in its Annual Report 2006. See, for example, WTO (2006b).

12 Given the formula applied here, this nomenclature is also used interchangeably as ad-valorem freight in literature.

13 Here, methodology follows Brooks and Hummels (2007).

14 The usual caveat is that the freight rates offered in Mearsk Sealand (2007), which we have considered in this paper, are the gross rates and not the negotiated rates that the shipping line entered into. Negotiated rates are happened to be lower than the gross rates.

15 Systematic data on Asia's import by origin and commodity are not available. The problem becomes more acute when one searches trade in weight in TEUs. As a result, we had to rely on Maersk Sealand for freight rates of commodities at bilateral level. Since COMTRADE does not provide trade in TEU, we had to convert the weight in

kg into weight in TEU. This was done based on author's personal communication with Mr. S Ghosh, formerly Sr. Vice President, International Navigation Association (PIANC), Brussels, and the Managing Director, Consulting Engineering Services Pvt. Ltd. (CES), New Delhi. The conversion rate we used here was 12,000 kg @ 1 TEU to get a loaded 20' container (popularly known as FCL), sourced from PIANC.

16 The reason is that if all goods are consumed as a constant fraction of GDP and price levels do not vary, but we do not see the expenditure shares or the price levels. In particular, the main way that international production sharing shows up here is that *E* varies a lot across countries as a function of what they are producing – a country makes lot of cars it demands an unusually large amount of car parts and components.

17 For example, a high price for a product may reflect higher production costs, or it may just reflect quality differences.

18 See Appendix 2 to know how the data extracted and the data size.

19 According to UNCTAD, freight costs in developing Asia are on an average 116 percent higher than developed countries, and this difference is mainly attributable to global trade structures, regional infrastructure facilities, logistics systems, and the more influential distribution strategies of shippers of developed countries (UNCTAD, 2006).

20 The advent of fast transport (air shipping and faster ocean vessels) is equivalent to reducing tariffs on manufactured goods from 32 to 9 percent between 1950 and 1998 (Hummels, 2001).

21 The rates are spot rates and collected for shipment of a 20' container (TEU) between the major container ports of origin and destination countries from the historical freight rate database. Rates are quarterly averaged for the years 2000 and 2005, and include container handling charges, documentation fees, government taxes and levies, etc. of both the trading partners. For details of ocean freight components, please refer De (2007, 2008a).

22 By auxiliary shipping charges we mean all shipping charges other than basic ocean freight in this study. Auxiliary shipping charges include container handling charge, government duties and miscellaneous charges, etc.

23 See, for example, De (2006a, 2006b, 2007)

24 Interestingly, ports in India impose two notorious charges: (i) peak season surcharge, and (ii) congestion surcharge to the serving shipping lines, which normally do not exist elsewhere in the world.

25 In literature, 'non-price' term was also used as infrastructure variable to facilitate the understanding of the importance of trade costs or the scope of trade costs.

26 For example, US Census Bureau provides periodically US imports data at 10-digit HS level by origin countries. US Department of Transportation supplies US imports by HS, transport modes and origin countries and destination provinces, besides the information on value and volume of imports.

27 Auxiliary shipping charges represent several explicit and implicit fees. For example, it covers all shipping charges other than basic ocean freight such as peak season surcharge, congestion surcharge, Bunker Adjustment Factor (BAF), Yen Appreciation Surcharge (YAS), Fuel Adjustment Factor (FAF), and delivery order, etc., which often make the shipping between the countries costlier. For example, exporters had to pay on an average US$ 35 per 20' container towards BAF in 2004, which was imposed by the shipping lines as fuel surcharge, and on an average US$ 30 per 20' container as YAS for cargoes going to Japan (De, 2007, 2008a).

28 Given the formula applied here, this nomenclature is also used interchangeably as ad-valorem freight in literature.

29 For example, Hummels and Skiba (2004) commented that a 10 percent increase in product weight-value leads to a 4 percent increase in ad-valorem shipping cost.

30 This is ideally true if the trade is undertaken at cost, insurance and freight (*cif*) price.

31 Appendix 3 presents partial correlation coefficients among the dependent and independent variables.

32 The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are (insignificant P-value, Prob>chi2 larger than 0.05) then it is safe to use random effects. We have used Stata 10.0, and the results of the specification tests are given in the Appendix 4.

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Appendix 1: Classification of Non-bulk Trade Commodity Groups

	Corresponding 2/4 - digit HS (2002)	Remarks
Agriculture products	01 - 24, 50 - 53	Taken at 4-digit HS excluding HS 01 and HS 06
Food	16 - 23	
Manufactures	28 - 43, 45 - 49, 54 - 70, 72 - 92, 94 - 96	Taken at 4-digit HS, excluding HS 44, 50 - 53, 71, 93
Chemical	28 - 36, 38	Taken at 4-digit HS, excluding HS 37
Pharmaceuticals	30	
Rubber and plastics	39 - 40	
Leather	41 - 43, 64	
Paper and pulp	47 - 48	
Textile and clothing	54 - 63	Taken at 4-digit HS, excluding HS 64 - 67, 71
Iron and steel	72 - 73	
Metal	68 - 70, 74 - 81	
Machinery and mechanical appliances	82 - 84	Taken at 4-digit HS, excluding HS 8415, 8418, 8471, 8473
Electrical and Electronics	85, 90, 91, 92, 95	Taken at 4-digit HS, including HS 8415, 8418, 8471, 8473
Office and telecom equipment	8517 - 8548	
Electronic integrated circuits	8542	
Transport equipment	86 - 89	
Automobiles and components	87	

Appendix 2: India's Imports: Extraction of Observations

Partner/Exporter/Origin	1996 Number of observations	2006	Number of observations considered
Australia	439	617	296
Bangladesh	25	230	16
Belgium	479	644	342
Brazil	198	404	115
China	577	923	438
Egypt	22	156	13
France	601	806	434
Germany	770	904	592
Indonesia	270	565	209
Iran	46	193	32
Italy	613	830	452
Japan	648	774	465
Malaysia	376	667	257
Myanmar	24	39	7
Nepal	97	266	58
Netherlands	528	706	371
Korea	515	731	368
Singapore	637	817	453
South Africa	232	452	127
Sri Lanka	137	431	91
Thailand	335	735	241
UAE	382	752	266
United Kingdom	733	882	559
USA	796	915	603
Grand total	9480	14439	6805

Appendix Table 3: Pair-wise Correlation Coefficients (Pooled Observations)

	Import	Transportation Cost	Tariff
Import	1		
Transportation Cost	0.7457* (0.000)	1	
Tariff	-0.2619 (0.2164)	-0.203 (0.3413)	1

*Significant at 5% level

Appendix 4: Results of Hausman Specification Test

Model 1 vs. Model 3

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 0.17

Model 2 vs. Model 4

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 0.02

Prob>chi2 = 0.8985

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