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Efficient Transport Services – Growth and Environmental Implications Case Study of India

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Abstract

Economic development is becoming increasingly sensitive with regard to environmental implications. Transport sectors – road, rail, air and water – are crucial to the growth and development of an economy. These sectors use heavy inputs of energy from petroleum products, coal and thermal electricity and are subject to various policy distortions including a complex tax regime. The key objective of this paper is to evaluate gains to the economy when the delivery of transport services becomes relatively efficient through removal of tax and other policy distortions. Such an analytical exercise is implemented using a computable general equilibrium (CGE) model of the economy within the framework of input–output flow matrices. The results show that the economy gains through improved efficiency of transport sectors. There are corresponding gains in trade and output. The real returns to the factors of production, viz. land, labour and capital, register increase. Positive scale effects are observed for the manufacturing sectors, particularly for heavy users of transport services. Enhanced efficiency of transport services lowers demand for energy in the economy. The analysis shows that increased efficiency of transport sectors leads to welfare gains in an environment friendly manner.

Efficient Transport Services – Growth and Environmental Implications
Case Study of India[1]

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1. Backdrop

Transport sectors have strong economic linkages with the rest of the economy. Road and rail transport services have strong backward and forward linkages whereas air transport has strong backward linkages. The prices of transport services may not be determined by the market forces in the presence of complex tax structure imposed on transport sectors in India.

A complex and inefficient tax regime in transport sectors in conjunction with their strong backward and forward linkages adversely affect allocation of productive resources. Inefficiencies in transport sectors get transmitted to other sectors of the economy. Many of these are relatively heavy users of transport services and have strong linkages with the rest of the economy.

The current transport pricing system is a result of multiple taxes and user charges established at different points of time at varying levels of governance. In addition, fuel tax is an integral part of transport pricing. The taxation structure is quite different across modes and states. This is partly due to constitutional mandate. The central government levies indirect taxes in the form of union excise, import duty, and service tax whereas the state governments levy sales tax / VAT, motor vehicle tax (MVT), and passenger and goods tax (P&GT). Taxes are imposed on inputs as well as outputs of transport services thus affecting the cost and price structure in these sectors. Within the road sector, about two-thirds of total tax revenue is collected by the state governments. The tax differentiation in this sector is determined by a number of parameters that vary across states, uses and types. Tax burden, measured as sectoral tax to sectoral value added, is 16 per cent in aviation and road sectors and 14 per cent in water transport sector. Overall, the aggregate tax burden including petroleum is about 30 per cent.

Apart from taxes, the governments also raise revenues from user charges. The toll charges are used mainly for the development and maintenance of road infrastructure. Similarly, route navigation facility charges; landing, parking and housing charges; terminal navigation landing charges; and service charges for the extension of ATC watch-towers are some of the user charges in the aviation sector. Ports also collect several user charges for port services.

Inefficiencies in transport sectors get transmitted to other sectors of the economy as some of the sectors are relatively heavy users of transport services and have strong linkages with the rest of the economy.

[1] This paper is based on NCAER study on Fiscal Issues and Allocative Efficiency in India's transport sectors sponsored by the National Transport Development Policy Committee (NTDPC): http://www.ncaer.org/downloads/Reports/NCAER_NTDPC.pdf

The objective of this paper is to analyse the impact of improving efficiency in the transport service sectors in India. It is not easy to capture the impact of integrated tax rationalisation in various sectors of transport. This paper, therefore, uses a computable general equilibrium (CGE) model of the economy. It is assumed that there is a wedge between the efficiency levels of the Indian transport services vis-à-vis some international norm which is not amenable to be quantified. Such wedge may arise due to various factors including inefficient taxation in these sectors and absence of a uniform GST regime. Other reasons include financing, maintenance, pricing, governance, etc. and the lack of coordination across sectors of transport. In the CGE framework we assume that the wedge may be represented through some hypothetical surrogate guess-estimated (guesstimated) custom duties on import of these services even when there are no declared rates. This hypothesises the fact that these services are operating under umbrella of some kind of protection and hence their delivery may not be matching international standards. Various analytical scenarios have been analysed assuming a broad including all kinds of inefficiencies in the delivery of transport services and also tax-related narrower wedge.

2. Tax Rationalisation

The differential multiple tax regime across sectors of production leads to distortions in allocation of resources thus introducing inefficiencies in the sectors of domestic production. A recent NCAER study has analysed the impact of introducing comprehensive goods and services tax (GST) on economic growth and international trade; changes in rewards to the factors of production; and the impact on output, prices, capital, employment, efficiency and international trade at the sectoral level (NCAER 2009). GST would lead to efficient allocation of factors of production. The overall price level would go down. It is expected that the real returns to the factors of production would go up. The present study looks at distortions in the tax structure with regard to transport sectors. Given that the taxation regime in transport sectors is complex, there is an urgent need to introduce fiscal reforms in this sector.

There may be many reasons for the transport sectors to be relatively less efficient compared with international standards. While we attempt to mimic overall reforms in sectors of transport we also narrow down our focus on the efficiency introduced in these sectors just because of GST reforms in India's taxation structure. This is conceptualised through assuming a wedge to be narrowed down by reforms of various types.

Tax policies play an important role in the economy through their impact on both efficiency and equity. A good tax system should keep in view issues of income distribution. It should also endeavour to generate tax revenues to support government expenditure on public services and infrastructure development. Cascading tax revenues have differential impacts on firms in the economy with relatively high burden on those not getting full offsets. This analysis can be extended to international competitiveness of the adversely affected sectors of production in the economy. Such domestic and

international factors lead to inefficient allocation of productive resources in the economy. This results in loss of income and welfare of the affected economy.

For a developing economy like India it is desirable to become more competitive and efficient in its resource usage. Apart from various other policy instruments, India must pursue taxation policies that would maximise its economic efficiency and minimise distortions and impediments to efficient allocation of resources, specialisation, capital formation and international trade. With regard to the issue of equity it is desirable to rely on horizontal equity rather than vertical equity. While vertical equity is based on high marginal rates of taxation, both in direct and indirect taxes, horizontal equity relies on simple and transparent broad-based taxes with low variance across the tax rates.

In sum, implementation of a comprehensive GST in India is expected to lead to efficient allocation of factors of production thus leading to gains in GDP and exports. This would translate into enhanced economic welfare and returns to the factors of production, viz. land, labour and capital.

3. Modelling Tax Rationalisation in Transport Sectors

We use a general equilibrium model to analyse the impact of India tax rationalisation in transport services.

The CGE model that we have developed is distinctly different from the existing models of Indian economy (Brown *et al* 1993 and 1996, Chadha *et al* 1998). Our India Model is a single-country, multi-sectoral CGE model. It incorporates some of the features of the new trade theory, viz. increasing returns to scale, monopolistic competition and product heterogeneity.[2]

The main data source is the Input–Output Transaction Table of the Indian economy provided by CSO (Central Statistical Organisation). The reference year for this database is 2003–04. Based on the economy-wide transactions, India is modelled to produce, consume and trade in 130 sectors of the economy. These sectors include 26 agriculture and allied services, 11 mining, 68 manufacturing, and 25 service sectors. There are five transport service sectors, viz. rail, land, water, air, and transport auxiliary services.

The final demand equations for various sectors are obtained assuming a single representative consumer who maximises utility subject to a budget constraint. It is assumed that the revenue from tariffs and indirect taxes gets re-distributed to consumers and then spent. Intermediate demands are derived from

[2] "The Impact of Trade and Domestic Policy Reforms in India: A CGE Modelling Approach", Chadha *et al,* University of Michigan Press, Ann Arbor, 1998. This reference provides details of the model as well as the closure rules. We assume that aggregate expenditure varies endogenously to hold aggregate employment constant. Such a closure may be thought of as analogous to the Johansen closure rule. Details of the Brown-Deardorff-Stern Michigan Model of World Production and Trade may be referred to at http://www.fordschool.umich.edu/rsie/model/analytics.html

the profit-maximising decisions of the representative firms in each sector. The manufactured products' markets are assumed to depict monopolistic competition behaviour and those in rest of the sectors (agriculture, Mining, and services) operate under perfect competition.

Consumers and producers are assumed to use a two-stage procedure to allocate expenditure across differentiated products. In the first stage, expenditure is allocated across goods without regard to the country of origin (whether India or ROW) or the producing firm. At this stage, the utility function is taken to be Cobb–Douglas and the production function requires intermediate inputs in fixed proportion. In the second stage, expenditure on monopolistically competitive goods is allocated across competing firms in India and ROW. However, in the case of perfectly competitive goods, since individual firm supply is indeterminate, expenditure on each good is allocated over the industry as a whole. The aggregation function in the second stage is a Constant Elasticity of Substitution (CES) function. We assume that aggregate expenditure varies endogenously to hold aggregate employment constant. Such a closure may be thought of as analogous to the Johansen closure rule.

Perfectly competitive firms are assumed to set price equal to marginal cost, while monopolistically competitive firms maximise profits by setting price as an optimal mark-up over marginal cost. The numbers of firms in sectors under monopolistic competition are determined by the condition that there are zero profits. The price changes are relative to the domestic *numeraire* price of the sector "iron and steel". This price is held constant while solving the model.

This model is solved using GEMPACK (Harrison and Pearson 1996). The solution of simulation yields percentage changes in sectoral employment and certain other variables of interest for India. Multiplying the percentage changes by actual levels given in the data base yields the absolute changes, positive or negative, that might result from India's unilateral trade and domestic policy reforms.

In addition to the sectoral effects that are the primary focus of our analysis, the model also yields results for changes in exports, imports, the overall level of welfare (measured through GDP) in the economy, and the economy-wide changes in real wages and returns to land and capital. Because both labour and capital are assumed to be homogeneous and mobile across sectors in these scenarios, we cannot distinguish effects on factor prices by sector.

4. Inefficiency Wedge of Transport Services

The wedge between the efficiency levels of transport services in India in comparison with some international standard is not easy to quantify. We are not aware of any benchmarks in this regard. However, we have attempted to capture some elements of differences in the efficient delivery of transport services across a group of countries. The information on input–output flow matrices of these

countries has been used for this purpose. The source of this information is OECD.[3] The countries selected for such comparison are a mix of some developed and some developing countries. The set of countries in our sample include Brazil, Canada, China, France, Germany, India, Japan, South Africa, South Korea, Thailand and the United States.

Transport intensity of total output, ratio of net indirect taxes to the output of transport services, and energy usage (petroleum products and electricity) per unit of output of transport services has been computed for all the 11 countries (Table 1).

One of the major observations refers to the overall usage of transport services as intermediate input used by the economy as a whole. This refers to the cost incurred on the purchase of transport services for producing one unit of output of the economy. India uses 4 paise worth of transport services to produce one rupee worth of total output, i.e. a usage of 4 per cent. This may be referred to as transport intensity. This is the highest value within the group of 11 selected countries. The corresponding value is 3.6 per cent for South Africa, 3.5 per cent for China and 2.9 per cent for Brazil. Thus the share of transport services used in each unit of total output in India is 11 per cent higher than that of South Africa, 14 per cent higher than that of China and 38 per cent higher than that of Brazil. The gap is much higher with respect to developed countries. Such differences indicate that India uses higher share of transport services in its production activity than other countries. This implies relatively less efficient usage of transport services. Such an inefficiency wedge may arise due to tax complexity in transport sectors along with various other reasons including financing, maintenance, pricing, governance, etc. We have used a conservative estimate of 35 per cent for this wedge.

Another important observation addresses the issue of tax intensity of transport sectors. It is observed from Table 1 that the ratio of net indirect tax to the output of this sector is 4.7 per cent in India. This is much higher than the corresponding value of 3.3 per cent in South Africa, 2.9 per cent in France and Germany, 2.7 per cent in Brazil, and 0.9 per cent in Thailand. While it may not be easy to quantify the impact of tax intensity and complexity within the overall inefficiency wedge of 35 per cent, we have assumed this to be less than half and hypothesised it as 15 per cent.

India's transport services do not make efficient use of fuels consumed. The energy use for transport services in India is higher than most countries except for Thailand (Table 1). This is a matter of concern with regard to the environmental pollution issues. The share of energy usage in India's transport sectors is 21.6 per cent which incorporates 20.1 per cent for petroleum products and 1.5 per cent for electricity. The total energy use intensity of transport sectors is 12.7 per cent in South Africa, 16.2 per cent in Brazil and 18.8 per cent in China. The developed countries have much lower values: France and Germany at 5.6 per cent, Japan at 8.2 per cent and the United States at 9 per cent.

[3] OECD link (there are 36 sectors of production).

Table 1: Cross Country Comparison of Transport Efficiency

Country	Tax intensity of Tpt output	Tpt intensity of Overall output	Energy intensity of Tpt output		
			Petroleum	Electricity	Total
Brazil	2.7	2.9	14.8	1.4	16.2
Canada	-0.4	2.4	9.5	0.6	10.1
China	-	3.5	17.3	1.5	18.8
France	2.9	2.9	4.9	0.7	5.6
Germany	2.9	3.4	4.7	0.9	5.6
India	**4.7**	**4.0**	**20.1**	**1.6**	**21.6**
Japan	-	2.3	6.6	1.7	8.2
Korea	-	2.3	18.8	0.6	19.4
South Africa	3.3	3.6	11.3	1.4	12.7
Thailand	0.9	1.9	25.1	1.1	26.2
USA	-	2.0	8.7	0.3	9.0

Tpt: Transport and Storage

Petroleum: Coke, refined petroleum products and nuclear fuel

Electricity: Electricity, gas and water supply

Source: Our computations based on OECD at

http://stats.oecd.org/Index.aspx?DataSetCode=STAN_IO_TOT_DOM_IMP

5. Transport Intensity and Linkages

As mentioned in the concluding section of Chapter 4, inefficiencies in transport sectors get transmitted to other sectors of the economy as well. Many of these are relatively heavy users of transport services and have strong linkages with rest of the economy. Based on the total usage of transport services we have identified top-10 sectors in each of 11 selected countries. Their transport usage intensities, i.e. the ratio of transport services as inputs to total outputs, have also been computed (Table 2). It may be observed that the heavy transport using sectors differ across countries. However, some of the identified sectors are common across most of the 11 countries. These include food products, beverages and tobacco; chemicals and chemical products; wholesale and retail trade; and transport and storage.

As mentioned earlier, India's usage of transport services as intermediate inputs is 4 per cent economy's output. It may be observed from Table 2 that eight out of the top-10 high transport using sectors have transport intensity of more than 4 per cent. The sectors with transport intensity less than 4 per cent include agriculture, hunting, forestry, and fishing, and public administration and defence. Three of the sectors with the highest transport intensity are textiles (8.3 per cent) basic metals (6.5 per cent) and transport and storage (6.3 per cent). Each of these eight sectors has high backward or / and forward linkages except water transport. All such issues get taken care of under the general equilibrium analysis.

Table 2: Transport intensity of output: Sector-wise

Country/ Column	India	Canada	Germany	Japan	Korea	South Africa	USA	Brazil	France	Thailand	China
C1: Agriculture, hunting, forestry and fishing	**2.6**	**3.2**	0.7	2.8	1.0	**7.9**	2.2	**2.1**	1.4	**1.1**	**2.1**
C2: Mining and quarrying	2.1	1.0	4.7	3.5	11.6	**17.8**	1.9	**10.0**	3.4	1.8	**4.3**
C3: Food products, beverages and tobacco	**5.5**	**2.6**	**3.7**	**3.0**	**3.3**	**2.6**	**3.6**	**4.7**	**3.3**	**1.5**	**2.6**
C4: Textiles, textile products, leather and footwear	**8.3**	0.9	1.0	2.4	2.0	2.0	3.3	2.3	3.0	**1.0**	2.2
C5: Wood and products of wood and cork	4.8	4.0	2.1	3.5	4.0	1.3	3.9	3.2	3.4	2.8	4.9
C6: Pulp, paper, paper products, printing and publishing	7.4	**4.1**	2.0	**3.4**	**3.1**	-	**3.0**	3.1	3.9	1.7	4.0
C7: Coke, refined petroleum products and nuclear fuel	2.3	2.7	**3.9**	2.9	0.9	**4.9**	2.0	1.8	2.3	0.1	3.6
C8: Chemicals and chemical products	**4.4**	2.7	**2.1**	**2.5**	**2.4**	-	**3.1**	**3.5**	**2.9**	**1.4**	**3.2**
C9: Rubber and plastics products	4.2	1.5	2.3	2.0	2.6	6.9	2.9	2.7	2.1	1.5	5.9
C10: Other non-metallic mineral products	6.7	3.7	5.4	5.7	**9.0**	-	8.9	4.4	5.4	**3.0**	4.7
C11: Basic metals	**6.5**	2.5	**3.9**	**2.7**	**2.1**	**4.0**	7.8	**5.3**	3.3	1.1	**3.9**
C12: Fabricated metal products except machinery and equipment	2.4	2.0	1.2	2.6	2.0	-	1.6	2.9	1.5	1.1	3.5
C13: Machinery and equipment n.e.c	2.4	1.5	**2.4**	1.7	**1.7**	-	1.6	3.2	1.5	1.4	**3.3**
C14: Office, accounting and computing machinery	6.1	2.4	4.2	1.5	1.2	-	1.4	2.3	1.4	0.9	2.3
C15: Electrical machinery and apparatus n.e.c	2.4	1.7	0.7	1.8	1.3	1.4	1.7	3.2	1.8	0.8	2.6
C16: Radio, television and communication equipment	1.9	1.2	2.3	1.7	**0.9**	1.5	1.3	4.0	1.8	0.5	2.0
C17: Medical, precision and optical instruments	8.6	-	2.0	1.4	1.4	-	1.2	2.8	1.7	1.1	3.0
C18: Motor vehicles, trailers and semi-trailers	2.8	**1.7**	**2.6**	**1.6**	0.9	1.1	2.2	**3.3**	**2.3**	0.9	2.6
C19: Other transport equipment	2.6	1.7	0.9	1.8	0.9	-	1.6	1.6	1.3	1.2	2.5

Country/ Column	India	Canada	Germany	Japan	Korea	South Africa	USA	Brazil	France	Thailand	China
C20: Manufacturing n.e.c; recycling	5.2	1.4	2.8	4.4	2.3	1.0	2.0	1.8	2.4	1.3	2.5
C21: Electricity, gas and water supply	**5.3**	1.2	**2.4**	2.2	0.3	1.7	**5.7**	1.7	2.3	0.5	**3.5**
C22: Construction	**5.7**	**1.8**	0.6	**3.4**	**1.0**	1.0	**1.5**	1.3	**1.4**	**8.0**	**3.9**
C23: Wholesale and retail trade; repairs	**3.7**	**2.3**	**8.6**	**2.1**	**6.6**	**4.5**	**1.6**	**4.1**	**5.4**	**1.9**	**2.9**
C24: Hotels and restaurants	4.2	0.9	0.4	**2.2**	0.5	0.9	1.3	1.8	**3.2**	**1.1**	2.6
C25: Transport and storage	**6.3**	**16.3**	**29.5**	**10.5**	**17.3**	**1.4**	**10.8**	**8.4**	**19.7**	**9.5**	**12.6**
C26: Post and telecommunications	1.0	12.0	2.5	1.8	1.0	**4.8**	0.6	**2.2**	0.8	2.3	1.5
C27: Finance and insurance	2.0	**1.3**	0.5	1.5	1.2	0.7	**0.9**	1.0	0.7	1.3	3.2
C28: Real estate activities	0.0	0.3	0.0	0.1	0.2	0.3	0.4	0.1	0.4	0.2	1.0
C29: Renting of machinery and equipment	1.0	1.1	0.4	1.2	2.0	-	3.7	-	1.2	-	-
C30: Computer and related activities	0.5	1.6	0.7	0.8	1.4	-	1.1	-	1.3	-	-
C31: Research and development	-	-	1.4	1.2	1.1	-	1.4	-	2.0	1.2	5.6
C32: Other Business Activities	1.2	1.3	0.5	0.9	-	**5.2**	0.5	1.6	**1.5**	1.6	4.4
C33: Public admin. and defence; compulsory social security	**2.1**	**1.5**	1.2	**3.0**	1.4	**1.6**	**1.7**	0.7	**1.3**	0.0	2.6
C34: Education	3.9	**2.6**	**1.9**	1.0	0.4	-	0.9	1.1	1.9	1.0	2.8
C35: Health and social work	3.9	0.5	0.1	1.2	0.7	2.1	1.0	2.0	0.9	1.1	1.3
C36: Other community, social and personal services	1.5	1.1	0.7	1.7	1.1	1.7	**1.3**	**4.1**	**2.4**	1.0	2.6
C37: Private households with employed persons								0.0	0.0	**6.9**	
C38: Total Intermediate Consumption	4.0	2.4	3.4	2.3	2.3	3.6	2.0	2.9	2.9	1.9	3.5

Tpt: Transport and Storage

Petroleum: Coke, refined petroleum products and nuclear fuel

Electricity: Electricity, gas and water supply

Source: Our computations based on OECD at http://stats.oecd.org/Index.aspx?DataSetCode=STAN_IO_TOT_DOM_IMP

6. Simulation Scenarios

In our experimental design we attempt to simulate the impact of introducing efficiency in transport services through comprehensive reforms inclusive of tax reform in theses sectors as well as the sub-component of rationalisation of tax structure. In the absence of any benchmarks study of this nature, we undertake some hypothetical exercises for demonstration purposes. Various scenarios have been discussed to incorporate the impact of improved efficiency realised through overall reform as well as reducing tax-related complexities and introducing a uniform GST reform. In the first scenario we assume a wedge of 35 per cent between the efficiency of India's transport sectors vis-à-vis some international standard benchmark. This implies that we guesstimate an implicit import tariff of 35 per cent on all the sectors of transport. However, as mentioned earlier, we acknowledge this efficiency wedge could be due to a combination of factors including financing, ownership (public, private, or PPP), maintenance, pricing, governance, and taxation among others. We consider an alternative scenario where such wedge is assumed to be lower at 25 per cent. The third scenario assumes that the purely tax-related inefficiency wedge may be even lower at 15 per cent. Fourthly, we also take into account the fact that all transport sectors may not be equally inefficient. We, therefore, attempt to simulate the inefficiencies in a non-uniform pattern, based on the respective transport intensity of each of the five transport sectors (Simulation 4). All such wedges are assumed to be represented through equivalent import tariffs.

Simulation 1: Elimination of implicit import tariff of 35 per cent on all the transport service sectors

Simulation 2: Elimination of implicit import tariff of 25 per cent on all the transport service sectors

Simulation 3: Elimination of implicit import tariff of 15 per cent on all the transport service sectors

Simulation 4: Elimination of implicit import tariff of 10 per cent on land transport services; 15 per cent on rail, air and water transport services; and 25 per cent on support and auxiliary transport services

7. Computational Results

The results of various simulation results are presented in Tables 3 to 6. Table 3 presents the percentage change in macro variables GDP, trade and real returns to factors for each of the simulations. Corresponding changes in value terms are presented in Table 4. The scale effect, an important indicator of operational efficiency, is presented in Table A.1. Scale effect refers to the

change in output per firm. Increase in the scale of production of a sector of production implies improved average efficiency of production in firms of that sector.

Changes in Welfare

Our results show that the economy gains under each of the four simulations. This implies that improved efficiency of transport sectors under all the four scenarios would have a welfare enhancing impact for the economy. However, the extent of gains varies across experiments.

We observe that welfare gains for the economy vary between 0.042 per cent under Simulation-1 to 0.015 per cent under Simulation-4 depending upon the wedge that has been knocked off (Table 3). There are corresponding gains in trade and output.

Returns to Factors

As the economy adjusts to the new equilibrium, resources will be allocated more efficiently as compared to the base equilibrium. The real returns to all factors of production, land, labour and capital, increase.

Table 3: Percentage Change in Macro Variables, Implicit Import Tariff Simulations

S. No.	Economic Indicator	Sim1	Sim2	Sim3	Sim4
1	GDP	0.0423	0.0326	0.0213	0.0148
2	Export	0.7361	0.5679	0.3703	0.2581
3	Import	0.5238	0.4041	0.2635	0.1837
4	Output	0.0247	0.0191	0.0124	0.0087
5	Real Returns to Land	0.0427	0.0329	0.0215	0.0150
6	Real Returns to Labor	0.0789	0.0609	0.0397	0.0277
7	Real Returns to Capital	0.0678	0.0523	0.0341	0.0238

Source: Our simulation results

Table 4: Absolute Change in Variables based on 2011-12 (Rs Crore), Implicit Import Tariff Simulations

		Sim1	Sim2	Sim3	Sim4
1	GDP	3,484	2,688	1,753	1,222
2	Export	10,742	8,287	5,404	3,767
3	Import	12,289	9,480	6,183	4,309

Source: Our simulation results

Scale Effects

Scale effect, an important indicator of efficient production, is measured as output per firm. Firms in the manufacturing sector have been modelled to operate under monopolistic competition. Under the assumption of free entry and exit, as the total output in a sector expands in country,

new firms may join in and vice versa. The positive scale effect refers to an increase in output per firm effect may be considered as an indicator of enhanced scale and reduced costs in the situation of monopolistic competition in the relevant manufacturing sector. A negative scale effect refers to a decline in output per firm.

As suggested by the design of our simulations, efficiency reforms in the transport service sectors would lead to lower costs of service delivery for the end consumer. Access to relatively low priced transport services would reduce the costs for firms with sectors under monopolistic competition in the medium-to-long run. While the firms are permitted to move in and out of the industry, only the efficient ones would stay in business. Competitive pressures leading to increasing returns of scale would show up as efficiency improvements in sectors. This would result in higher values of output per firm as the firms strive to achieve more efficient plant size and lower per unit costs. Thus the gains in economic welfare are expected to come from improved allocation of resources, lower prices to consumers and business firms, and availability of more varieties to consumers. The realisation of economies of scale in manufacturing reinforces these welfare-enhancing effects.

The results of our demonstrative experiments bring out positive scale effects for all sectors of manufacturing.

Even though the magnitude of scale effects varies across simulations, the pattern remains promising for the economy in each simulated scenario. We discuss the results of Simulation 3 as presented in Table A.1. The highest improvements are observed in woollen textiles (0.20 per cent), textile products including wearing apparel (0.19 per cent), silk textiles (0.18 per cent), art silk, synthetic fibre textiles (0.15 per cent), cotton textiles1 (0.11 per cent), and tea and coffee processing (0.07 per cent). It may be noticed that these sectors have a high transport intensity measured as the share of five transport services in total input costs. Transport services account for as much as 11.5 per cent of the total input use in woollen textiles (Table A.2). Similar figures for silk textiles are 6.1 per cent, 8 per cent for art silk, synthetic fibre textiles, 16.9 per cent for cotton textiles and 32.5 per cent for tea and coffee processing. This shows that the sectors that are heavy users of transport intensity stand to benefit the most in terms of efficiency improvements. Transport intensity measures of all sectors are presented in Table A.2.

Environmental Implications

Economic development is becoming increasingly sensitive with regard to environmental implications. Any present policy is assessed for its environmental impact. In this section, we present and discuss the results of our simulations with special focus on energy sectors in the

Indian economy. Any changes in the energy sectors, in terms of consumption, are likely to have direct effects on the *greening* of Indian economy.

Based on the 130 sectors in the India input–output transaction table for the year 2003–04, we identify five core sectors that can be collectively referred to as the *energy* sector. These include natural gas, crude petroleum, petroleum products, coal tar products and electricity.

Various sectors of the economy have different energy requirements. We have computed energy intensities, defined as proportions of energy inputs in total inputs, across various sectors. Further, the composition of energy usage also varies across sectors with some sectors depending on a particular type of fuel. Sector-wise energy intensities for each type of fuel are presented in Table A.3. Figures show that two of the five transport services studied have high energy intensities.

The results of simulations indicate that enhanced efficiency of transport services will move the economy towards a new equilibrium with lower demand in each of the constituting sub-sectors of the composite energy sector. Tables 5 and 6 present the percentage and absolute changes in final demand of energy sectors, respectively. These tables show the impact on environment.

As can be seen from Table 6, the final demand for each of the fuel types, under all demonstrative cases, goes down. Under the most conservative scenario of tax rationalisation (Simulation 3), the economy would realise a decline of (-) 0.017 per cent in final demand of natural gas. Similarly final demand of crude petroleum would decline by (-) 0.004 per cent, and petroleum products by (-) 0.018 per cent. Comparable declines in the final demand of coal tar products and electricity are (-) 0.01 and (-) 0.013 per cent, respectively. Even though the percentage numbers look small, these point towards greener environment.

Thus making transport sectors more efficient than their current performance levels would not only be welfare enhancing but also environment friendly.

Table 5: Percentage Change in Final Demand, Energy Sectors

S No.	Economic Indicator	Sim1	Sim2	Sim3	Sim4
1	Natural gas	- 0.0340	- 0.0262	- 0.0171	- 0.0119
2	Crude petroleum	- 0.0103	- 0.0079	- 0.0052	- 0.0036
3	Petroleum products	- 0.0518	- 0.0399	- 0.0260	- 0.0181
4	Coal tar products	- 0.0287	- 0.0222	- 0.0145	- 0.0101
5	Electricity	- 0.0378	- 0.0292	- 0.0190	- 0.0133

Source: Our simulation results

Table 6: Absolute Change in Final Demand, Energy Sectors (Rs lakh)

S No.	Economic Indicator	Sim1	Sim2	Sim3	Sim4
1	Natural gas	- 718864	- 554553	- 361665	- 252069
2	Crude petroleum	- 8880663	- 6850797	- 4467912	- 3113999
3	Petroleum products	- 974	- 752	- 490	- 342
4	Coal tar products	- 1246158	- 961322	- 626949	- 436964
5	Electricity	- 597	- 461	- 300	- 209

Source: Our simulation results

8. Concluding Remarks

Documentation of taxes and user charges in various sectors of transport in India indicates that the prevailing regime is quite complex and not amenable to a meaningful analysis of its objectives and the impact on the national and state economies. There are wide differentials in tax regimes across states. Intra-modal tax structures are also complex within each state. Taxes on various categories of fuel vary within and across states. The issue of incorporating externalities of social costs including congestion and pollution do not seem to have been addressed while formulating the tax regimes. This has resulted in less than efficient delivery of transport services which would, in turn, affect the efficiency of other sectors. It is not easy to capture the impact of integrated tax rationalisation in various sectors of transport. This paper, therefore, uses a computable general equilibrium (CGE) model of the economy.

The results obtained from the general equilibrium model show that the economy gains through improved efficiency of transport sectors. However, the extent of gains varies across experiments. There are corresponding gains in trade and output. The real returns to the factors of production, viz. land, labour and capital, register an increase. Positive scale effects are observed for the manufacturing sectors, particularly for heavy users of transport. Enhanced efficiency of transport services lowers demand for energy in the economy. Our analysis shows that increased efficiency of transport sectors leads to welfare gains in an environment friendly manner.

Our research brings forth the need to establish a task force on transport taxes and user charges. The task force would chart out a model act on transport taxes and user charges. This would then be circulated among states and union territories for their consideration of adoption. Relatively uniform and transparent tax regime would facilitate the country to move towards a common market[4].

[4] This Act may be somewhat analogous to the Model Act on Agricultural Marketing (2003).

Table A.1: Percentage Change in Output per Firm: Scale Effects

S No.	Sector Description	Sim 1	Sim 2	Sim 3	Sim 4
1	Sugar	0.027	0.021	0.014	0.010
2	Khandsari, boora	0.028	0.021	0.014	0.010
3	Hydrogenated oil (vanaspati)	0.025	0.019	0.013	0.009
4	Edible oils other than vanaspati	0.027	0.021	0.014	0.009
5	Tea and coffee processing	0.135	0.104	0.068	0.047
6	Miscellaneous food products	0.042	0.032	0.021	0.015
7	Beverages	0.051	0.039	0.026	0.018
8	Tobacco products	0.027	0.021	0.014	0.010
9	Cotton textiles[1]	0.221	0.171	0.111	0.078
10	Woollen textiles	0.394	0.304	0.198	0.138
11	Silk textiles	0.362	0.280	0.182	0.127
12	Art silk, synthetic fibre textiles	0.298	0.230	0.150	0.104
13	Jute, hemp, mesta textiles	0.060	0.046	0.030	0.021
14	Textile products including wearing apparel[2]	0.381	0.294	0.192	0.134
15	Wood and wood products	0.032	0.025	0.016	0.011
16	Furniture and fixtures – wooden	0.037	0.028	0.019	0.013
17	Paper, paper products, and newsprint	0.064	0.049	0.032	0.022
18	Printing and publishing	0.057	0.044	0.029	0.020
19	Leather footwear	0.054	0.042	0.027	0.019
20	Leather and leather products	0.058	0.044	0.029	0.020
21	Rubber products	0.115	0.089	0.058	0.040
22	Plastic products	0.112	0.086	0.056	0.039
23	Petroleum products	0.029	0.023	0.015	0.010
24	Coal tar products	0.034	0.026	0.017	0.012
25	Inorganic heavy chemicals	0.064	0.049	0.032	0.022
26	Organic heavy chemicals	0.068	0.053	0.034	0.024
27	Fertilizers	0.052	0.040	0.026	0.018
28	Paints, varnishes, and lacquers	0.069	0.053	0.035	0.024
29	Pesticides	0.050	0.039	0.025	0.018
30	Drugs and medicines	0.053	0.041	0.027	0.019
31	Soaps, cosmetics and glycerine	0.068	0.053	0.034	0.024
32	Synthetic fibres, resin	0.096	0.074	0.048	0.034
33	Other chemicals	0.047	0.036	0.024	0.017
34	Cement	0.042	0.032	0.021	0.015
35	Structural clay products	0.045	0.034	0.022	0.016
36	Other non-metallic mineral products	0.042	0.033	0.021	0.015
37	Iron, steel and ferro alloys	0.009	0.007	0.005	0.003
38	Iron and steel casting and forging	0.000	0.000	0.000	0.000
39	Iron and steel foundries	0.003	0.002	0.002	0.001
40	Non-ferrous basic metals	0.020	0.016	0.010	0.007
41	Hand tools, hardware	0.006	0.005	0.003	0.002
42	Miscellaneous metal products	0.012	0.009	0.006	0.004
43	Tractors and agricultural implements	0.005	0.004	0.003	0.002

S No.	Sector Description	Sim 1	Sim 2	Sim 3	Sim 4
44	Industrial machinery (F&T)	0.007	0.005	0.003	0.002
45	Industrial machinery (others)	0.010	0.008	0.005	0.004
46	Machine tools	0.014	0.011	0.007	0.005
47	Other non-electrical machinery	0.007	0.006	0.004	0.003
48	Electrical industrial machinery	0.006	0.004	0.003	0.002
49	Electrical wires and cables	0.040	0.031	0.020	0.014
50	Batteries	0.013	0.010	0.006	0.004
51	Electrical appliances	0.017	0.013	0.009	0.006
52	Communication equipment	0.004	0.003	0.002	0.002
53	Other electrical machinery	0.019	0.015	0.010	0.007
54	Electronic equipment	0.013	0.010	0.006	0.004
55	Rail equipment	0.018	0.014	0.009	0.006
56	Ships and boats	0.006	0.004	0.003	0.002
57	Motor vehicles	0.002	0.001	0.001	0.001
58	Motorcycles and scooters	0.008	0.006	0.004	0.003
59	Bicycles, cycle rickshaws	0.003	0.003	0.002	0.001
60	Other transport equipment	0.005	0.004	0.003	0.002
61	Watches and clocks	0.026	0.020	0.013	0.009
62	Medical, precision and optical instruments	0.045	0.034	0.022	0.016
63	Gems and jewellery	0.035	0.027	0.017	0.012
64	Aircraft and spacecraft	0.015	0.012	0.008	0.005
65	Miscellaneous manufacturing	0.051	0.039	0.026	0.018

Source: Our simulation results

Notes:

1: includes khadi, cotton textiles (handlooms) and cotton textiles

2: includes carpet weaving, readymade garments and miscellaneous textile products

Table A.2: Transport Intensity, Share of Transport Services in Total Inputs (per cent) Input–Output

S No.	Sector Description	Total Transport Services	Rail Transport Services	Land Transport Services	Water Transport Services	Air Transport Services	Auxiliary Transport Services
1	Paddy	5.6	1.2	3.6	0.3	0.0	0.4
2	Wheat	4.6	0.7	3.0	0.3	0.0	0.4
3	Jowar	7.2	0.8	5.8	0.2	0.0	0.4
4	Bajra	7.0	0.8	5.7	0.2	0.0	0.4
5	Maize	7.1	1.0	5.4	0.2	0.0	0.5
6	Gram	4.5	0.5	3.4	0.2	0.0	0.3
7	Pulses	4.5	0.4	3.5	0.1	0.1	0.3
8	Sugarcane	5.3	0.9	3.8	0.1	0.0	0.4
9	Groundnut	4.7	0.5	3.8	0.1	0.0	0.3
10	Other oilseeds	6.8	0.7	5.2	0.3	0.0	0.4
11	Jute	8.2	1.0	6.5	0.2	0.0	0.5
12	Cotton	4.8	0.6	3.7	0.1	0.0	0.3
13	Tobacco	6.9	1.2	5.0	0.2	0.0	0.5
14	Coconut	5.3	0.5	4.2	0.3	0.0	0.4
15	Tea	9.2	0.6	7.8	0.2	0.0	0.7
16	Coffee	4.9	0.0	4.4	0.2	0.0	0.4
17	Rubber	8.1	1.1	6.0	0.2	0.0	0.7
18	Fruits	6.8	1.0	5.2	0.2	0.0	0.5
19	Vegetables	5.3	0.7	4.1	0.1	0.0	0.3
20	Other crops	5.5	0.9	3.9	0.2	0.0	0.4
21	Milk and milk products	8.6	0.4	6.6	0.0	0.8	0.8
22	Animal services (agricultural)	9.3	0.4	7.1	0.0	0.9	0.9
23	Poultry and eggs	4.9	0.7	3.1	0.5	0.1	0.5
24	Other livestock products and gobar gas	9.2	0.4	7.0	0.0	0.9	0.9
25	Forestry and logging	33.1	2.7	29.9	0.1	0.1	0.2
26	Fishing	10.2	0.4	8.6	0.4	0.0	0.8
27	Coal and lignite	13.6	2.0	11.0	0.1	0.1	0.4
28	Natural gas	10.5	1.6	8.3	0.1	0.1	0.4
29	Crude petroleum	6.7	1.1	5.1	0.1	0.1	0.4
30	Iron ore	12.3	4.0	7.7	0.2	0.0	0.3
31	Manganese ore	18.1	8.4	9.4	0.1	0.1	0.1
32	Bauxite	9.5	4.0	4.6	0.3	0.0	0.5
33	Copper ore	9.3	3.6	5.3	0.1	0.1	0.2
34	Other metallic minerals	6.8	1.6	4.6	0.2	0.1	0.4
35	Lime stone	9.7	2.7	6.5	0.1	0.1	0.3
36	Mica	5.8	1.2	4.7	0.0	0.0	0.0
37	Other non-metallic	11.1	2.6	8.1	0.1	0.1	0.3

S No.	Sector Description	Total Transport Services	Rail Transport Services	Land Transport Services	Water Transport Services	Air Transport Services	Auxiliary Transport Services
	minerals						
38	Sugar	2.0	0.1	1.6	0.0	0.0	0.1
39	Khandsari, boora	2.0	0.1	1.6	0.0	0.0	0.1
40	Hydrogenated oil (vanaspati)	3.3	0.4	2.1	0.5	0.1	0.3
41	Edible oils other than vanaspati	3.1	0.3	2.0	0.5	0.1	0.2
42	Tea and coffee processing	32.5	0.2	28.5	0.1	0.0	3.7
43	Miscellaneous food products	6.0	0.5	4.6	0.3	0.1	0.4
44	Beverages	6.8	0.6	5.0	0.5	0.2	0.6
45	Tobacco products	7.9	0.8	6.4	0.2	0.1	0.4
46,47	Cotton textiles[1]	16.9	0.1	14.8	0.0	0.2	1.8
48	Woollen textiles	11.5	0.2	9.9	0.0	0.1	1.2
49	Silk textiles	6.1	0.2	5.0	0.0	0.2	0.6
50	Art silk, synthetic fibre textiles	8.0	0.3	6.6	0.1	0.1	0.9
51	Jute, hemp, mesta textiles	4.6	0.5	3.6	0.1	0.1	0.3
52, 53, 54	Textile products including wearing apparel[2]	8.0	0.2	6.7	0.0	0.3	0.8
55	Furniture and fixtures–wooden	9.0	0.9	6.7	0.5	0.1	0.8
56	Wood and wood products	6.8	0.5	5.3	0.3	0.1	0.6
57	Paper, paper products and newsprint	10.0	1.1	7.5	0.2	0.3	0.9
58	Printing and publishing	11.0	0.4	8.6	0.0	1.0	1.0
59	Leather footwear	9.1	0.8	6.5	0.0	1.2	0.6
60	Leather and leather products	8.5	0.4	6.2	0.0	1.3	0.6
61	Rubber products	6.6	0.5	5.3	0.1	0.1	0.6
62	Plastic products	5.8	0.4	4.7	0.0	0.1	0.6
63	Petroleum products	2.4	1.9	0.4	0.1	0.0	0.0
64	Coal tar products	11.7	7.5	3.3	0.5	0.0	0.5
65	Inorganic heavy chemicals	7.3	1.5	5.0	0.2	0.1	0.5
66	Organic heavy chemicals	6.2	1.0	4.5	0.2	0.1	0.5
67	Fertilisers	8.5	1.2	6.2	0.3	0.0	0.7
68	Paints, varnishes and lacquers	6.6	0.9	4.9	0.1	0.1	0.6
69	Pesticides	4.1	0.4	3.1	0.1	0.1	0.4

S No.	Sector Description	Total Transport Services	Rail Transport Services	Land Transport Services	Water Transport Services	Air Transport Services	Auxiliary Transport Services
70	Drugs and medicines	7.3	0.7	4.9	0.1	1.0	0.7
71	Soaps, cosmetics and glycerine	6.8	0.9	5.2	0.1	0.1	0.6
72	Synthetic fibres, resin	6.6	0.7	5.2	0.1	0.1	0.6
73	Other chemicals	5.7	0.6	4.3	0.3	0.1	0.5
74	Cement	14.5	7.0	6.0	0.7	0.1	0.7
75	Structural clay products	12.0	2.4	8.5	0.4	0.0	0.7
76	Other non-metallic mineral products	9.0	1.3	6.8	0.2	0.1	0.6
77	Iron, steel and ferro alloys	10.0	5.7	3.4	0.4	0.0	0.5
78	Iron and steel casting and forging	7.2	3.2	3.4	0.2	0.0	0.3
79	Iron and steel foundries	6.4	2.4	3.4	0.1	0.1	0.4
80	Non-ferrous basic metals	8.9	4.1	4.0	0.3	0.0	0.5
81	Hand tools, hardware	4.9	1.1	3.3	0.1	0.1	0.4
82	Miscellaneous metal products	7.1	2.9	3.5	0.2	0.1	0.4
83	Tractors and agricultural implements	3.9	0.7	2.7	0.0	0.2	0.3
84	Industrial machinery (F & T)	4.4	0.9	3.0	0.0	0.1	0.3
85	Industrial machinery (others)	5.3	1.3	3.6	0.0	0.1	0.3
86	Machine tools	5.3	1.0	3.7	0.0	0.2	0.4
87	Other non-electrical machinery	4.5	1.0	3.0	0.0	0.1	0.3
88	Electrical industrial machinery	4.3	0.7	3.2	0.0	0.1	0.3
89	Electrical wires and cables	3.9	0.4	3.1	0.0	0.0	0.4
90	Batteries	3.3	0.2	2.8	0.0	0.0	0.3
91	Electrical appliances	5.0	0.5	3.8	0.1	0.3	0.4
92	Communication equipment	2.9	0.3	2.2	0.0	0.2	0.2
93	Other electrical machinery	6.4	0.9	4.9	0.1	0.2	0.4
94	Electronic equipment (including TV)	3.7	0.3	2.9	0.0	0.3	0.3
95	Rail equipment	5.5	1.4	3.6	0.1	0.1	0.4
96	Ships and boats	3.6	1.0	2.3	0.0	0.1	0.2
97	Motor vehicles	4.8	0.7	3.4	0.0	0.3	0.3
98	Motorcycles and scooters	4.2	0.5	3.2	0.0	0.2	0.3

S No.	Sector Description	Total Transport Services	Rail Transport Services	Land Transport Services	Water Transport Services	Air Transport Services	Auxiliary Transport Services
99	Bicycles, cycle rickshaws	6.8	0.7	5.3	0.0	0.1	0.6
100	Other transport equipment	3.9	0.5	3.0	0.0	0.1	0.3
101	Watches and clocks	12.9	0.4	11.1	0.0	0.2	1.2
102	Medical, precision and optical instruments	15.3	3.5	10.0	0.1	0.8	0.8
103	Gems and jewellery	9.1	5.1	3.5	0.2	0.0	0.1
104	Aircraft and spacecraft	2.6	0.2	2.1	0.1	0.1	0.1
105	Miscellaneous manufacturing	9.5	1.8	6.4	0.1	0.6	0.7
106	Construction	9.1	1.1	6.9	0.2	0.1	0.8
107	Electricity	7.8	4.1	2.9	0.4	0.1	0.4
108	Water supply	2.4	0.9	1.4	0.0	0.1	0.0
109	Railway transport services	10.8	9.1	1.5	0.1	0.1	0.0
110	Land transport including via pipeline	6.4	0.5	4.9	0.5	0.2	0.3
111	Water transport	10.7	0.2	10.2	0.1	0.1	0.2
112	Air transport	11.7	0.3	10.8	0.3	0.1	0.2
113	Supporting and auxiliary transport activities	28.9	1.7	26.2	0.0	0.6	0.4
114	Storage and warehousing	6.6	1.2	5.1	0.0	0.1	0.2
115	Communication	4.7	0.8	3.6	0.0	0.2	0.1
116	Trade	23.1	0.3	22.1	0.1	0.4	0.2
117	Hotels and restaurants	5.9	0.4	4.4	0.3	0.3	0.6
118	Banking	6.7	1.2	5.2	0.0	0.3	0.1
119	Insurance	16.9	3.9	11.4	0.1	1.0	0.5
120	Ownership of dwellings	0.0	0.0	0.0	0.0	0.0	0.0
121	Education and research	23.9	0.1	23.1	0.0	0.5	0.2
122	Medical and health	8.2	0.4	5.3	0.0	1.7	0.8
123	Business services	3.2	0.5	1.7	0.0	0.9	0.1
124	Computer and related activities	3.1	0.6	1.8	0.0	0.7	0.1
125	Legal services	0.3	0.0	0.2	0.0	0.1	0.0
126	Real estate activities	0.6	0.0	0.5	0.0	0.1	0.0
127	Renting of machinery and equipment	4.0	0.0	3.9	0.0	0.1	0.0
128	Other commercial, social and personal	5.9	0.4	5.3	0.1	0.1	0.1

S No.	Sector Description	Total Transport Services	Rail Transport Services	Land Transport Services	Water Transport Services	Air Transport Services	Auxiliary Transport Services
	services						
129	Other services	2.1	0.2	1.5	0.0	0.3	0.1
130	Public administration	0.0	0.0	0.0	0.0	0.0	0.0

Source: Our computations based on Input–Output Table, CSO, 2003–04
*Notes:*1: Includes khadi, cotton textiles including handlooms (46, 47)2: Includes carpet weaving, readymade garments and miscellaneous textile products (52, 53, 54)

Table A.3: Energy Intensity, Share of Energy Inputs in Total Inputs (per cent)

S No.	Sector Description	Total Energy	Natural Gas	Crude Petroleum	Petroleum Products	Coal Tar Products	Electricity
1	Paddy	9.1	0.0	0.0	4.1	0.0	5.0
2	Wheat	8.0	0.0	0.0	2.7	0.0	5.2
3	Jowar	8.8	0.0	0.0	8.3	0.0	0.5
4	Bajra	9.4	0.0	0.0	7.9	0.0	1.5
5	Maize	13.4	0.0	0.0	9.7	0.0	3.7
6	Gram	16.7	0.0	0.0	13.1	0.0	3.5
7	Pulses	5.2	0.0	0.0	3.6	0.0	1.7
8	Sugarcane	7.5	0.0	0.0	3.2	0.0	4.3
9	Groundnut	5.7	0.0	0.0	4.8	0.0	0.9
10	Other oilseeds	12.6	0.0	0.0	8.0	0.0	4.6
11	Jute	7.7	0.0	0.0	7.7	0.0	0.0
12	Cotton	6.3	0.0	0.0	3.7	0.0	2.6
13	Tobacco	7.8	0.0	0.0	4.3	0.0	3.5
14	Coconut	3.2	0.0	0.0	3.2	0.0	0.0
15	Tea	3.0	0.0	0.0	3.0	0.0	0.0
16	Coffee	1.6	0.0	0.0	1.6	0.0	0.0
17	Rubber	1.8	0.0	0.0	1.8	0.0	0.0
18	Fruits	15.1	0.0	0.0	8.5	0.0	6.7
19	Vegetables	11.3	0.0	0.0	6.3	0.0	5.0
20	Other crops	6.2	0.0	0.0	3.0	0.0	3.1
21	Milk and milk products	0.0	0.0	0.0	0.0	0.0	0.0
22	Animal services (agricultural)	0.0	0.0	0.0	0.0	0.0	0.0
23	Poultry and eggs	0.0	0.0	0.0	0.0	0.0	0.0
24	Other livestock products and gobar gas	0.2	0.0	0.0	0.1	0.0	0.1
25	Forestry and logging	10.3	0.0	0.0	9.4	0.0	0.9
26	Fishing	26.1	0.0	0.0	26.1	0.0	0.0
27	Coal and lignite	19.2	0.0	0.0	3.3	0.0	15.9
28	Natural gas	18.2	0.0	0.6	6.1	0.0	11.5
29	Crude petroleum	17.3	0.0	1.7	9.5	0.0	6.1
30	Iron ore	31.1	0.0	0.0	15.0	0.0	16.2
31	Manganese ore	8.2	0.0	0.0	7.1	0.0	1.2
32	Bauxite	13.2	0.8	0.0	3.7	1.0	7.7
33	Copper ore	23.4	0.0	0.0	11.4	0.0	12.0
34	Other metallic minerals	25.1	0.2	0.0	8.3	0.2	16.3
35	Lime stone	22.8	0.0	0.0	8.5	0.0	14.3
36	Mica	27.9	0.0	0.0	27.9	0.0	0.0
37	Other non-metallic minerals	13.6	0.0	0.0	6.5	0.0	7.1
38	Sugar	2.1	0.0	0.0	1.2	0.0	0.9
39	Khandsari, boora	2.1	0.0	0.0	1.2	0.0	0.9
40	Hydrogenated oil (vanaspati)	1.8	0.0	0.0	0.7	0.0	1.1
41	Edible oils other than vanaspati	1.7	0.0	0.0	0.8	0.0	1.0

S No.	Sector Description	Total Energy	Natural Gas	Crude Petroleum	Petroleum Products	Coal Tar Products	Electricity
42	Tea and coffee processing	5.0	0.0	0.0	2.3	0.0	2.7
43	Miscellaneous food products	3.6	0.1	0.0	1.4	0.0	2.1
44	Beverages	5.4	0.0	0.0	2.3	0.0	3.2
45	Tobacco products	2.1	0.0	0.0	1.0	0.0	1.1
46, 47	Cotton textiles[1]	10.8	0.0	0.0	2.6	0.0	8.2
48	Woollen textiles	7.9	0.0	0.0	2.4	0.0	5.6
49	Silk textiles	5.4	0.9	0.0	1.8	0.0	2.7
50	Art silk, synthetic fibre textiles	8.9	0.1	0.0	3.6	0.0	5.3
51	Jute, hemp, mesta textiles	10.7	0.0	0.0	0.7	0.0	10.0
52, 53, 54	Textile products including wearing apparel[2]	4.8	0.4	0.0	1.5	0.0	3.0
55	Furniture and fixtures–wooden	4.9	0.0	0.0	1.2	0.0	3.6
56	Wood and wood products	3.6	0.0	0.0	0.9	0.0	2.7
57	Paper, paper products and newsprint	9.8	0.0	0.0	3.3	0.0	6.4
58	Printing and publishing	4.4	0.0	0.0	1.1	0.0	3.3
59	Leather footwear	3.1	0.0	0.0	1.0	0.0	2.1
60	Leather and leather products	3.2	0.0	0.0	1.1	0.0	2.1
61	Rubber products	7.9	0.3	1.2	2.6	0.0	3.8
62	Plastic products	6.9	0.1	0.0	2.1	0.0	4.7
63	Petroleum products	90.9	0.0	84.0	5.0	0.0	1.9
64	Coal tar products	41.1	0.0	32.7	3.2	2.3	2.8
65	Inorganic heavy chemicals	18.5	3.0	0.4	7.9	0.4	6.8
66	Organic heavy chemicals	13.8	1.4	0.0	5.2	0.3	6.9
67	Fertilisers	34.4	10.3	0.0	21.1	0.0	2.9
68	Paints, varnishes and lacquers	9.6	1.2	0.6	3.3	0.2	4.2
69	Pesticides	8.4	0.8	0.0	3.1	0.1	4.5
70	Drugs and medicines	5.7	0.5	0.0	1.7	0.0	3.4
71	Soaps, cosmetics and glycerine	4.2	0.0	0.0	2.0	0.1	2.1
72	Synthetic fibres, resin	9.9	1.1	0.0	6.3	0.0	2.4
73	Other chemicals	12.8	2.5	1.7	2.9	0.1	5.6
74	Cement	22.8	1.6	0.0	5.1	0.1	15.9
75	Structural clay products	23.5	0.2	0.0	13.2	0.1	10.0
76	Other non-metallic mineral products	19.4	0.2	0.0	8.9	0.8	9.5
77	Iron, steel and ferro alloys	16.6	2.5	0.1	2.9	1.7	9.5
78	Iron and steel casting and forging	12.8	0.5	0.0	2.8	0.4	9.1
79	Iron and steel foundries	7.9	0.8	0.0	1.9	0.5	4.8
80	Non-ferrous basic metals	11.3	1.0	0.0	2.3	0.9	7.1

S No.	Sector Description	Total Energy	Natural Gas	Crude Petroleum	Petroleum Products	Coal Tar Products	Electricity
81	Hand tools, hardware	5.6	0.1	0.0	1.7	0.0	3.7
82	Miscellaneous metal products	9.0	0.9	0.0	2.1	0.6	5.5
83	Tractors and agricultural Implements	5.4	0.1	0.0	1.1	0.0	4.3
84	Industrial machinery (others)	5.1	1.0	0.0	1.3	0.0	2.8
85	Industrial machinery (others)	4.4	0.7	0.0	1.2	0.1	2.5
86	Machine tools	4.7	0.2	0.0	1.3	0.0	3.1
87	Other non-electrical machinery	5.0	0.4	0.0	1.4	0.0	3.2
88	Electrical industrial machinery	4.2	0.0	0.0	1.3	0.0	2.8
89	Electrical wires and cables	3.1	0.0	0.0	0.9	0.0	2.2
90	Batteries	6.6	0.0	0.0	1.1	0.2	5.3
91	Electrical appliances	6.2	0.1	0.0	3.1	0.0	3.0
92	Communication equipment	3.1	0.0	0.0	0.7	0.0	2.4
93	Other electrical machinery	5.9	0.1	0.0	1.9	0.1	3.7
94	Electronic equipment (including TV)	3.2	0.0	0.0	0.9	0.0	2.2
95	Rail equipment	7.7	0.1	0.0	2.4	0.2	5.0
96	Ships and boats	2.5	0.0	0.0	0.8	0.0	1.6
97	Motor vehicles	5.2	0.0	0.0	1.0	0.0	4.2
98	Motor cycles and scooters	8.4	0.0	0.0	1.0	0.0	7.4
99	Bicycles, cycle rickshaws	4.7	0.0	0.0	1.6	0.0	3.1
100	Other transport equipment	8.0	0.0	0.0	1.1	0.0	7.0
101	Watches and clocks	3.2	0.0	0.0	0.5	0.0	2.6
102	Medical, precision and optical instruments	7.9	0.1	0.0	1.5	0.0	6.3
103	Gems and jewellery	0.7	0.0	0.0	0.1	0.0	0.5
104	Aircraft and spacecraft	8.2	0.0	0.0	5.2	0.0	3.0
105	Miscellaneous manufacturing	7.5	0.1	3.8	1.4	0.0	2.2
106	Construction	9.4	0.0	0.0	2.1	3.9	3.5
107	Electricity	50.5	2.8	0.4	11.7	0.3	35.2
108	Water supply	10.1	0.0	0.0	0.5	0.0	9.5
109	Railway transport services	24.1	0.0	0.0	4.7	0.0	19.3
110	Land transport including via pipeline	43.5	0.0	0.0	42.3	0.0	1.2
111	Water transport	8.0	0.0	0.0	6.7	0.0	1.3
112	Air transport	21.5	0.0	0.0	19.5	0.0	2.0
113	Supporting and auxiliary transport activities	11.6	0.0	0.0	2.6	0.0	9.0

S No.	Sector Description	Total Energy	Natural Gas	Crude Petroleum	Petroleum Products	Coal Tar Products	Electricity
114	Storage and warehousing	48.7	0.0	0.0	1.9	0.0	46.8
115	Communication	13.3	0.0	0.0	2.9	0.0	10.4
116	Trade	11.3	0.1	0.1	5.2	0.0	6.0
117	Hotels and restaurants	4.7	0.0	0.0	1.5	0.0	3.2
118	Banking	7.0	0.0	0.0	1.8	0.0	5.1
119	Insurance	11.9	0.0	0.0	4.9	0.0	6.9
120	Ownership of dwellings	0.0	0.0	0.0	0.0	0.0	0.0
121	Education and research	2.7	0.0	0.0	1.9	0.0	0.8
122	Medical and health	2.5	0.0	0.0	1.7	0.0	0.8
123	Business services	3.6	0.0	0.0	0.1	0.0	3.5
124	Computer and related activities	0.8	0.0	0.0	0.0	0.0	0.8
125	Legal services	1.0	0.0	0.0	0.1	0.0	0.9
126	Real estate activities	1.0	0.0	0.0	0.1	0.0	1.0
127	Renting of machinery and equipment	0.0	0.0	0.0	0.0	0.0	0.0
128	Other commercial, social and personal services	1.5	0.0	0.0	0.2	0.0	1.4
129	Other services	2.4	0.0	0.0	0.5	0.0	1.9
130	Public administration	0.0	0.0	0.0	0.0	0.0	0.0

Source: Our computations based on Input–Output Table, CSO, 2003–04

Notes:

1: Includes khadi, cotton textiles including handlooms (46, 47)

2: Includes carpet weaving, readymade garments and miscellaneous textile products (52, 53, 54)

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