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Modal Shares in Transport: Significance for the Development of India

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Authors' note -- Writing for an Indian audience is always a challenge. Experts who work in India quickly learn two things: that Indian audiences can be among the world's most knowledgeable and intellectually demanding; and, that Indian audiences can also be among the proudest of (and the most sensitive to apparent criticism about) the manifest accomplishments of India's railways. The dilemma is how to say challenging things in a way that is perceived as constructive. This article should be seen in this context – enormous respect for what has been accomplished coupled with a belief that the Indian Railways (IR) of tomorrow will not look like the IR of yesterday – or even the IR of today. The path to the future is always paved with earnest argument and, sometimes, honest differences of opinion.

Freight Transport

Freight transport – the ability to move goods from producer to consumer – is an increasingly important aspect of modern economic development. The globalized economy has made efficiency in freight transport even more important: countries that pay too much for transport, or have transport of poor quality, are at a costly disadvantage. Passenger transport – the freedom of individuals to find and travel to employment, the opportunity to visit family and friends, movement of tourists, and the vital human interactions needed to support trade in goods and services is also one of the critical underpinnings of all open societies. Economies do not function well without good transport.

Transport is, however, rarely consumed for its own sake. For the most part, passengers travel to get somewhere and back, and not for the journey alone: instances of freight "joy riding" are almost too rare to identify.[2] Thus, transport is, in economic terms, a "derived demand:" that is, demand for transport is defined by the demand for the underlying goods or human movement needs that it serves.

As a result, transport plays a significant role in what can and does happen elsewhere in the economy. If an electric power plant wishes to buy coal and has a choice between two

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[1] Opinions in this article are those of the authors alone, and should not be attributed to the World Bank , its Directors or its member.
[2] Certain liquors – Genever Gin in the Netherlands, are sent on long sea voyages to promote aging.

mines of equal quality and mine head cost, it is unlikely to buy from the mine 1000 Km away if there is a mine 150 Km from the plant. Individuals can readily commute 5 Km each way to work (they can even walk this distance if they are energetic), but almost never commute farther than 200 Km each way, unless they have free transport.

Issues in transport are made more complex by the number of choices available to shippers or travelers. A shipper of goods can choose human power (head loading, freight cycles or bicycles), animal power, small goods vehicles, large trucks, rail, barges, river ships, intra-coastal ships, deep sea ships, pipeline, or air. In some cases, a shipper will have competitive offers from two, three or even more different modal possibilities. Similarly, passengers can walk, cycle, use an automobile, bus, train, boat, ship, or airplane and, in many cases, the passenger can choose among modes for the same trip.

The Basis for Modal Choice

So freight and passenger modal choices must be made, on the basis of the relative cost, trip time and quality of the transport offered. In cases where only one mode is available or all choices are too expensive, the choice is to use transport or not ship at all (or stay at home). Where there are several modal choices available, the issue of modal choice, and how it might be influenced arises.

Early demand modelers tended to view the cost/time/quality tradeoffs as being fairly simple. Later experience has expanded the definition of these terms so that "cost" now includes not just the line haul tariff or fare, but also local pick up and delivery, insurance (affected by quality), and inventory impacts of different minimum shipment sizes, among many others. Trip time includes not only line haul travel time once started, but also departure frequency and reliability of departure and arrival. Quality includes not only comfort, but also safety, lack of damage to cargo, information en route as to arrival times, en route services such as reliable refrigeration, and many others. The rapid emergence of "just-in-time" logistics has emphasized the complexity of the modal choice calculation, and has shown how important it can be to understand all of the factors acting on freight shipment decisions. The importance of the airline practice of yield management makes the same point: passengers on the same airplane may be paying many different prices for legitimate reasons depending on their travel demand characteristics (the tourist who bought a non-refundable ticket 6 months in advance pays a lot less than the day-trip business person). In fact, the economic efficiency of transport is significantly promoted when customer and transporter (freight or passenger) can interact flexibility across the full range of cost and performance options, and when government policies do not distort the choices they make.

Market economists argue that transport choices are made relatively effectively. Shippers or passengers tend to know the cost/performance choices available to them and (within the normal limits of information and rationality) choose what best meets their needs. Taken together, these choices define the modal shares that each mode enjoys. There is also a clear recognition of the economic importance of modal choice: when Government policies distort modal choices (through unbalanced regulation or biased promotional

spending on a particular mode without adequate user charges to compensate), the entire economy can pay a very high price.

External Costs

There is, however, a clear exception to this principle when there are aspects of cost or performance that the system user does not perceive or pay for or, when the transport mode does not pay for the costs of the transport infrastructure or capacity it consumes. These are in fact important exceptions. External costs (costs that are not perceived by the provider or user) such as pollution, noise, safety, and congestion are often not seen as costs and thus do not affect modal choice the way they would if the user had to pay. In some countries, heavy trucks do not pay their full share of the cost of building and maintaining highways: the resulting public subsidies are distorting modal choice. Much the same can be said of rail passengers traveling for free or at severely reduced fares without adequate and direct public compensation to the carrier.

Measuring Market Share

Discussions of modal choice often are confused by conflicting definitions of how modal output actually should be measured. Two approaches are often used – passengers handled (or tons[3] lifted) versus passenger-km (or ton-km moved). The first measures the quantity of **goods or passengers** handled, the other measures the quantity of **transport** produced. Another definition – revenue generated from transport (or expenditure on transport in the case of private carriage) -- measures in effect the **value** of the transport services rendered. Each can have a valid purpose, but they can yield very different pictures of the role of each mode. Moreover, as discussed below, modal choices and shares can vary significantly from country to country depending on income levels, geography, commodities produced, etc. Much more important, modal shares are dynamic – they change, sometimes rapidly and significantly, in response to underlying changes in the costs and performance of the modes of transport.

[Figure 1] shows the three market share measures as applied in the U.S. (where the full data are available). Rail's share of the market in tons originated is 25.8 percent, in ton-km 37.1 percent; but, in revenue, the rail share is only 9.4 percent. Corresponding shares for intercity trucks are 38.6 percent of tons, 27.7 percent of ton-km, but 75.6 percent of revenues. Put another way, trucks carry about 75 percent as many ton-km as rail, but they generate over eight times as much transport revenue! A very different perspective, indeed!

[Figure 2] displays the changes in modal share in freight, and [Figure 3] displays the changes in modal share in passenger transport for a number of countries over time. These Figures are based on ton-km or passenger-km, which are the most familiar measures -- but the reader is cautioned to keep in mind that other measures might yield a different

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[3] Throughout this note, only metric measures will be used. Thus, tons are 1000Kg (2204 pounds). Numbers published from U.S. sources are usually given in short tons (2000 pounds) and short ton-miles (0.621 miles per Km).

perspective. Evidently, market share can change greatly in response to underlying changes in capacity, cost and performance of the various modes. There are two important points: 1) market share, especially for freight, is a dynamic, not a static concept; 2) put a different way, if market shares can change, then they can probably be influenced by a number of factors, including public policy.

Detailed discussions of the determinants of modal shares rapidly become impossibly complex for a short paper. It is necessary to separate the discussion of freight from passenger, and it is necessary to simplify the discussion considerably.

Freight Modal Choices and Competition

Freight modes will normally consist of trucks, rail, water (rivers, intra-coastal and international), and pipelines. Generally speaking, where pipelines exist, they are a superior competitor and take all of the liquid traffic for which they are designed. Much the same can be said for water transport: it tends to take most of the low cost, bulk traffic for which it is intended to compete. Air transport carries primarily extremely high value, small sized shipments and is not a significant competitor (in ton-km terms) with either rail or truck. For these reasons, this paper will exclude air, pipelines and water from the competitive discussion and focus primarily on rail and truck

Freight Tariff Structures

In any particular economy and for a given, desired commodity flow, the competitive interface between freight modes is determined fundamentally by the tariff structure the shipper faces and the performance of the competing modes. Tariff structure means the freight pricing system as related to its general level as well as the size of shipment, the commodity and the length of haul. Performance means the relative speed of the mode in combination with the length of haul, cargo loss and damage experience, and reliability of service, along with a number of much more complex factors.

In market competitive conditions, especially when the role of the Government or of Government-owned enterprises as shippers begins to diminish, the railway's competitive position, and its market share will depend critically on its ability to relate effectively to each shipper's needs. Freight tariff systems are highly detailed, sometimes filling long books, but it is possible to make some general comparisons of the flexibility of the system to accommodate the demand elasticities of particular commodities and of the general level of tariffs. [Figure 4] shows the cumulative percentage of ton-km that are carried at various ratios of the specific commodity group tariff to the average tariff for all commodities. For example, approximately 38 percent of U.S. Class I ton-km are carried at tariffs that are only 57 percent of the average tariff. By contrast, only about 15 percent of the Indian Railways ton-km are carried on tariffs that are 57 percent or less than the average.

This Figure shows that the rail freight pricing system of the U.S. railroads is far more flexible in adapting to needs of particular shippers and to the competitive forces in

particular markets. It charges less when it needs to do so, and thus generates significant traffic at lower ratios, but also charges more when it can in order to generate maximum net contribution (revenue minus marginal cost) when competitive conditions permit. This is an illustration of the so –called "Ramsey pricing": price deviations from marginal cost are in inverse relation to the elasticity of demand for shipment of the commodity in question.

The comparison with China is interesting. In general, it is fair to say that the Chinese freight pricing system is a remnant of central planning, when all prices were determined without relationship to demand (or cost) factors and when shippers, being also subject to the Plan, were neither price nor performance sensitive. Two curves are shown for China. The blue curve shows the book tariff structure – the tariffs that would be charged if the book tariffs were the only consideration. In addition, though, China adds a flat surcharge per ton-km to all tariffs in order to finance construction of new lines. The construction surcharge per ton-km is about 70 percent of the average freight tariff per ton-km so imposition of the surcharge has the effect of significantly reducing the range of actual variation that the shipper sees, assuming that the shipper simply adds the basic tariff and the surcharge and considers this the total cost (a reasonable presumption). The net effect is that the tariff structure the shipper in China sees is the green curve which is nearly vertical – highly insensitive to commodity considerations and thus not very effective at promoting the market share of China's railways and not effective at generating the maximum contribution for the railway from the assets and capacity available.[4]

The IR tariff structure (the black curve) falls between the Chinese and the U.S. tariff structures. To some extent, this reflects the history of IR as a major part of the planned economy in India, though with somewhat more pricing flexibility than China. Arguably, the narrower (than the U.S.) range is also a result of the lack of a freight profit and management center in IR. Though there is no doubt a great deal of interaction between shippers and IR (perhaps even when the shipper is itself a Government agency), the absence of a bottom line for freight reduces the impetus to adjust freight tariffs as thoroughly as has been done in the U.S. railways.

Another consideration in the difference in freight tariff dispersion between the U.S. and India is the pervasive use in the U.S. railroads of traffic costing models that permit comparison of the revenue generated from a particular piece of traffic with the specific costs that vary with that traffic. This difference is particularly important on the more price sensitive commodities where freight tariffs may need to go below fully allocated average costs and approach variable costs.[5] Indeed, U.S. regulatory practice is based on the use of variable costs in two ways: 1) a tariff that is provably **below** variable costs is deemed potentially predatory and therefore too low; and, 2) a tariff that is provably

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[4] It is also significant that the construction surcharge is not applied to passenger tariffs. Since passenger traffic is about 20 percent of traffic units (p-km + ton-km), this has the effect of exaggerating the impact of the surcharge.

[5] U.S. railways and regulators tend to use the term "variable" cost rather than "marginal" cost. Variable is used to indicate that some accounting allocations of costs are made, but the allocations fall far short of attempting to allocate all costs, or to allocate average long-run costs.

above 180 percent of the relevant variable cost is considered prima facie evidence of the potential existence of market power, which opens the rail tariff to deeper regulatory examination. Use of these models explains the difference between the U.S. curve (red) and the Indian and Chinese curves in the range where tariffs on particular commodities (particularly coal in the U.S.) are well below the average tariff.

[Figure 5] provides more detail on the tariff dispersion in the U.S. freight railroads, and adds an interesting dimension – the relationship between the tariff and the estimated variable cost of moving the commodity. This Figure shows, on the left hand vertical axis, the average revenue per ton-km for the 15 most important commodities (% of tons) for the U.S. rail system and shows on the right hand axis the ratio for each commodity of the revenue generated to the variable cost of handling the commodity. For example, the significant commodity (coal) with the lowest tariff ($/ton-Km) also has quite a high ratio of its tariff to variable cost: that is, coal is both cheap to ship and profitable to the railways. By comparison, the commodity with the highest average tariff (transportation equipment) is certainly not the most profitable because its costs are higher. These conclusions would be difficult to reach without traffic costing models and, more important, the ton-km market share or U.S. railways would be significantly constrained if the railways did not have the flexibility and information needed to engage in this sort of pricing.

Tariff structure is thus an important determinant of modal shares, and tariff structure is determined both by the flexibility of the railway to develop tariffs that respond to customer demands and needs, and by the costing information available to the railway to support tariff decision-making. Without both flexibility and information, the modal share of the railway will be limited (or, of course, the railway's profits will be diminished).

Freight Tariff Levels

In parallel with the tariff structure issue is the question of tariff levels: that is, even if tariffs are flexibly adjusted to customers and competitive conditions, if the average **level** of tariffs is too high, then the competitive position and the modal share of railways vis a vis trucks is going to be limited. [Figure 6] gives a broad comparison of the average freight and passenger tariffs and the average passenger and freight leads in Russia, China, India, the U.S. and, to bring some European perspective, SNCF and DB. The average tariffs are shown both in official U.S. dollars (the dollar value converted at the official exchange rate) and in PPP$ (the dollar value converted from local currency using the Purchasing Power Parity rate as calculated by the International Comparison Project). Although there are arguments as to the accuracy of the PPP calculations, they are generally regarded as reasonably reflective of the actual value of the different currencies, especially those that are not freely convertible on world markets.

Figure 6 shows that, in PPP terms, the U.S. freight railroads have by far the lowest freight tariffs per ton-km. Interestingly, the average rail freight tariffs in Russia and China are roughly comparable to each other, and are somewhat more than double the tariffs in the U.S. The freight rates of SNCF and DB are also similar, and they are 10 to 30 percent

above those in Russia and China. The average rail freight rates in India are **far higher** than the other countries – about 5.6 times higher than in the U.S., more than twice the levels in Russia and China, and nearly double those in Europe. Even though the trucking competitors in India are also likely to be somewhat more costly than in the other countries because of the limitations of Indian highways and the generally smaller size of Indian trucks, the market share in freight for Indian Railways will always be limited by this large disparity in freight tariffs.

The average intercity truck tariff in the U.S. is around US$ 0.17 per ton-km, and the average tariff for intercity **truckload** trucking is around US$ 0.10 per ton-km. Rough estimates suggest that the trucking tariffs in India are not far different in PPP terms from the U.S. levels which is not surprising, given similar fuel costs and the fact that lower labor costs in India might roughly be balanced by smaller trucks and slower highway travel. If true, then the costs by rail and truck in India are very close, and not far apart as in the U.S. If Indian highways continue to improve, IR might be faced with trucking competitors that can nearly equal IR's freight tariffs. Thus, IR's market share vis a vis trucking will also be increasingly vulnerable as the highway system is expanded and trucking technology improves.

Figure 6 also contains at least part of the explanation for the disparity in freight tariffs: differences in policies toward cross subsidies between freight and passengers and differences in traffic mix among the railways shown. The U.S., SNCF and DB have effectively eliminated cross subsidies by paying for passenger losses directly through PSO systems. The ratio of passenger tariffs to freight tariffs[6] in these countries (1.56 to 11.06) is thus free to reflect roughly the balance of costs of production (research has shown, for example, that rail labor productivity tends to fall rapidly as the percentage of passenger traffic increases): thus, railways with high passenger traffic percentages would normally have higher costs, and the ratio of passenger tariffs to freight tariffs should reflect this. The Russian and Chinese Governments have tried to limit freight to passenger cross subsidies by keeping passenger tariffs roughly in line with freight tariffs and their ratios reflect this (0.97 to 1.19). India, by contrast, has actively fostered cross subsidies from freight to passenger, and Figure 6 emphasizes the difference, with the ratio of 0.31 being among the lowest in the world, and certainly the lowest among the larger railways. With passenger tariffs being held down (and, to be sure, this will promote the passenger market share of IR), freight tariffs have no place to go but up if IR is to operate at break-even or better.

In fact, as Figure 6 shows, the unusually high level of India's rail freight tariffs is aggravated by the leverage of having the highest passenger to freight traffic mix. If, as in China, only 24 percent of traffic were passengers, then lower passenger tariffs would not have such an effect in pushing up freight tariffs: but, with extremely low passenger tariffs and a high share of passenger traffic, the IR freight tariffs are pushed even higher.

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[6] This ratio is useful because it factors out any discussion of currency values, local, official or PPP. It uses the same currency on top and bottom, and conversions would not affect the ratio.

To be fair, of course, no simple set of measures can capture the full complexity of the various railway settings. IR, for example, has a large percentage of suburban passengers which reduces the average passenger lead ("lead" means the average length of haul in p-km/passengers or t-km/tons), and the average revenue per passenger-km. But Russia has a large number of suburban passengers as well, and SNCF and DB have even shorter average passenger leads. Russia, China and the U.S. have longer average freight leads than IR, but SNCF and DB are shorter. Russia, China and the U.S. have much lower percentages of passenger traffic, but SNCF and DB are not far from comparable with IR's percentage. Trying to make exact comparisons is clearly impossible, but this should not obscure the basic point that the market share in freight of IR is being significantly reduced by a policy of cross subsidy from freight to passenger services combined with (and partly caused by) a relatively high percentage of passenger traffic to total traffic. This effect could actually worsen with time as has happened in all other countries when incomes have increased and highways have been expanded and modernized.

Impact of Performance and Service Quality

Aside from cost, shippers also care about performance, primarily speed and reliability of service. Railways inevitably cede a reliability advantage to truckload shipments because of the need to marshal wagonloads at various points in a movement. Each point of marshalling adds both delay and the possibility that a wagon will miss the outbound train or even miss several trains (or be lost entirely).

There are no good, totally comparable measures of freight total trip time and reliability. [Figure 7] gives one indirect measure – average speed in freight train service. It is not clear that the statistics shown are tabulated exactly the same way or that they have the same definition, but the comparisons are interesting. They show that Russian freight train speed is higher than the U.S. and that the U.S. is in turn significantly higher than IR (China is about the same as the U.S.). This seems logical, since the Russian network operates at high freight traffic densities and little passenger train interference with scheduled and standardized (+/- 55 wagons) freight trains. The U.S. operates longer freight trains (average length in 2001 was 69 wagons, with an average of load of 68 tons), mostly on demand and not scheduled (and very little passenger traffic interference, at least in the past). IR operates shorter freight trains (around 50 4-axle equivalent wagons) trains but on a network with a lot of interference from short haul and long haul passenger train traffic. This is substantiated by [Figure 8] which compares the ratio of engine hours spent in hauling freight trains with the total engine hours including hours on marshalling trains of various types. This comparison shows that IR uses a significant percentage more marshalling effort in freight trains, and it suggests (but does not prove) that IR probably has a higher degree of unpredictability in the arrival time of its freight loads.

Trends in the U.S. have been toward running more block trains (often 100 wagons or more with up to 113 net tons per wagon). In addition to increasing average freight train speed, increasing the block train ratio reduces marshalling effort and significantly reduces the effect of marshalling on arrival time reliability. In fact, a block train can compete

with the reliability (if not the actual trip time) of trucks. In market share terms, block trains have permitted the U.S. railroads to extend their market share in markets, such as high value autos and auto parts, where service reliability is actually more important than small differences in trip time. IR also has made an effort in recent years to increase the percentage of block trains and this should have had an effect on average freight train speed and in reduction of marshalling effort: why this is not so is an interesting question.

Taken together, [Figures 7 and 8] show that IR will not be as competitive as the U.S. railroads and the Russian and Chinese railways over longer distances. Higher average speeds reduce trip times and competitive position, a factor that becomes more important with increasing distance. In addition, higher speed and reduced marshalling will improve reliability of arrival time as well, which again acts to increase market share for rail in freight transport. One way for IR to maintain market share in freight would be to attempt to increase freight operating speeds.

Another factor in the modal share equation is the information available to the shipper on expected pick up and delivery times and information available to the railway to control operations and track cargoes to ensure service quality. The U.S. railroads have invested large amounts of money into wagon location and control systems that permit them to locate and track wagons in real time. Shippers are enabled to access the system directly and locate their own cargo hour-by-hour (of course, they cannot locate the cargoes of other shippers). Railways can track wagons originating on their lines or destined to terminate on their lines as well, which permits them to develop good schedules of delivery. In general, with better wagon location information comes a significant improvement in service reliability.

China is in the final stages of commissioning a similar system (Traffic Management Information System – TMIS). This system, under planning and construction for a decade, will permit wagon management in China on a level comparable to the U.S. Among other things, this will permit development of a privately financed wagon leasing business that will foster the introduction of more specialized wagons and related equipment. As of now, the system is intended for railway use and does not have shipper interfaces, but these can be added with small difficulty as communications in China improve. Russian railways has a similar system with more limited capabilities, both in data available and in real-time operation.

IR appears to have the least capability to do wagon tracking and management in real time, and IR's system does not afford shippers direct access for tracking cargo location and expected delivery times.. As shipper needs in India become more complex and sophisticated, IR's ability to develop real-time information will become more important in competition with trucks. Fortunately, technology to do so is evolving rapidly and innovations such as GPS-based location systems may permit IR to leapfrog the more expensive technology used elsewhere.

A final, and impossible to quantify, issue is simple "user friendliness." Does the railway answer the telephone, and does it respond quickly to shipper needs? Can a wagon be

made available quickly for loading (or is a consideration required in order to get a wagon at all)? Does the wagon arrive when expected, and is it delivered as and when promised? Is there a high loss and damage ratio, and does the railway promptly settle claims? These are problems for all freight railways, and anecdotal evidence suggests that IR is no exception. Of course, service quality requirements are different for different types of cargo: coal is not time sensitive, but TV sets are. This said, improving market share will require a tight and intense focus on improving the shipper's belief that the railway cares about the freight business.

Summarizing Freight Market Shares

[Figure 9] helps to bring the freight discussion together, displaying the rail versus truck market share (other freight modes have been removed in order to focus on the rail/truck interface) as a function of the average length of haul of the railway for a number of developing, former socialist and developed economies. The intuitive argument that the rail share should increase with larger distances is confirmed.

It is interesting that the formerly socialist countries tended to have a much higher rail freight market share than the more market-oriented economies at any given freight lead. This appears to be an artifact of the command and control economies in which the planners focused on line haul costs and ignored total logistics costs. Moreover, the composition of the planned economy output was weighted toward basic commodities which also favored rail. This is quite likely to change as these economies adapt to market forms and as shippers make bottom line decisions.

We can also observe that IR is almost exactly on the regression line despite its high freight tariffs. The most likely explanation is that trucking in India has also been hindered by lack of high quality highways and the smaller trucks that the Indian highway conditions have fostered. Another reason may have been the large impact that Government controlled shipping decisions has had on the traffic of IR. It seems reasonable to speculate that the IR market share will be pushed downward by better trucking competition and a shift toward private production of freight commodities. The question is whether an improvement in average speed and service reliability can act to counteract competition. Another question is whether bottom line management at IR coupled with greater pricing flexibility will be helpful. The question of Government policy of cross-subsidizing passengers from freight is also crucial: if this does not change (and Russia, China, the U.S. and the E.U. **have** changed their policies in this regard) then the freight market share for IR will continue to be constrained.

Potential Impacts of Inclusion of External Costs

Thus far, this note has focused on the more or less explicit and direct costs of the transport system. How much does the shipper have to pay, or what are the measurable performance parameters of the competing modes? In economic terms, these can be called the "internal" costs of transport and they clearly are the current drivers of modal choices made by shippers of travelers.

There are, however, "external" costs – costs and performance factors that are not part of the decision-making process. Simple examples are pollution or highway congestion. Shippers do not have to pay for the pollution emitted by trucks and travelers are not charged for pollution emitted by their auto or bus (or 3-wheeler). Truck drivers are not charged for the congestion their traffic generates (though they do pay for delays through higher labor and fuel costs as well as lower truck utilization). No transport users pay for the Carbon Dioxide (CO_2) which their movements generate. In all cases, the costs and impacts on service are very real, but they do not enter into the shipper/traveler's modal choice decision because they are either not paid at all or are paid in a way that does not generate a transport demand response. To the extent that highways pollute more than railways without paying for it, or to the extent that trucking companies do not pay for the highway congestion or the CO_2 they generate, then IR's share in Indian transport is lower than it should be.

Whether this has a significant impact on the efficient modals or not is hard to say convincingly. [Figure 10] shows the range of energy consumption of the various freight modes and [Figure 11] shows the same for the major passenger modes. Since energy consumption is directly related to CO_2 generation, this is a good measure of the relative emissions of greenhouse gases. Energy use is not so directly related to localized air and noise pollution (2-cycle, 3-wheelers are more fuel efficient than autos, but emit much more pollution), these Figures may not be as good at representing environmental external costs. [Figure 12] shows the relative level of fuel taxation in a number of countries in 1998 (latest year data are available). Fuel prices (and taxation) in China and Russia are lower in the U.S. (and among the lower in the world). Diesel prices in India are lower than in the U.S., while petrol prices are somewhat higher. Taken together, these Figures certainly raise a question as to whether trucks and autos are being taxed at levels which might compensate for pollution and CO_2 generation. By comparison with the U.S., China and Russia, India's low diesel prices actually are having a more adverse impact on the freight modal shares than on passenger modal shares – again a problem that will get worse as highway capacity is expanded and improved.

Marginal costs in transport are higher than average costs if capacity is being stretched and social costs are higher than financial costs if there are social costs that user charges are not fully compensating. There are no good studies available for India exploring this issue. Again, indications can be gained from [Figure 12] and [Figures 13, 14 and 15], which show the results of studies done in the U.S. and the U.K. of highway costs and revenue allocations from taxes. [Figure 13] shows that, in the U.S., autos pay fuel taxes which roughly cover the financial cost of building and maintaining highways for auto use. Light trucks (similar to many trucks in India) and heavy trucks in the U.S. fall short of paying their way financially. This means broadly that Government subsidies to highway construction and maintenance in the U.S. are reducing the rail market share in freight - but not in passengers. By contrast, in the U.K., autos, light trucks and heavy trucks all pay fuel taxes that more than compensate the government for the financial cost of the highways – no great surprise when fuel taxes and prices in the U.K. are compared with those in the U.S. Given the similarities of fuel taxation of India, Russia and China

with those in the U.S., there is a reasonable suspicion that trucks might not be paying their share of the financial costs of highways in India as well.

This of course deals only with the financial cost of highways. If the social marginal cost of highway use is taken into account, the difference is more pronounced, as [Figures 14 and 15] show. Even in the U.K., with its high fuel taxation, highway modes do not cover their social marginal costs: in the U.S., the gap is much higher because of low fuel prices (similar to India). Moreover, while some aspects of the social marginal cost calculations are debatable (it is hard to agree on the actual costs of pollution, or CO_2 emissions and human life in safety calculations), the costs of highway congestion are clearer. [Figure 15] shows that a significant percentage of the social marginal costs are congestion alone, and only heavy trucks in the U.S. come close to covering the congestion component of social marginal costs. If U.S. conditions are relevant to India, there is some reason to believe that if highway access and user charges were set at full financial cost, and even more so, social marginal costs, this would benefit the market share of IR.

Passenger Transport

Much of the discussion above has touched on passenger modal shares as well as freight (because many aspects of the issue are inter-related). The focus in this note is on freight, so passenger issues will not be discussed in detail. It is worthwhile, however, to discuss passenger modal shares briefly in order to complete the picture of next steps in actions that could be taken to reach efficient modal shares in India. As discussed above, passenger transport choices extend from walking (and biking) through motorcycles, 3-wheelers, autos, rail, bus and air. In broad terms, these choices are made in a short trip (mostly urban) milieu or in a longer trip environment. Decisions are made differently in the two arenas.

Urban and short trips are usually made for personal reasons (shopping, visits to family or friends) and for business or employment reasons (especially commuting from home to work). Walking can be a major share of these trips in the denser or smaller cities. Choices between the common carrier modes, bus and rail, are determined by availability and frequency, and usually by government subsidy policies. Commuting by auto is usually limited when incomes are low, but begins to grow rapidly when incomes rise, especially if road congestion is not intolerable and parking costs are low. Typically, western cities have a higher proportion of urban space dedicated to roads (20 percent or more) than is prevalent in Asian cities (often less than 15 percent). As a result, the trend toward motorization has hit early and hard in many of the larger Asian cities, and congestion will get worse as these cities (Mumbai and Delhi are examples) grow. Combined with the dramatic trend toward urbanization now being felt in developing countries, especially the large mega-cities of Asia, urban congestion is a crucial arena for transport policy.

Public policies have a major impact on modal choice in the urban context. When access to urban areas is underpriced (many Asian cities do not even have parking charges for autos), then the tendency for commuters to try to drive to work will increase rapidly with

incomes. If mass transit access (heavy rail and suburban rail as well as trams, trolleys and buses) is good and fares are low (and subsidies are high) then modal shares can be shifted from auto (or, at least, the growth of auto traffic can be slowed) back to public modes.

In this sense, the Indian policy of keeping suburban rail passenger fares low (suburban fares in India are among the lowest in the world) may well be economically justifiable. Mumbai, for example, which is one of the economic engines of the Indian economy, depends heavily on good rail service at low fares. Mumbai, and India, would suffer greatly if the IR suburban services were not maintained.

Longer haul passenger services may be somewhat different. As a general rule of thumb, autos should be faster and cheaper at distances up to about 200 km (or more, when there is more than one passenger in the auto) whereas air will be faster and cheaper than rail at distances of more than 500 km. Given the condition of the highways in India, railways can offer relatively faster and cheaper trips at much shorter distances than is true of China and Russia (much less the U.S.). On the other hand, inefficient airports and airlines have in the past meant that air services in India only became competitive at longer distances than are typical of China, Russia and the U.S. Both of these relative advantages for IR will change with time: better highways will make autos more competitive over short and even medium distances and better air service (especially privatized airlines and airports) will erode IR's long haul passenger markets as they have elsewhere. IR's market share will more closely resemble that of Russia and China (and the E.U.) as the Indian highway and air infrastructure develop and as incomes increase.

Policies to Develop Efficient Modal Shares in India

Despite the complexity of the modal choice issues, it is possible to provide a broad outline of policy and financing actions available to the Indian Government that would support the emergence of efficient modal shares in Indian transport. In this case, "efficient" means that the total cost of transport to the economy is minimized and that the economy can develop rapidly without being constrained by transport bottlenecks.

- Reduce or eliminate cross subsidies from freight to passenger transport in railways. As discussed, IR's freight tariffs are too high because they have to carry the burden of low passenger tariffs. If the passenger deficits are funded directly by Government, as is the practice in E.U. and the U.S. (and as is the objective in China and Russia), through PSO contracts, then IR's freight tariffs would be freed to reach a better competitive level. This does not argue that there should not be passenger subsidies for suburban or long haul passenger services: rather, it argues that IR cannot reach an efficient freight modal share so long as it has to finance passenger losses from freight surpluses. In fact, as the U.S. experience with freight regulation and Amtrak shows, cross subsidies cannot be sustained when unregulated competition emerges.
- Significantly relax the control over the IR freight tariffs, including more ability to develop and implement contract tariffs, in cases where it can be shown that IR is not earning excessive monopoly profits. This will permit IR to price more flexibly in competition with trucks. Of course, this implies that IR should organize its freight

     operations by lines of business so that freight profits can be measured and managed. More broadly, IR will need to ability to change its business policies (management structure and tariff levels and structure) in order to react to the rapidly developing competitive scenarios.

- Given changes in management structure and tariff flexibility, IR may be able to use innovative tools, such as specialized companies for marketing higher value commodity shipments (e.g. Concor in India and J.B. Hunt in the U.S.) that would give IR a chance to recover its share in freight shipments in the longer-haul but less-than-trainload category.

- Consider whether fuel taxes, especially low taxes on diesel fuel, are fostering an unnecessarily high market share for trucks in the freight market. This deserves consideration both because of India's need to construct and maintain new highway capacity and because the social marginal costs of autos and trucks should at least be partially compensated from user charges. If not, then IR's market share will be constrained at the expense of the overall economy.

- Consider the need for further organizational change of IR as the different IR markets come under more vigorous attack. It will do no good to rectify imbalances in other modes if IR itself is not prepared to take advantage of the opportunity. It has been suggested that IR might manage itself by lines of business: that is, have profit centers for freight (and for particular markets by commodity or type of service within freight), for longer haul passenger services and for each of a series of very large suburban passenger services. This type of organizational evolution would help IR to respond to growing competition and would permit IR to do a better job of targeting resources and justifying PSO contract payments. Such organizational change must be accompanied by a Management Information System (MIS) that provides accurate and defensible information in respect of costs, especially marginal costs.

- Assess the experience in Mumbai of gradual evolution of planning and at least partial funding of suburban services to the local communities. In the longer run, IR may wish to follow the model of railways in most of the countries in the developed world who have found that running suburban railways consumes resources and managerial effort that is better dedicated to running freight and intercity passenger trains.

There are no simple formulae for success. Competition from truck, barges and pipelines in the U.S. has forced the U.S. Class I freight railroads to work very hard just to survive. Changes in Government policy in the U.S., specifically the creation of Amtrak (to take passenger losses from the freight side and put them in the Federal budget) and deregulation have at least partly leveled the competitive conditions and saved the economy billions of dollars annually in transport costs. China has thus far avoided the problem of massive rail passenger losses (it has higher intercity passenger fares and few commuters), but the Chinese Government is already looking at various railway reforms in order to stabilize the railway in the face of growing highway competition (and air competition) and of growing competition of privately financed carriers that WTO membership will generate. The Russian Government is also engaged in a long range restructuring effort in the Russian Railway in order to relieve the railway of its passenger losses, transfer suburban responsibilities to urban or oblast levels, and to create rail versus rail competition in area where no trucking competition can be expected to emerge.

India **is** different (so goes the refrain), but it is not **that** different. Adapted to Indian conditions, many of the same measures will be an important part of reform in the Indian transport sector as India finds its own way to economic development.

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Figure 1
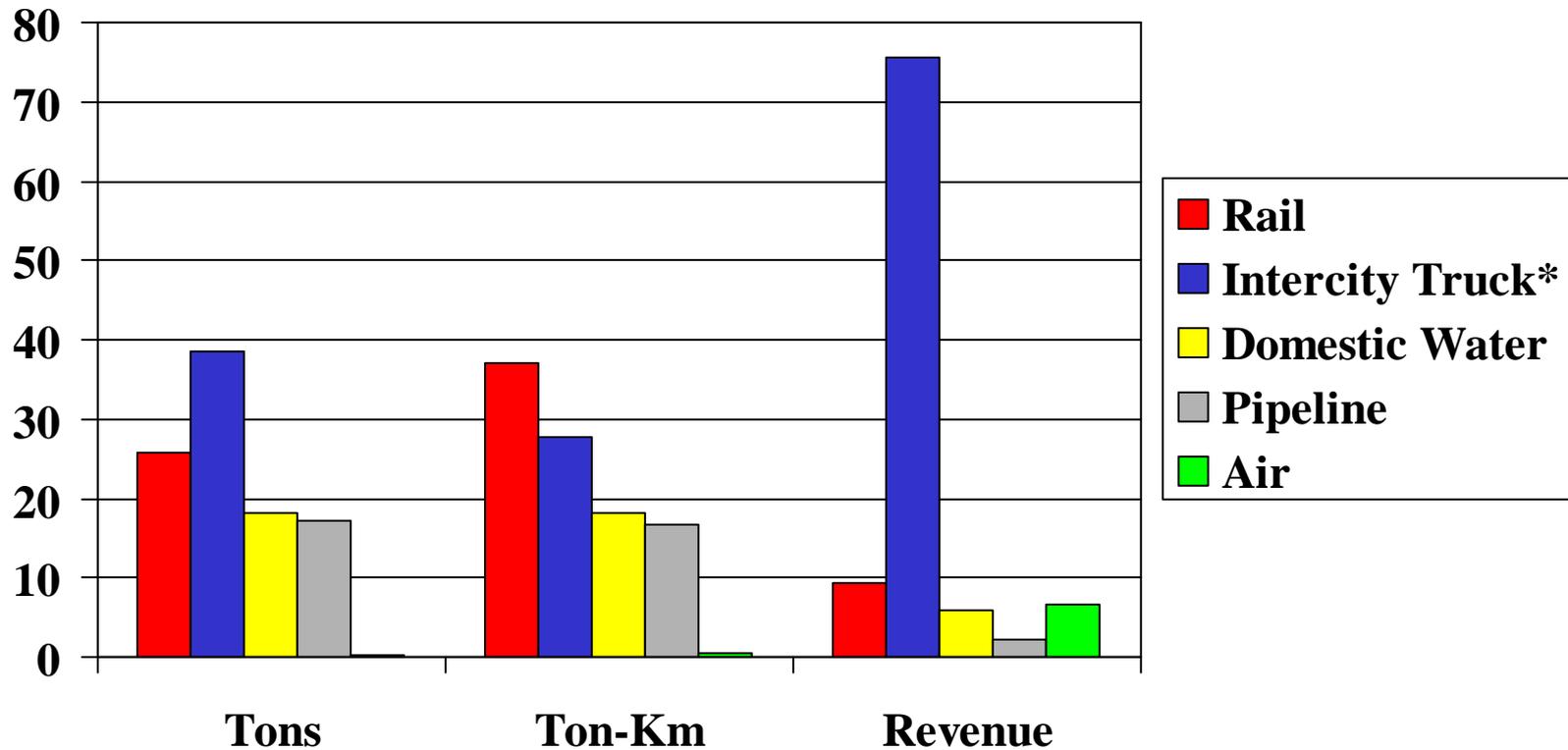# Market Shares in U.S. Transport (1998)

Legend:
- Rail (red)
- Intercity Truck* (blue)
- Domestic Water (yellow)
- Pipeline (gray)
- Air (green)

Categories: Tons, Ton-Km, Revenue

Figure 2

Freight Modal Shares (ton-km) over time

		1950	1960	1970	1975	1980	1985	1990	1995	1998/2000
US	Rail			34.7	33.0	30.7	29.7	32.4	35.1	37.1
	Road			18.7	19.9	18.6	20.7	23.0	26.1	27.7
	Other			46.7	47.1	50.7	49.6	44.7	38.8	35.2
China	Rail			72.3	58.3	47.5	44.2	40.5	36	31.3
	Road			3	2.8	6.4	10.4	12.8	13.1	13.8
	Other			24.7	38.9	46.1	45.4	46.7	50.9	54.9
Russia	Rail		82.3	65.6	63.1	53.1	49.8	42.8	34.4	32.4
	Road		1.5	1.7	1.4	2.0	1.9	1.2	1.0	1.0
	Other		16.2	32.7	35.5	44.9	48.3	56	64.6	66.6
India	Rail	88.0	84.5	71.1	70.5	65.0	53.1	49.0		49.9
	Road	12.0	15.5	28.9	29.5	35.0	46.9	51.0		50.1
	Other									
E.U. (15)	Rail			32.6		25.8		18.6	14.2	13.4
	Road			47.6		56.3		68	73	74.7
	Other			19.8		17.9		13.4	12.8	11.9

Figure 3

Passenger Modal Shares (p-km) over time

		1950	1960	1970	1975	1980	1985	1990	1995	2000
US	Auto			94.5	94.3	91.4	90.4	90.1	89.7	89.2
	Local/Intercity			0.2	0.2	1.4	1.2	1.0	0.9	0.9
	Rail			0.3	0.2	0.2	0.1	0.2	0.1	0.1
	Air			5.0	5.3	7.0	8.3	8.7	9.3	9.7
China	Auto			24.2	26.1	32	38.9	46.6	51.1	54.3
	Local/Intercity									
	Rail			69	66.5	60.6	54.5	46.4	39.4	37
	Air			0.3	1	1.8	2.6	4.1	7.6	7.9
Russia	Auto			24.6	29.3	33.9	34.4	33.1	34.0	35.7
	Local/Intercity			13.4	12.2	11.8	12.0	11.3	18.0	20.9
	Rail			47.1	41.2	36.8	35.3	34.7	34.8	31.8
	Air			13.5	16.1	16.5	17.4	20.2	13.0	11.5
India	Auto									
	Local/Intercity									
	Rail									
	Air									
E.U. (15)	Auto			74.0		76.2		79.1	79.5	79
	Local/Intercity			14.4		13		10.4	9.8	9.5
	Rail			10.1		8.4		6.7	6.1	6.1
	Air			1.5		2.5		3.9	4.6	5.4

Figure 4

Rail Freight Rate Distribution In China, India and in the US:
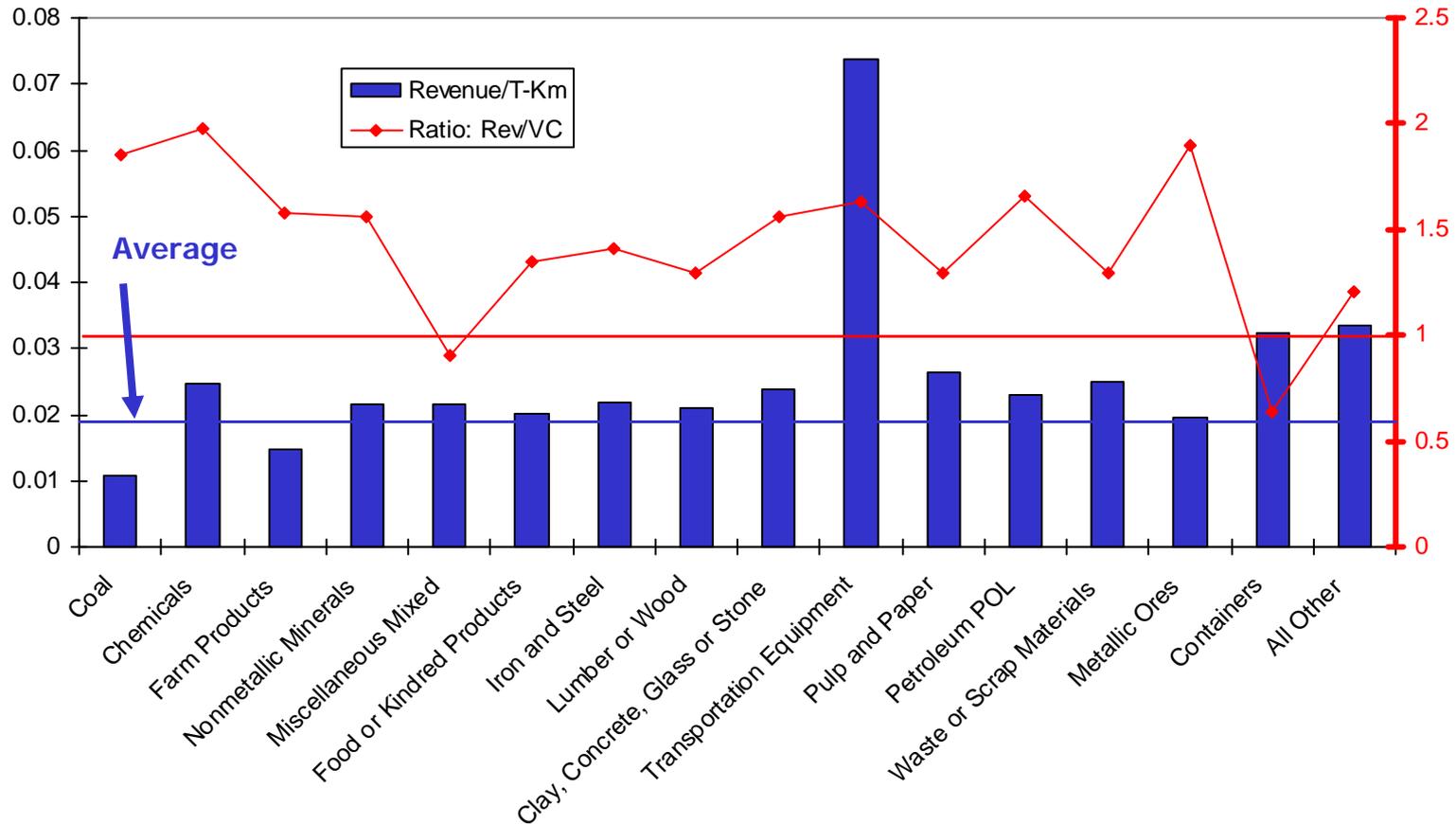(Cumulative Percent Of Ton-Km vs. Ratio of Tariff to Average Tariff)
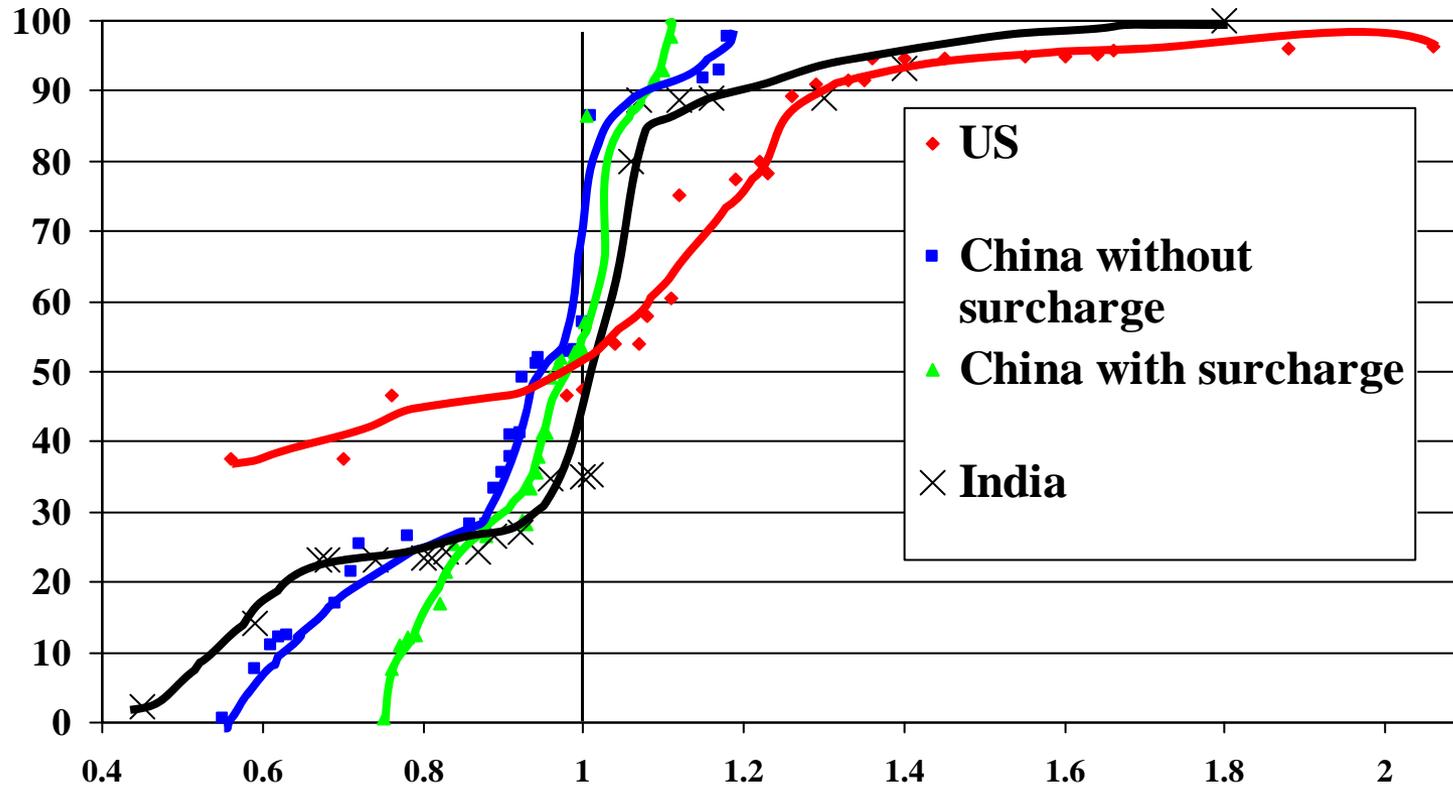
Figure 5

2000 U.S. rail traffic

Top 15 commodities, 98 % of ton-km

Figure 6

		Russia	China	India	U.S.	SNCF	DB
Passenger Traffic		1998	1999	1999	2000	2000	2000
Revenue/pass-km	Official $/p-km	0.0071	0.0099	0.0050	0.1668	0.0742	0.1308
Revenue/pass-km	PPP$/p-km	0.0345	0.0466	0.0259	0.1668	0.0767	0.1306
Avg passenger lead	Km	105	414	94	390	78	43
Freight Traffic							
Revenue/ton-km	Official $/t-km	0.0073	0.0083	0.0162	0.0151	0.0475	0.0426
Revenue/ton-km	PPP$/t-km	0.0355	0.0390	0.0842	0.0151	0.0491	0.0426
Avg freight lead	Km	1,271	802	661	1,358	391	268
Ratio: Avg passenger tariff to average freight tariff		0.97	1.19	0.31	11.06	1.56	3.07
Percent of P-km to TU (p-km/(p-km+t-km))		12.2	24.8	58.5	0.9	55.8	49.2

Official means at the official rate of exchange (what you pay if you change money in the country)
PPP means Purchasing Power Parity

Figure 7

Average speeds in freight service
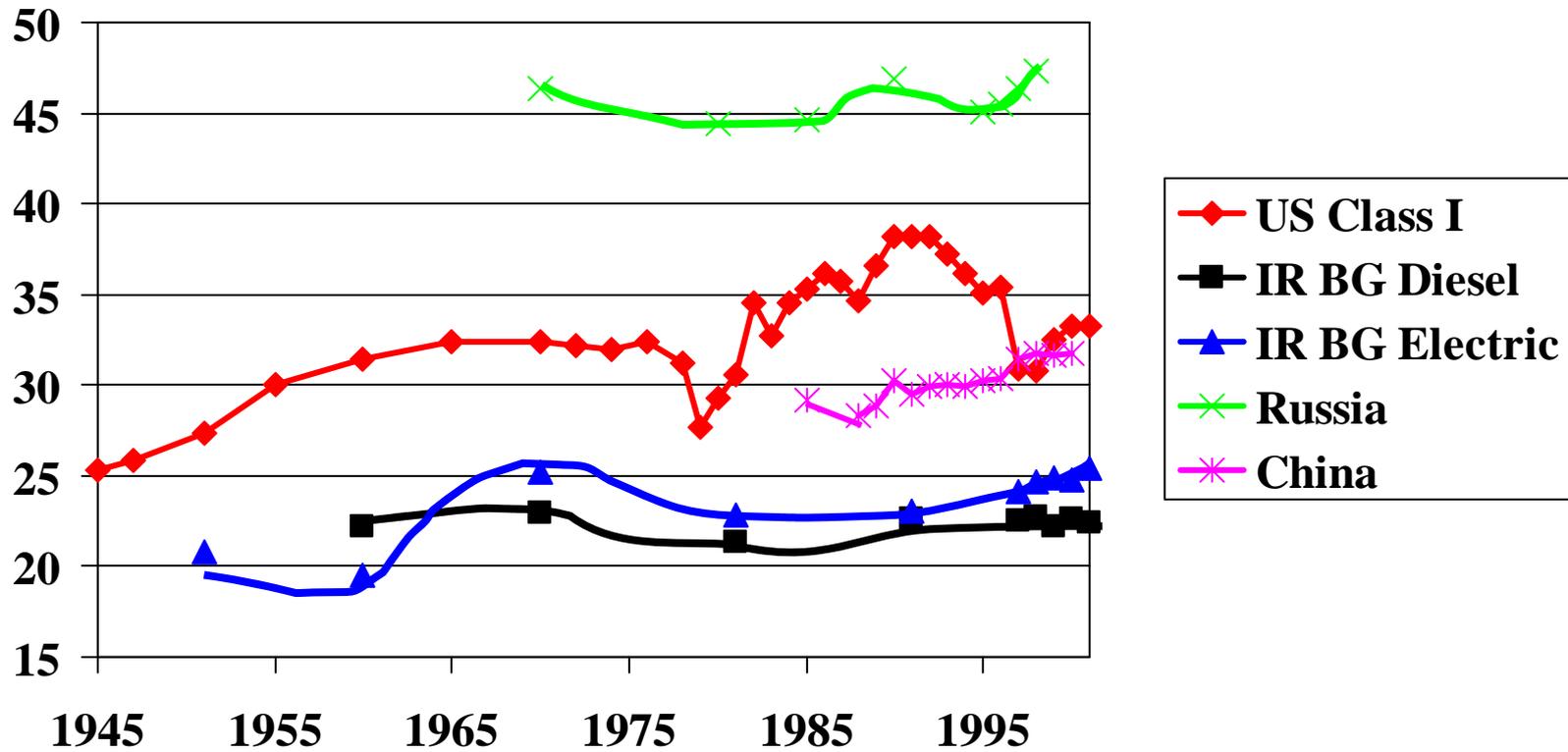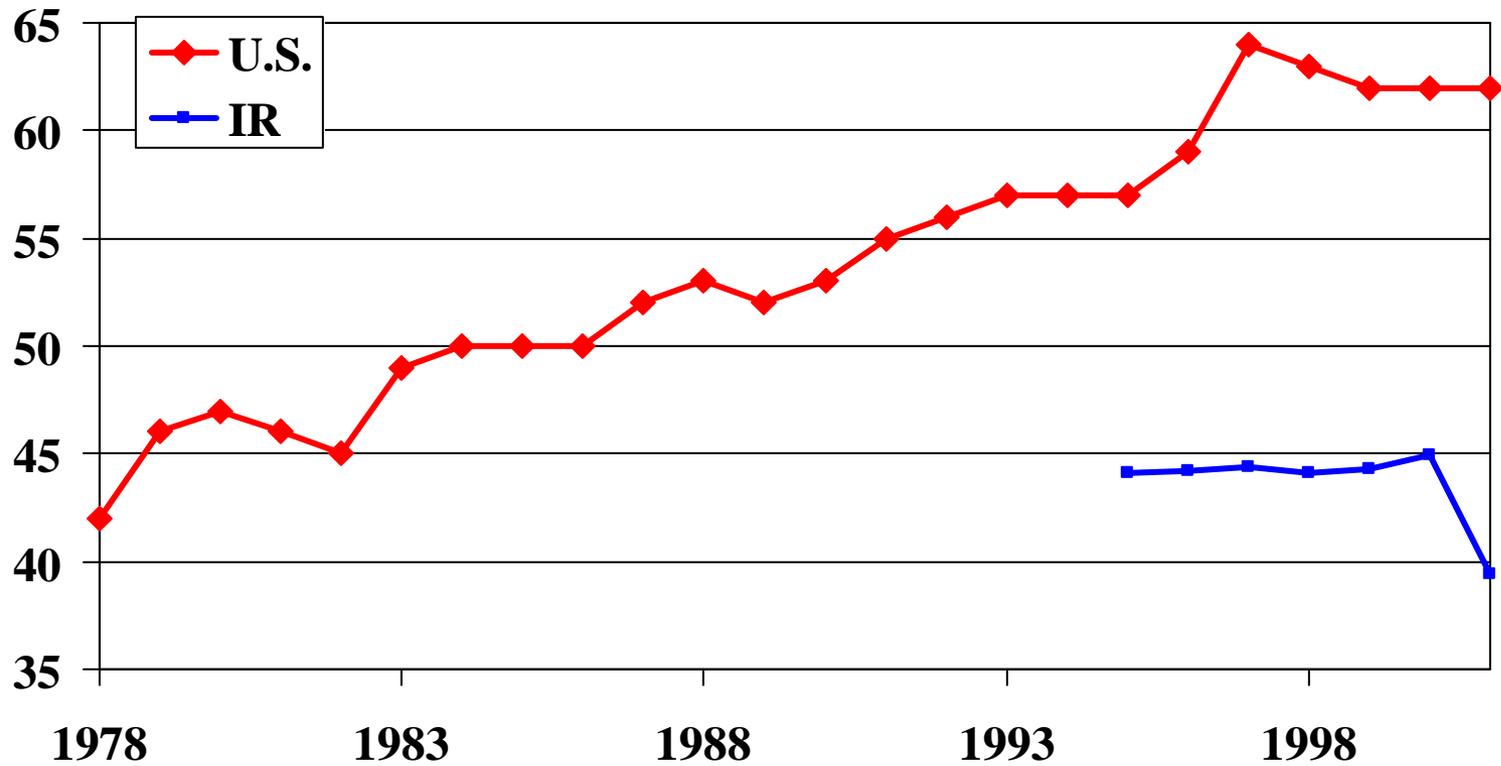
Figure 8

Ratio of road engine hours to total engine hours

Figure 9

Rail Share of Rail + Truck Traffic (%) versus Average Rail Length of Haul
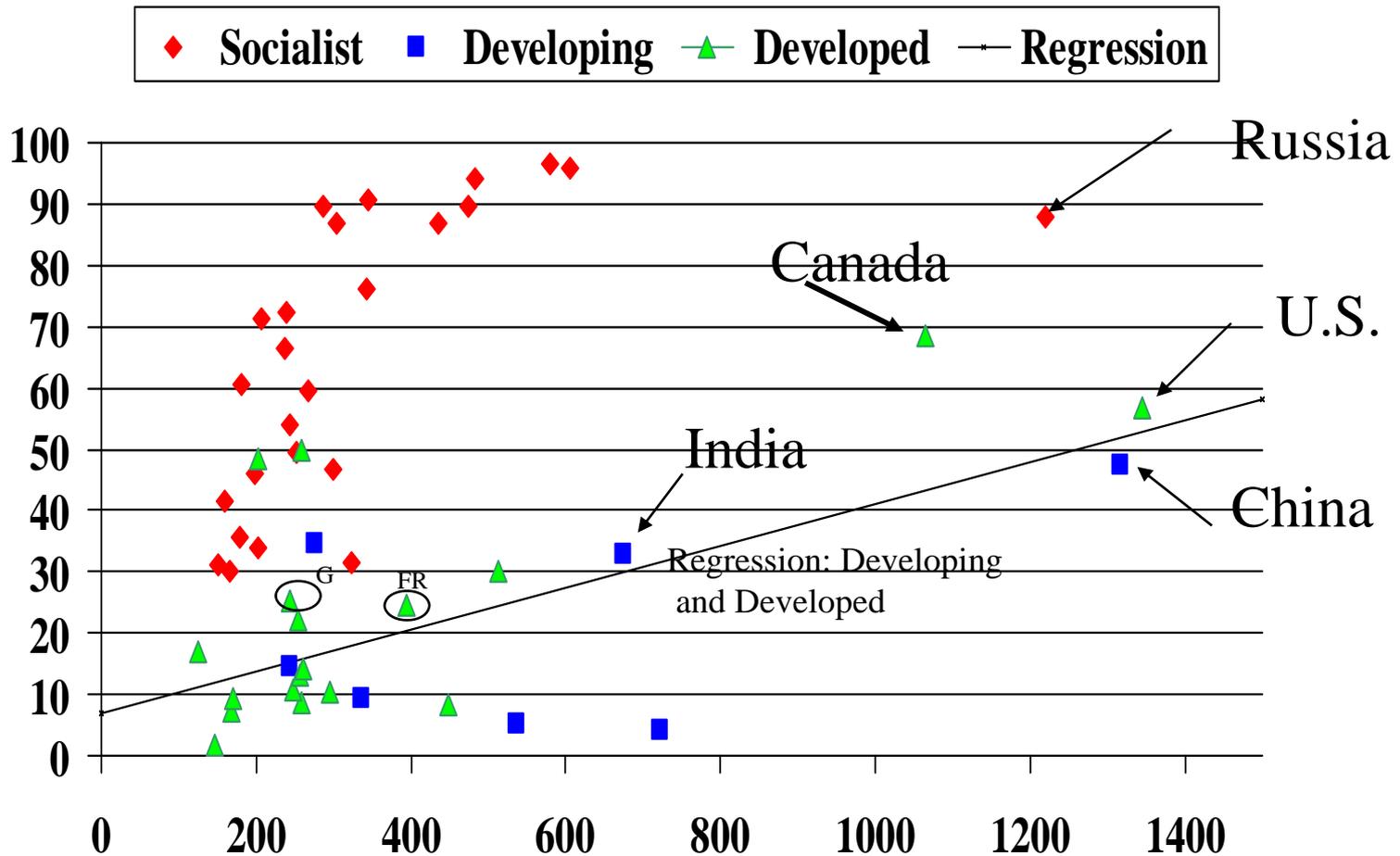# *1998*

Figure 10
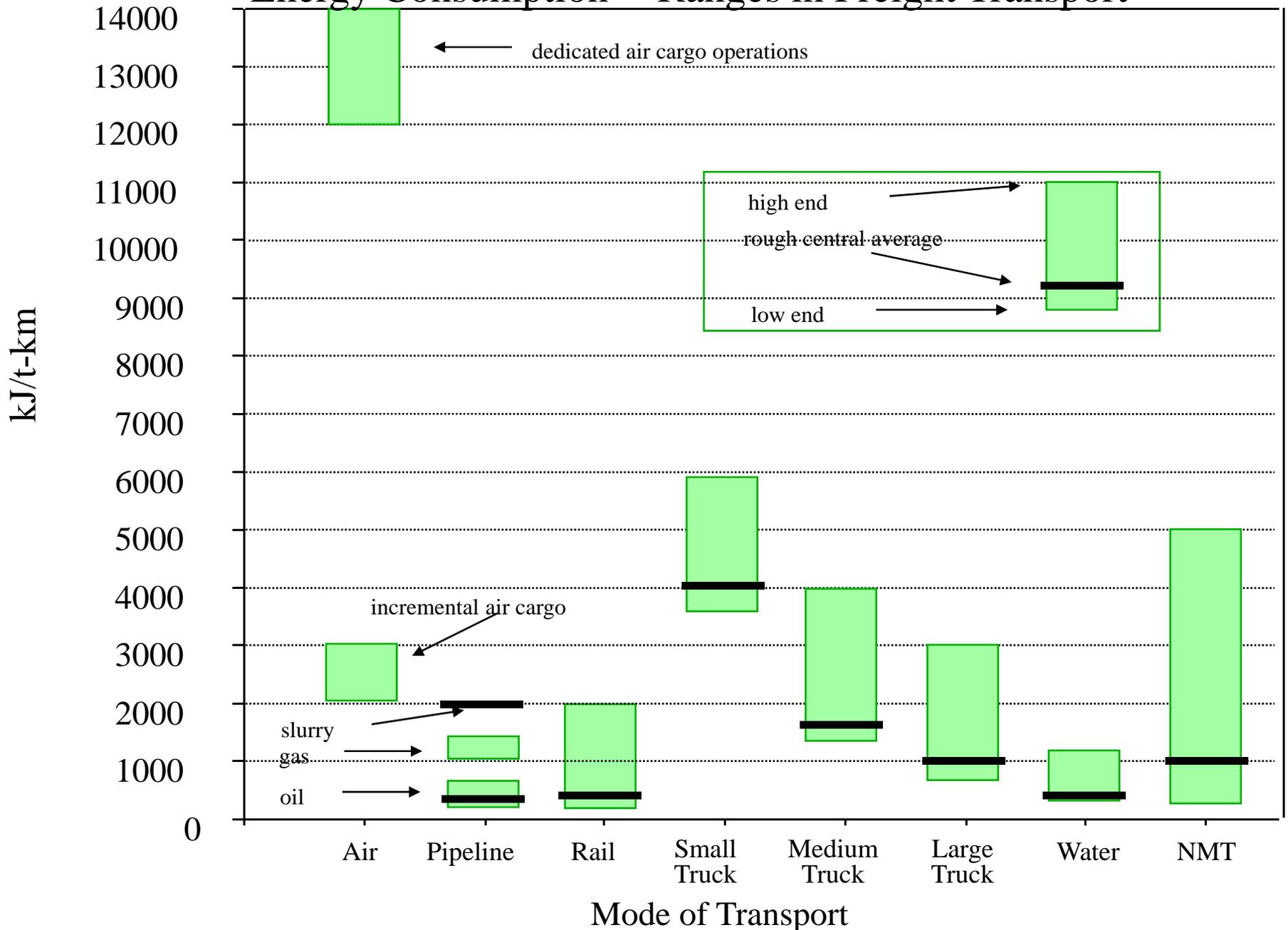Energy Consumption -- Ranges in Freight Transport

Figure 11

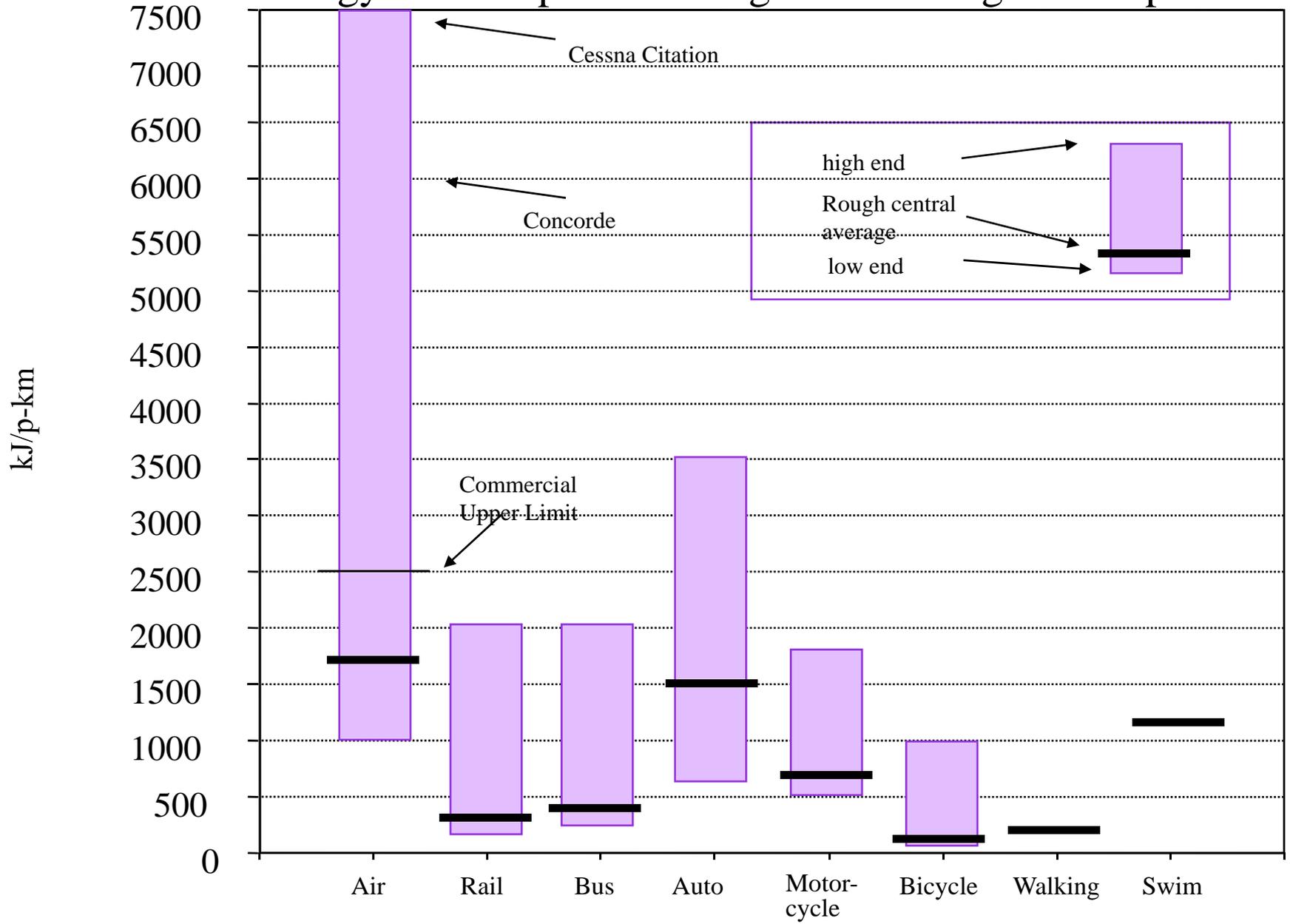Energy Consumption -- Ranges in Passenger Transport

Figure 12

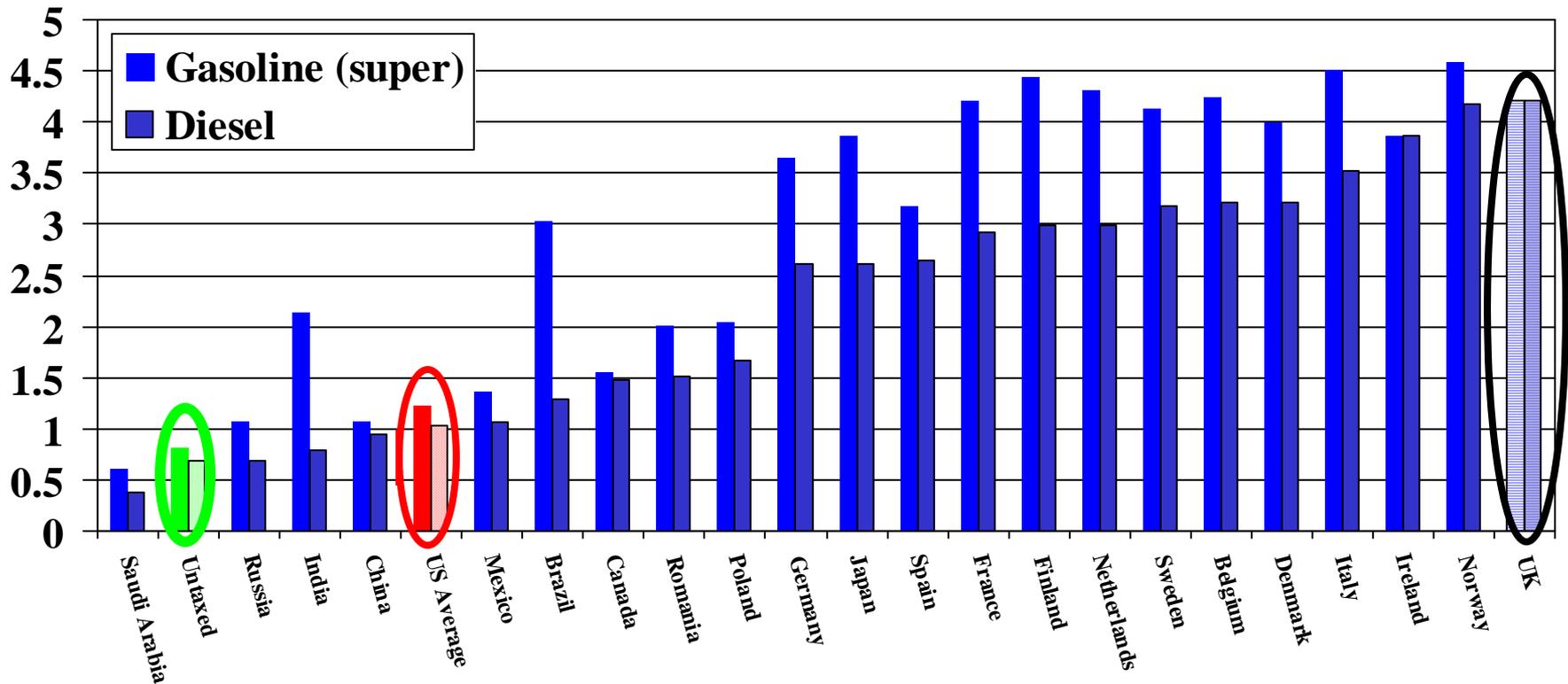# Gasoline and diesel fuel prices (US $/gallon) 1998

Source: Fuel Prices and Taxation, GTZ, May 1999

Figure 13
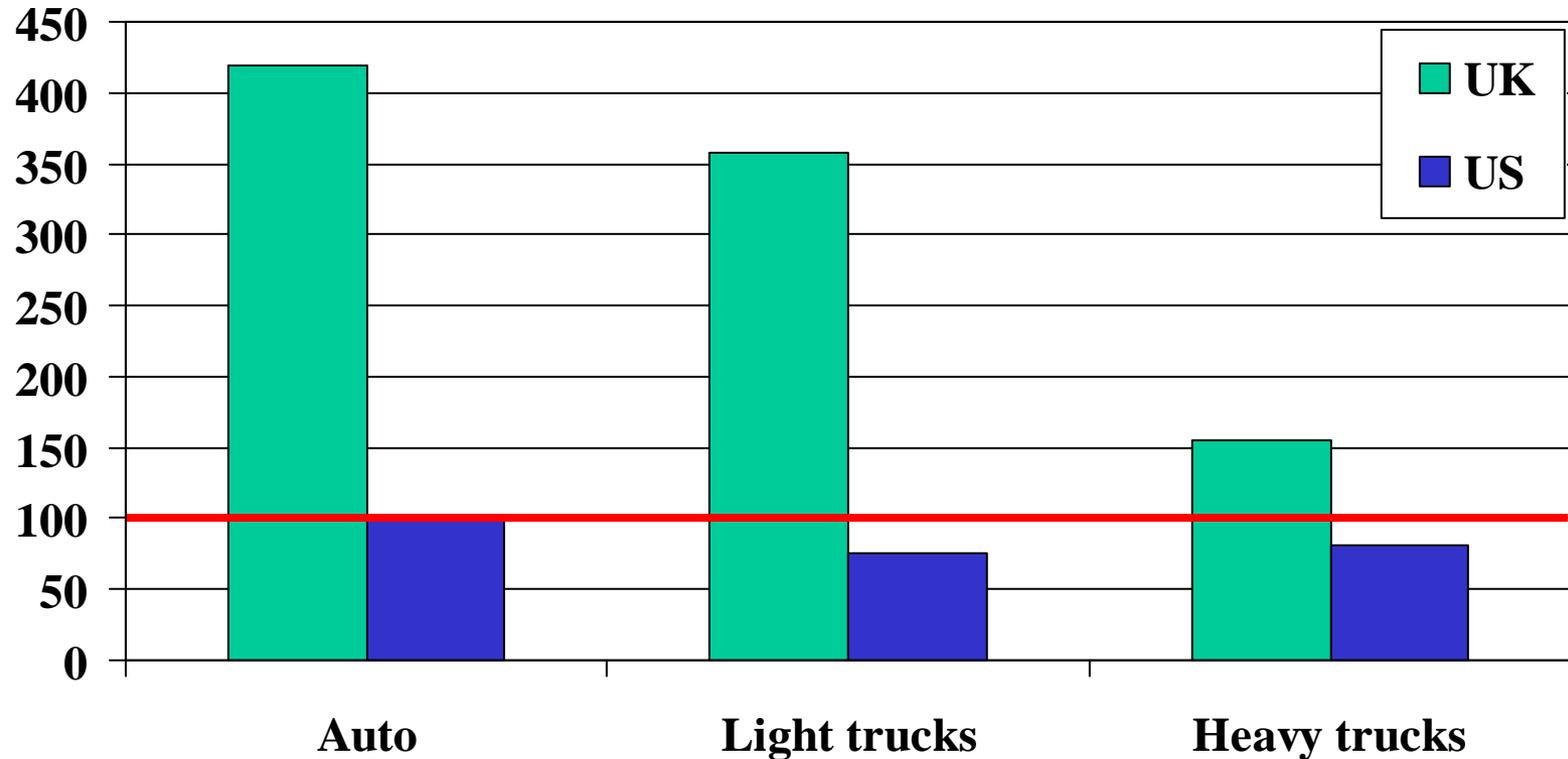
Ratio of highway user charge revenue to fully allocated infrastructure costs

Figure 14
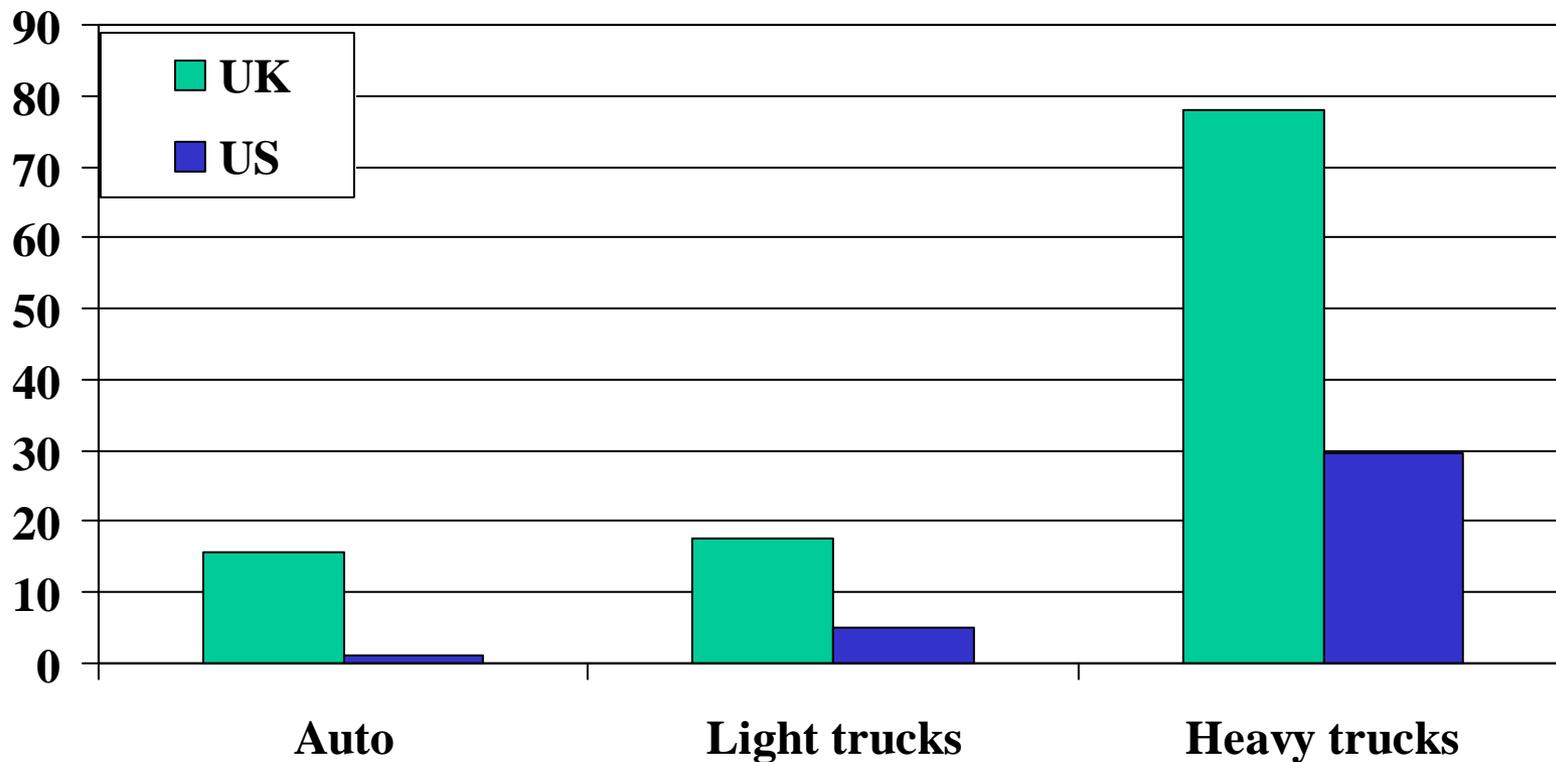Ratio of highway user charge revenue to marginal transport costs in the U.K. and U.S.

Figure 15

Percent of marginal costs attributable to congestion