Chapter 5

DETERMINANTS OF RAILWAY FREIGHT CAPACITY IN INDIA

5.1 The Policy Determinants

The preceding chapters, which were largely descriptive in content, have sought to lay a comprehensive foundation for more rigorous analysis of railway freight operations in India. In doing so, two considerations have emerged which are important in the bearing they have on the discussion to follow. Firstly, the problems afflicting freight operations of IR are seen to have changed over time as a natural consequence both of growth of the economy and of Indian industry, and the overall evolution of Indian transport infrastructure and of competing segments within it. Since neither of these developments has been short term - as indeed no infrastructural variable is, a period of sufficient duration has to be considered in order to make such changes visible. Secondly, the differential performance of railways in India through all three post-Independence phases cannot entirely be explained in terms of supply-side efficiency of railway operations alone, since freight demand conditions generated by the evolution of the economy have a lot to do with determining the successes and failures of IR, especially over the long 'plateau' phase. This is further established on the strength of the analysis made earlier of selected world railway systems, whose experience in more recent decades has been at least partially similar to IR in respect of the common problem of rising inroads from freight competition and changing traffic composition.

With these considerations firmly in mind, it is now proposed to embark on an empirical analysis of IR freight operations as they have evolved over the planning period. The two empirical sides to freight performance are again freight demand and supply. However, since the initiative has slowly but ineffably swung away from the railways in India with the rise in demand and supply for road transport, the aspect that needs first consideration is whether IR has been able to enter into competition head-on, given the freight dominance that it had enjoyed earlier, or whether it has - in a manner of speaking - 'retired from the field'. The relevance of this question lies in the fact that if current freight trends can be ascribed to the former event, the railways have been provably outcompeted in both quantum and quality of service, while if on the other hand the latter attribute holds, the declining presence of IR in certain traffic segments will appear to have been a matter of design rather than an accident. Thus the crux of the issue is the role of transport policy in India.

Analysis of IR wagonfleets made in the immediately preceding chapter has brought out their changing composition and increasing specialisation, over time, to the needs of bulk freight and long lead traffic. Why this change took place requires an examination of railway policy, and in its larger element, of intermodal transport policy in India. The present chapter shall undertake this, through a review of statements of transport policy in India made at different points of time, and their reflection on the plan allocations made to IR. It is anticipated that where transport policy is more or less a statement of intent, fund commitments by Government are a manifestation of that intent and can fruitfully be studied as such. However, instead of diffusing its attention over all areas of railway investment, subsequent discussion shall build around the evolution of IR freight capacity, represented by the IR wagonfleet and its component wagon-types. After studying freight capacity in this systematic manner, it will be possible to draw conclusions about whether changes in IR freight capacity constitute a policy response to major economic trends, or whether they have a more *ad hoc* character.

This accomplished, it will be possible to move on, through two subsequent chapters, to examination of the major consequences of IR and national transport policy on railway freight operations. Inevitably, the analysis at that stage will become more disaggregated, and hence both variants of the process, *i.e.* disaggregation over time and disaggregation over space shall be considered. The quantitative methodology employed by the empirical analysis in all three chapters will be drawn from standard econometric procedures and techniques. The third empirical chapter, namely chapter 7, shall in addition formulate a complete freight-adjustment model for IR, after it has been verified that IR freight trends are more the product of shortages of freight capacity, than of freight demand constraints. Analysis of freight trends in the proposed manner shall then open for discussion, the larger issue of the place and viability of railway freight in overall transportation infrastructure in India, which the final chapter shall attempt to address in the light of the comparative experience of railways the world over.

5.1.1 The Components of Government Transportation Policy

The rationale for long-term government intervention in the planning of transportation infrastructure emerges from the larger role of government in framing policies conducive to the balanced development of a country's regions and economic sectors. The immensity of transportation projects and the low returns to capital invested in such projects have seldom made them viable for private enterprise. As a consequence, investments in transportation projects are largely financed and/or regulated by government. The major economic decisions relating to transportation availability therefore vest with government and its policies are expected to be directed towards achieving high operational efficiency within the envelope of social and financial cost constraints. While government policy is likely to emphasise the public utility aspect in transportation, it is necessary that investment also be made towards expansion of networks and augmentation of capacities, in addition to maintenance of existing operational levels. Failures to maintain existing networks owing to resource scarcity amount to 'negative investment', *i.e.* disinvestment, on the part of the government.[1] Thus the general health of transportation sectors is largely dependent on the degree of cogency and comprehensiveness achieved by transport policy.

The main spheres of influence of government transport policy, subject to variation between time, modes and countries, are control of quality and quantity of services, control of organisation within the transportation sector and control of its resource allocation processes.[2] Efficiency of resource allocation determines the operability of controls in the other spheres and hence recent attention has been focused on raising investment efficiency in transportation. Investment in transportation infrastructure may be financed by either private or public capital, depending on which mode of transportation is being considered. In the LDCs, where capital is generally scarce, judicious planning of transport investment becomes imperative and may be considered now by way of its components

The first component in investment planning is the decision on the magnitude of fund allotments to transportation infrastructure vis-a-vis other economic sectors, this being governed once again by the decisions of government on whether primarily to foster the development of sectors which create demand for transportation services and then raise transportation capacity accordingly, or whether to build transportation infrastructure and capacity as a first step, and wait for sectoral transportation demands to rise to levels commensurate with capacity in the long run. The traffic-adjustment policies involved in either case thus relate to time, and where the former alternative requires that short-term investment adjust to short-run transportation demand, the latter calls for long-term investment to be adjusted against expectations of rising transportation demands over the longer timeframe.

The second component in investment planning of transportation infrastructure is the decision on the proportion of fund allocations between alternative transportation modes, and as seen earlier, differs from country to country depending upon size, geographical features and settlement density, with the railways gaining importance wherever settlement density is high.. On the other hand, where spatial size is too small to guarantee railway volumes, or where there is large and empty geographical space that has to be filled, investment on roadways is generally deemed more important. Even so, developed countries can as a rule afford to invest more on both surface modes and other advanced modes of transportation like airways, when compared to the LDCs.

The third component in investment planning of transportation is the decision on internal fund allocations within specified modes of transport, which ultimately determine the quality and quantum of services provided. The study shall presently attempt to identify the major spheres of investment within railway systems, primary segments of which are railway construction works and network-expansion; augmentation of stocks of mobile capital assets or rolling stock comprising railway locomotives, coaches and wagons; and technological stock like signalling, marshalling and traffic-handling equipment. Maintenance and upgradation of operational railway capability through track renewal and through conversion, maintenance and modernisation works on existing railway stock and improvements in managerial and communication (*i.e.* information-flow) techniques form an adjunct to these.

As outlined earlier, the first phase in railway investment primarily comprises 'sunk costs' involving heavy outlays on laying track and installing equipment prior to commencement of railway operations. Intensive utilisation of railway stocks thereafter requires phased additional investment for maintenance and for the replacement of overaged and wornout capital assets. Phasing-in of investments on upgradation of signalling and marshalling equipment, track renewal, electrification and gauge conversion, all of which come under the generic description of 'railway modernisation' is, on many railway systems, also part of comprehensive transport policy. Advanced railway systems in the world have also laid stress on networked computerisation as a way of improving the efficiency of handling highly dispersed operations, an innovation that necessarily involves significant outlays of expenditure. 'Phasing' aspects therefore spell out the time-relations that govern railway investment as a long-run infrastructural variable, and the need for having an overall system of time-capacity management which constitutes transportation planning. The crux is limited availability of capital resources on the vast scale required. Thus in the face of capital shortages, a cogent national transport policy that subsumes all three components of investment planning is required to phase capital outlays in order that highest benefits may be reaped for transport operations and for the economy as a whole.

5.1.2a Transport Committees & Commissions in post-1947 India

There has been no dearth of commissions and committees to evaluate the performance of railways in pre-Independence India, at a time when railways represented the Indian transportation infrastructure almost in entirety. A few of these, such as the Mackay Committee and Acworth Committee [IRC], had been mentioned earlier as charged with the responsibility of planning and coordinating railway development in the country, the IRC also framing the Railway Convention of 1924 which led to separation of railway finances from the general finances of government, and the institution of the annual Railway Budget. Other committees such as Railway Finance Committee [1921] and the Inchcape Committee [1923] generally had more limited terms of reference, such as streamlining budgeting and administration. Since competition *per se* did not exist for the Indian railway companies because of limited presence of waterways and absence of highways in the country, the concept of intermodal coordination of transport did not develop quite as naturally as it did in Britain or France. Till Independence, therefore, the task of government vis-a-vis transportation in India was confined to maintaining the operability of existing railway services, without much need for technological input or expansion, despite the Mackay Committee's enthusiastic endorsement at the turn of the century of a 100,000km railway network being necessary for the country.

The Indian Railway Enquiry Committee [IREC] (also known as the Kunzru Committee] was constituted in 1947 to examine the future organisation for railways for independent India, and its recommendations paved the way for nationalisation of the many company railways then in existence, after the Railway Convention of 1949 relating to perpetual dividend liabilities had been adopted. One recommendation of the IREC that however was never followed up related to the setting up of a Statutory Central Railway Authority (also recommended in the Government of India Act [1935] as a Federal Authority), and control over IR still vests firmly with the Railway Board, which is charged with both policy-formulation and policy-implementation.[3]

Infrastructural development in post-Independence India commenced with a series of thrusts in certain segments of the overall transportation infrastructure through successive FYPs. Certain vulnerabilities within the economy because of non-coordination within the network became visible within the first planning decade, and were sought to be addressed by the Committee on Transport Policy and Coordination [CTPC] set up in 1959, in what was the first government attempt to coordinate transportation in the country. The terms under which the Committee operated allowed it to examine and project the sequence of long-term transportation demands that had been generated by institution of planned industrialisation, so as to provide guidelines to the Planning Commission on the need perceived for phasing allocations to the transportation sector, including the modal splits required in Plan outlays. However the CTPC Report[4] took nearly seven years to formulate and was only submitted in 1966, by which time the railway crises of the 3FYP had already arrived to nullify some of the initial optimism regarding transportation trends. With the entire economy going into a tailspin in the mid-1960s, economic reasons for which will be examined at length in the following chapter, traffic uncertainty continued to assail the foundations of transportation planning in India resulting in drastic scaling-down of

Government outlays towards it. Secondly, the need for diversifying modal transportation facilities began to acquire visible importance with stress being laid now on the expansion of roadways and the production of commercial vehicles, not the least because these would be based on larger involvement of the private sector, without taxing the exchequer to as considerable an extent. Hidden within this also was recognition that the downstream development of industry engendered by planning had generated new commodity flows, the distribution of which could not always be provided for by railways. Meanwhile problems had also arisen in the allocations of transportation capacity made by IR to different freight categories, since while excess capacity prevailed in bulk-sector freight facilities throughout most of the 1960s, a freight squeeze appeared at the other end. While the cause of the overall crisis has become clearer with hindsight and rests explicitly in the buildup of PSU inventories and consequential cutback in public-sector spending and production, the simpler prognosis of the time was that capacity in general had exceeded transportation demand and justified reduced fund allocations towards transport.

The traffic uptrend that emerged with the refurbished 4FYP launched in 1969-70 temporarily allayed transport planners' worries, as buoyancy was restored to the economy. However a chain of economic setbacks including war and the effects of the worldwide Oil Crises led again to seesawing traffic trends over the entire 1970s as the economy restructured to the new energy regime, and saw gaps and excesses in transportation capacity emerge again. By the end of the decade and the 5FYP, it was abundantly clear that the old foundations of transportation policy in India had been rendered out-of-date both by revised energy equations and by changes in the cost structure of Indian industry.

The appropriate response for IR was to innovate, especially by inducting modernised technology, lack of which had significantly contributed to steady weakening of its operating position. With a large technological backlog already in existence because of the plan squeeze during the late-1960s and 1970s, this would by no means be easy unless new means of raising railway capital were found. An Expert Group on the Capital Structure of Indian Railways was accordingly constituted by the Planning Commission preparatory to the 6FYP to explore the capital requirement for meeting the technological challenges and alternative means to raise it, and quickly submitted its report in 1978. The need for a comprehensive revision of transportation policy with particular emphasis on intermodal infrastructure, which had also become simultaneously apparent, was entrusted to the National Transport Policy Committee [NTPC] set up the same year to advise the Planning Commission in this respect.

A major task accomplished by the Expert Group related to outlining the need to enhance the internal provisions made by IR against asset depreciation that are incorporated in the Depreciation Reserve Fund [DRF]. This was deemed to be as essential as meeting dividend payments to government from the perspective of internal resource mobilisation. Another aspect in the Group's recommendations that merits contemporary attention relates to the financial overburden being carried by IR on account of its having to make additional contributions from its operating surpluses to the revenues of government, over and above its perpetual dividend liability. In the view of the Group Report, annulment of this requirement could effectively provide relief to IR and raise internal capitalisation at a time when budgetary support was consistently dwindling.[5] A different perception within the Finance Ministry led to rejection of the recommendation, on grounds articulated in the dissenting note attached to the Group recommendations by its Member (Finance). A reading of this note is fairly indicative of the mindset of the Ministry, since the grounds cited include prior endorsement of the surplus payment practice by previous Railway Conventions, and most importantly, the plea that with financial arrangements of the Government of India having been made all along under expectation of certain revenues, a departure from past practice would not be well-advised.[6]

The primary objective assigned to the NTPC was on the other hand to formulate integrated transportation policy for the country that would allow complementary development in all modes of surface transportation around an optimum intermodal freight-mix. The focus besides this was on comprehensive long range planning of the entire gamut of transport operations in the light of current and expected development trends in the economy. The significance of the perspective plan devised by the NTPC lay in its association, for the first time, of growing demand for transportation services with sectoral growth in the economy, and in its renewal of the argument that the creation of infrastructural capacity should precede demand, since the income elasticities of transportation demand exceed unity[7] and since evidence from the first planning decade showed that in ideal circumstances, transportation requirements in the country tended to increase at a much higher rate than the rate of growth of economic sectors and national income.[8] The NTPC noted also that transportation demand derived intrinsically from the demand for mobility of labour services and commodities, which found reflection in the originating traffic of passengers and freight. Efficient use of transportation was thus deemed capable of developing backward rural regions in the country via agricultural growth and industrialisation, which enjoined that IR therefore should ensure an adequate supply of services based on 'realistic appraisal of traffic demand.'[9]

It was recognised however that investments on transportation involve a risk element arising from possible traffic inadequacy, or from supply-side weaknesses such as technological obsolescence of railway facilities to the point where they are rendered incapable of meeting even existing traffic demand. Either case could lead to either nonmaterialisation or nonrealisation of adequate traffic, adversely affecting the returns on investments made in future transportation capacity and on maintaining existing capital assets. Additional risk factors arose also because of the long gestation lags involved in the planning and implementation of transportation projects. The NTPC further recognised that while creation of transportation infrastructure should in principle precede traffic demand, policy of this kind will always be subject to the quality of administration, education and the 'people's propensity to grow'.[10] On the other hand, inadequacies in transportation infrastructure could become potential impediments to economic development and hence shortfalls in capacity should not be allowed to exist. Creation of large-scale transportation capacity ahead of traffic demand also determined the 'lumpiness' in the investment involved.

The most important components of the NTPC Report were the alternative transport demand projections arrived at by the Committee. Three major issues that the NTPC attempted to identify via these projections were the total magnitude of investment required by the Indian transportation sector, the intermodal distribution of such allocations over different transportation modes, and the determination of tariffs commensurate with the returns expected on the investments to be made. Addressing these conclusions, the Report proposed significant increases in the allocation of financial resources in order that 'net capacity' might grow at a 'critical rate' that kept pace with economic development.[11] Constrained capacity might lead to lopsidedness in development and an unrealistic intermodal mix. Accurate assessments of transport demand and the intermodal costs of transportation were therefore twin prerequisites to the development of an optimum intermodal mix where alternative transportation modes performed as complements rather than as substitutes. Traffic forecasts over a long time horizon formed the core of the NTPC's exercise at formulating comprehensive transport policy, and the methodologies adopted to arrive at these are briefly outlined below.

Besides projecting traffic demand volumes, the Report also commented on pricing mechanisms for transportation infrastructure that could be adopted by a controlled economy like India. While short run marginal cost [SRMC] pricing has been the general consensus in the transport pricing literature examined earlier, the NTPC contended however that traffic earnings should be made to cover the projected returns on investment in addition to short-run operating costs, depending on the quantum of funds invested by government. On the basis of this principle, the Report suggested a rational pricing policy with tariffs being set above short run operating costs and maintenance costs, and the additional revenue accruals forming a common pool resource for the exchequer. Alternative transportation modes could then draw from the common pool for their incremental investments.[12]

The NTPC Report formed a virtual watershed for infrastructural development in India since it radically changed government perceptions on the relative placement of IR and of transportation infrastructure in general within the economic priorities of the country. The immediate task for IR after submission of the NTPC Report was to constitute the Railway Reforms Committee to advise on technological and other reorientations within the administrative and operating structures of IR, the outcomes of which have already been alluded to elsewhere. The combined exercise of the NTPC and the RRC had already been preceded in part by the Expert Group on the Capital Structure of Indian Railways in 1978 when it had first mooted the need for raising capitalisation of the railways in India to cope with the growing challenge of technological change, but the key to an ultimate solution lay in restoring the profitability of IR operations. While technological upgradation would partially assist this by raising efficiency and lowering costs, the major contribution could only come from rationalisation of railway tariffs.

5.1.2b Railway Rates & Tariff Commissions

An important policy determinant of the profitability of railway freight operations is the power to set and regulate rates. The need for regulation springs theoretically from allowing a monopoly to operate a public utility service and instituting control over the exercise of its pricing powers. As seen earlier from railway history, regulatory mechanisms were thus instituted at some time or the other on most major world railways, even though the trend in recent years has been for deregulation after transport monopolies collapsed under the competitive assault of the roadways. With no move towards privatisation till date, the monopoly character of the railways in India has remained entrenched through much of their existence, and it needs to be seen whether this has had carryover effects on the pricing of freight services by IR.

No comprehensive modalities or guidelines for railway rate setting existed before Independence partly because of the company structure adopted for railways in India, and partly because of the obligation of government to make up revenue shortfalls to the railway companies. After the takeover of private equity and the institution of state railways under the Railways Act of 1890, rate-setting remained at the sole discretion of government and the provision for a rate-regulatory Railway Commission built into the Act was never invoked. The Act itself remained a particularly long-lived piece of legislation and its provisions held sway for a hundred years till its repeal in 1989. Following the Acworth Committee recommendations however and after adoption of the Separation Convention in 1924, a Railway Rates Advisory Committee was constituted in 1926 to deal with disputes arising between freight consigners and the company railways, and functioned till Independence. Scope for fundamental alteration of railway rate-structure did not however vest with this Committee which could only address the cases referred to it by Government.[13]

Following Independence, the original Acworth Committee recommendation was followed up temporarily by constituting the Railway Rates Tribunal [RRT] by amendment of the Railways Act in 1949, which broadened the powers of rate regulation and adjudication of the advisory body.[14] Besides being empowered to adjudicate undue preference, unreasonable rate-setting and unfair charging, the RRT could thus also reclassify any commodity to a higher rate class on application by government. The power of reclassification was an immediate casualty of the review made of the provisions of the RRT by the Railway Freight Structure Enquiry Committee [RFSEC] eight years later. While expanding jurisdiction, the RFSEC decided against conferment of further mandatory rate-making powers to the body, since this would deter the mobilisation of resources from the railway revenues which accrued to government. It however envisaged an informal regulatory role for the tribunal which would resemble that of the Interstate Commerce Commission [ICC] in relation to the US railroads.[15] This recommendation proved unacceptable and the new Railways Act brought in 1989 in replacement of the Railways Act [1890] went so far as to include an explicit provision that no jurisdiction may vest with the RRT in respect of setting and reclassification of freight classes or fixation of rates and fares.[16] It emerges therefore that the power to set their own rates without interference has been assiduously protected by the Indian railways, both before and after Independence, creating a piquant situation where, while rate-setting by major world railways has undergone considerable deregulation after worldwide changeovers in market attitudes, in India these have never been regulated at all.[17]

Periodic revisions of the IR freight-tariff structure have thus largely been left to the competence[18] of the Railway Budget presented to Parliament every year. Three Expert Committees have however been constituted at different times since Independence to examine vexed issues relating to public-utility pricing and rating principles to be followed by IR.. While consolidating the annual revisions made in railway rates, these committees have also formulated long-term guidelines for framing tariffs, giving due consideration to the rise in input costs and the need for internal mobilisation of capital resources by IR. The first of these bodies was the RFSEC constituted in 1955 under the chairmanship of A.Ramaswami Mudaliar, which examined freight pricing during the landmark 2FYP.

The Rail Tariff Enquiry Committee [RTEC] headed by H.K.Paranjape and constituted in 1977 worked concurrently with the NTPC and reexamined the entire tariff structure of IR including both coaching and wagon services. By this time, the folly of tailoring railway investment by the external availability of funds had been well acknowledged and the climate existed for expanding IR's internal effort. The principle of rate-setting adopted by the RTEC strove accordingly to maintain tariff uniformity across the country as far as practicable, and to partially relieve IR of its social burdens by ensuring that railway revenue would cover the fully distributed costs of operation.[19] Viewing transport subsidies in effect as resources denied to the railways, the RTEC noted that with four-fifths of IR freight being composed of bulk commocities and 91 percent of passengers travelling by Second Class, it had become inevitable that these categories bear the burden of tariff hikes since the possibilities of further cross-subsidisation from higher-rated traffic sectors had been exhausted.[20] The IR follow-up to the RTEC report, orchestrated through the RRC, was to raise tariffs across the board on freight as well as passenger segments by hiking standard mileage rates. By 1993, when tariff options had become non-viable, resort was made to more indirect stratagems of raising revenues such as multiplying commodity classifications, redesignating all BG trains with average speeds of 55kmph and above as the more expensive 'Superfast' class of trains, and creating the new Sleeper Class on mail and express trains.[21] On the freight front, the RTEC pricing principles introduced prohibitive rates for traffic in the parcel and smalls categories and raised minimum chargeable distance as a means of discouragement, since traffic in this class is more expensive to handle than long-lead freight in full rakeloads.

In their departure from older principles of public utility rate-making which had guided IR after nationalisation, the RTEC recommendations were expected to induce commercial orientation in IR operations. However with the concepts of railway costing in India being nebulous and relatively undeveloped, the restriction of railway costs that should have been the principal means of raising operating efficiency failed to materialise. While basic restructuring of IR rates in accordance with the RTEC recommendations had already been implemented by 1983 during the 6FYP, *ad hoc* revisions involving reclassification of commodities were made thereafter in 9 out of 10 years uptil 1993-94,[22] the sole objective being to shore up IR revenues and generate operating surplus. The relativity of the rate-schedules designed by the RTEC was thus inevitably destroyed by these frequent revisions, while the arbitrary manner of increasing rates without making reference to costs or to what the traffic was willing to bear drove a large segment of high-valued commodity-freight away to the roadways, in a vicious circle of revenue shortfalls and further tariff-hikes. The RTEC had also targeted a high 10 percent rate of return p.a. on railway capital-at-charge before dividend payment, which in the absence of adequate budgetary support for railway investment, contributed to the upward spiral that railway rates have experienced ever since.[23]

Investigation of IR pricing and operations was conducted most recently between 1991 and 1993, after the launching of economic reforms in India, by the Railway Fare & Freight Committee [RFFC] constituted under the chairmanship of D.M.Nanjundappa. The Committee was thus given especially broad terms of reference and examined the gamut of fare and freight structure and ancillary matters concerning IR, against expectations of traffic, operating costs and technological upgradation and the broad parameters of the national transport policy.[24] The reference made to the Committee thus extended into traffic costing, special traffic under postal and military categories, parcel charges, and subsidiary multimodal container services such as those being provided by the Container Corporation of India [CONCOR], a railway PSU. In its exercise, the RFFC stepped contextually into the larger areas of railway productivity and efficiency, and the main report accordingly runs into 900 pages, accompanied by appendices and summaries of seminars and special studies.

The stance adopted by the RFFC on the question of railway pricing was one of bringing IR finances back to a state of health by the reiterated need for IR tariffs to cover fully distributed costs of operation. However it did not recommend allround increase in tariffs thereby bypassing the vital issues of reducing these costs through restructuring of railway management, and by raising railway productivity through the infusion of efficient technology. The RFFC report was thus able to take note of the bottlenecks which have been responsible for long-term decline in the freight position of IR.The tariff positions which had developed and were inherited by the RFFC had amounted to monopoly pricing by IR of committed traffic in order to cross-subsidise its low-density operations. However while constant raising of freight rates was capable of leading to long-term stagnation in traffic, the rate of return required on railway capital-at-charge would have to rise to an improbable 16 percent p.a. for IR to be able to meet its requirement of new investment and replacement arrears through internal effort,[25] making some amount of tariff escalation inevitable. The freight structure recommended by the RFFC was therefore based on removal of subsidies on low-density freight and passenger traffic, while lowering rate classifications on general commodities that were being overcharged in terms of their *pro rata* costs of haulage. The latter measure was recommended to recover freight traffic that had been surrendered to the roadways and to restore vitality to IR freight operations, which in the RFFC's words had suffered because "continuous increase in the railway freight rates and classifications during the last decade has taken away whatever chance IR had in retaining this category of traffic."[26]

The method of differential freight pricing that has always been followed by the railways in India is *rate classification*, which is analogous to the scheduling of rates on other railway systems. Among the radical measures that the RFFC recommended was reduction in the horizontal spread of rate-classes on 113 major commodities which contributed 98 percent of IR's freight revenues from 60 categories to 14, by elimination of all sub-classifications within them, and by abolishing exempted traffic categories like grains and pulses.[27] As a tariff measure for improving railway efficiency, it was recommended instead that new class rates with a sharpened telescopic taper be introduced for all full trainload traffic with lead of over 250km, to favour the long-lead haulage of full rakes.[28] Another recommendation made with similar bearing was that of eliminating the 'Smalls' classification in rate schedules, so that the smallest scale on offer henceforth would be the wagonload rate scale. With IR rate scheduling set to undergo a metamorphosis with the RFFC's recommendations, stress was laid on reformulating the 'minimum weight' loading requirements to suit 8-wheeler BOXN and BCN wagons, which should progressively become the *standard* wagon unit on IR.[29] The RFFC also felt concerned about the high proportion of empty wagon-km being run by these upgraded wagons and hence recommended that specific rate rebates might be offered to consignments travelling with the direction of empties, and to consigners willing to load 'damageable' consignments like cement, fertilisers, foodgrains, oilseeds, salt, etc., on open wagons which ran the highest proportion of empty wagon-km. In a departure from the orthodox rate-scheduling method, special lumpsum or negotiable contractual rates available to major consigners were also envisaged offering upto 50 percent rebate on standard scheduled rates, without prior financial concurrence being needed from the Railway Board.[30] In a recommendation that sought to expand divisional autonomy within IR, it was proposed that authority to contract such arrangements should vest in the Zonal Railways.

Besides being radical, these new tariff proposals of the RFFC duplicated similar developments occurring in many world railways through the 1980s and 1990s, including several of those studied in Chapter 2. What they were not accompanied by was a comprehensive proposal for privatisation or corporatisation of IR, which would have been necessary to duplicate the world developments in their entirety. Instead, as a departmental undertaking, IR remained tied to the apron-strings of government, with no loosening being made during the recent process of economic reforms in the country. The common complaint from major IR clients including the PSUs concerned several non-pecuniary aspects of freight services such as delays, corruption and pilferage, etc., as well as arbitrary charging in wharfage and demurrage penalties. The review made by RFFC of these pricing anomalies ultimately reopens the issue of instituting informal controls over IR rates by reiterating the 1957 recommendation of the RFSEC for a nonstatutory 'bureau' on the lines of the US Interstate Commerce Commission. The RFFC in fact observed in this respect, that no instance existed of the Government of India ever having made a reference on tariff setting or freight classification before the Railway Rates Tribunal [RRT] over the 33 years of the RRT's existence, despite such reference being statutorily admissible.[31] Use of the statutory provision would have allowed railway clients to join issue with IR on its monopoly tariff-setting and would have restored railway competitiveness, but would also have proved inconvenient to governmental preoccupation with raising revenue from a tariff-base rather than through improvements in railway turnover. Hence the recommendation still hangs fire at a time when other RFFC recommendations have largely been accepted in phases.

5.1.3 Projections of Transportation Demand

With the longterm character of infrastructural investment and the gestation lag before suitable returns begin to accrue, the projection of future demand remains vital to formulation of infrastructural investment plans. Planning in the freight sector is confronted by more imponderable problems rooted in the complex interaction of the two groups of economic factors that ultimately determine transportation demand and supply. Principal supply factors include for instance the degree of investment in alternative transportation modes which may prove complementary or competitive in their eventual nature, thus bringing the intermodal allocation of investment into reckoning. The materialisation of transportation demands adequate to this depends however on the flow of upstream and downstream investments into the economic sectors which constitute the clientele for transportation services. As such, the projection of transportation demand has an assumptional character resting on fulfilment of spatially and secularly interlinked investment plans. It is also important that the projection forward extends over a sufficient length of time so that coalescence of different sectoral demands within the economy into resultant transportation flows is rendered visible.

In India particularly, projection of demand for railway freight transportation is rendered considerably more difficult because of juxtapositioning of public and private sectors within transportation with the overall process of economic development. Since the future volume of private investment in the roadways can at best be a 'guesstimate' which depends partially on growth conditions within the economy, partially on the presence or lack of railway investment, and partially on the degree of parallel investment in the state-sector road networks, estimates of the eventual configuration that transportation demand will have can vary widely from each other depending on the assumptions and methodology used. Traffic projections made in India have to be considered in this light.

Even though the first exercises in integrated transportation planning commenced with the work of the CTPC during the 3FYP period, it has taken some time for any degree of consensus to evolve around the future outlines of transportation demand, because of the problems just alluded to. Serious exercises in railway traffic projection only commenced in the late-1970s, well after successive oil shocks had permanently altered the cost economics of alternative transport and pointed out glaring bottlenecks in the transportation infrastructure. The critical review in this section briefly explores the projection exercises since.

Emerging freight-structure trends and the policy onus they placed on Indian transportation planning are well covered in the NTPC Report and are therefore reviewed at length here. The major observation from such trends was of the advance made by the roadways in India, with respective intermodal shares of railways versus roadways having declined from 74:26 for freight traffic and 89:11 for passenger traffic in 1950-51, to levels of 40:60 and 67:33 for the same by the 1970s.[32] While pointing apparently to reduced competitive importance of IR, the change in ratios also concealed a polarisation of railway operations around bulk freight, with the remainder of incremental transportation demand in the country flowing to the roadways by default because of inability on the part of IR to invest in the creation of adequate railway capacity. Two important areas critically examined in the NTPC study were the efficiency of energy-use in alternative modes of transportation, and the nature of lagged demand responses within the infrastructure-economy linkage which affected freight flows in the country and their commodity-composition. The NTPC Report consequently recommended an intermodal mix that would optimise traffic and restore complementarity between road and rail transportation, albeit by increasing the depth and circumscribing the range of IR freight operations to provide an adequate foothold to the former.

Transport projections in the NTPC study were arrived at through a transport-gravity model, whereby regional output levels (*i.e.*commodity supply) were forecast on a "share and shift" method that subsumed base-year regional production shares as well as the expected shift in industrial locations. Breakdowns of regional final demands for commodities for the projection were obtained after factoring in regional growth in *per capita* incomes and population.[33] Given these estimates of commodity supplies and demands, potential interregional freight movements were estimated on the principle of *gravity-flow*, or flow from regions with highest surplus production to regions with highest unfulfilled demand. Use of this particular projective model had the intrinsic advantage of keeping all transport parameters as endogenous and of generating predictions of freight by distance-slab. The NTPC estimated from these that 50.9 percent (355.76MT) of IR originating tonnages in the year 2000-2001 would have a traffic lead of over 500km, compared to 50.2 percent (149.07MT) for the traffic distance-slab estimate for 1982-83.[34] While the professed purpose of the NTPC freight forecasts becomes clear from these computations, revealing that the basis of these estimates was a freight-structure that was subsequently to remain unaltered, the overall optimism in the NTPC traffic projections has been belied by the actual freight performance of IR in the period since.

Several other traffic projections more directly focused on railway freight made in the period just preceding or subsequent to the NTPC projection include estimates by the Indian Railways Corporate Plan [IRCP 1976], the Tata Economic Consultancy Services [TECS] and the Operations Research Group [ORG] around the same period, the Energy Policy Working Group [EPWG 1979], the Rail Tariff Enquiry Committee [RTEC 1980], the Railway Reforms Committee [RRC 1983], the Indian Railways Corporate Plan [IRCP 1987], the Working Group on Railway Programmes for 8FYP [WGRP 1989] and the Railways Fare & Freight Committee Task Force [RFFC 1993]. The alternative IR freight projections for the turn of the century arrived at by these expert groups, which are summarised in Table 5.1, show marked variation over a range between 250-970 billion net tonne-km of traffic with a consensual level of just over or just under 400 billion net tonne-km in five of the alternative estimates. What is also of note in the table is the apparent downscaling of traffic estimates over time. Thus early estimates with a forward projection period of 25 years or more such as IRCP [1976] assume much more resilience in railway freight traffic in the 1980s and 1990s than has actually transpired. Although the NTPC estimate downscales this, the sequence of estimates by RTEC, RRC, IRCP [1986], WGRP and eventually the RFFC Task Force turn increasingly pessimistic following the demonstration of failure on the part of IR to retain an adequate proportion of the evolving traffic flow.

***Figure* 5.1: Expert-Group Projections of IR Freight Level by the Year 2000**

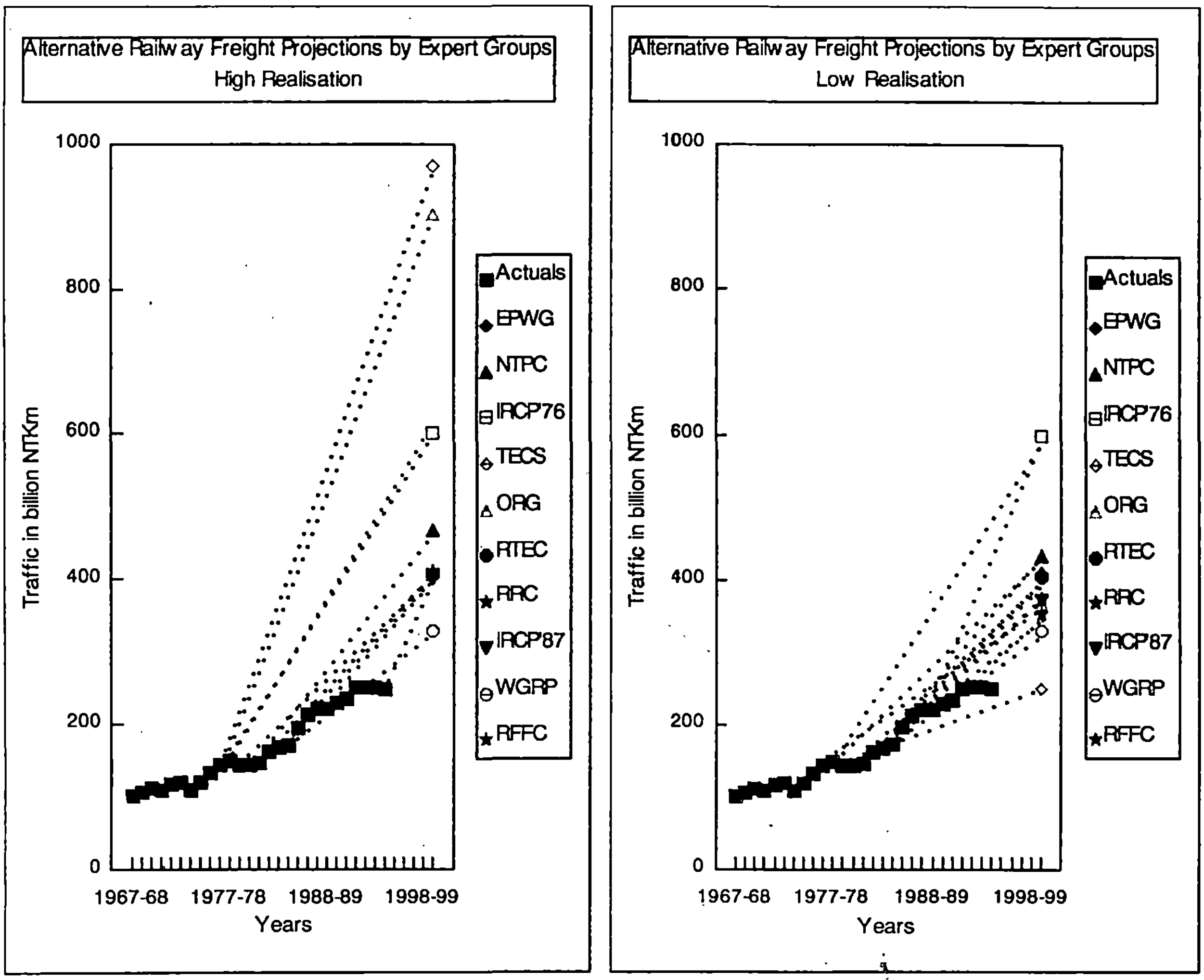


Table 5.1: Alternative Projections of IR Freight Traffic for the Year 2000

Year	*Policy Group*	*Traffic Projection [bill tonne-km]*	
	Energy Policy Working Group [EPWG]	410	
1976	Indian Railways Corporate Plan 1976 [IRCP'76]	600	
	Tata Economic Consultancy Services [TECS]	250-970	
	Operations Research Group [ORG]	368-903	
1980	National Transport Policy Committee [NTPC]	435-468	
1980	Rail Tariff Enquiry Committee [RTEC]	406	
1983	Railway Reforms Committee [RRC]	375-413	
1987	Indian Railways Corporate Plan 1987 [IRCP'87]	374-400	
1989	Working Group on Railway Programmes for 8FYP [WGRP]	330	**for 8FYP-end*
1993	RFFC Task Force	353-408	**for 2001-2002*

Source: adapted from RFFC [1993]: *Railway Fare & Freight Committee Report,* 1(6):133, Table 6.1

The two commissioned private-sector studies of railway traffic demand by TECS and ORG prove interesting from this standpoint. Although criticised by later statutory committees such as the RFFC as having pitched their estimates unrealistically high, the two studies envisage multiple expectation scenarios ranging from optimistic to pessimistic depending on the degree to which the assumptions that complement traffic generation are fulfilled. Thus while the low-growth scenarios pertain to the estimation of *restricted demand* because of capacity restraints on IR freight operations, the high-growth scenarios in either study estimate *fully unconstrained demand*, with all complementary expectations having been fulfilled. The wide range of difference between pessimistic and optimistic estimates and the fact that actual IR freight performance is closer to the former than to the latter would imply that considerable restraint operates on the development of freight flows in India because of lacunae in the IR infrastructure, and that the pickup in railway capital investments since the 6FYP has been insufficient to undo this.

Problems in planning and projecting transportation infrastructures arise when possible chain effects are overlooked, whereby the provision of transportation services generates increasing *per capita* incomes and consumption demands, satisfaction of which requires further multiplication in services. It becomes necessary therefore that the projections of transportation demand which guide the planning process should be accurate and should amply capture dynamic evolution within the economy over time. The accuracy of the projections will depend on the nature of forecasts of different macroeconomic variables that are capable of affecting transportation demand. Commonly-used methodologies for projecting traffic demand besides the gravity model used by the NTPC, include time-trend analysis, regression analysis and transport-coefficient modelling. Each of these methods works under specific equational frameworks which project transportation demand on the average growth rates of agricultural, industrial and mining sectors within the economy and the annual rate of growth of GDP, and broadly indicate the traffic volumes that would be generated as a result of projected economic growth if current locational and distribution policies are sustained through time. The assumptional structure as exemplified in the equational frameworks is however rigid since it leaves little or no scope for evolutionary transportation demands being incorporated in future periods. The traffic forecasts made in the NTPC Report have therefore been candidly termed 'broad prognostications of magnitude, based on specified assumptions and trends'.[35]

Besides assumptional rigidity, another flaw commonly present in projective methodology is marked variation between estimates depending on the method used. Projections using trend methods for instance estimate the railway shares of freight by extending past-trend lines into the next few decades. IR experience with freight operations show continuing decline in railway traffic share for at least a decade following the 3FYP, which automatically depresses the projection for the subsequent period when the past-trend method of traffic projection is used. On the other hand, regression-modelling of the relationship of transport traffic with indices of industrial and agricultural production during the 1970s projects a future rise in the railway share in freight as a follow-up to growth of the economy. Such disparities in projective estimates are often baffling, and can grossly influence the formulation of policy in the short run, leading eventually to demand-supply imbalance.

Despite these contentious issues, projected intermodal allocation of traffic estimated by the NTPC, based on combined analysis of past trends, resource costs (including imputed costs for scarce inputs like energy), traffic breakeven points and increases in POL prices, was 72:28 between rail and road freight for the turn of the present century, representing a rise of 9 percent in the railway share compared to the years which immediately preceded the Report. Subject to implementation of appropriate investment and pricing policies by government, the corresponding shares for passenger traffic were put at 60:40.[36] These projections were later refined in the report of the Steering Committee on Perspective Planning for Transport Development submitted to the Planning Commission in 1988, using detailed results from a Rail India Technical & Engineering Services [RITES] study which had projected total freight traffic on all modes to reach a level of 643 billion net tonne-km by the year 2000. Of this, IR was again expected to retain the intermodal share of 72 percent, or 463 billion net tonne-km.[37] In outright contrast, internal estimates by IR spread over the period of five years since, such as IRCP [1987] and RFFC [1993], project IR freight share at much lower levels of 400-408 billion net tonne-km by the turn of the century, even under the most optimistic scenarios. The fact that actual traffic performance by IR in 1994-95 was just 249.6 billion net tonne-km on total freight loadings of 364.96MT, [*see ch 3*] and that IR loading performance of 429.30MT in 1997-98 accounted for a mere 40 percent of intermodal tonnage freight leaves little scope for such projections to be realised.

5.1.4 Policy Implications for IR

Among the several traffic projections made over the past two decades which have just been considered, the NTPC projection would hold special place as part of the comprehensive enunciation of national transport policy which accompanied the rejuvenation of IR through fresh capital investment beginning with the 6FYP. The RFFC later commented that there appeared to be no explanation for the sudden and sharp reduction in plan allocations to transportation in general and to IR in particular that had taken place between 1966-79,[38] and squarely blamed this for the serious transport bottlenecks that had arisen in the country during the plateau period and after. Replacement-capital needs for meeting the technological backlog that existed even at the end of the 7FYP were estimated at a phenomenal Rs.17,512 crore, comprising Rs.4876 crore for rolling stock, Rs.7825 crore for track renewal, Rs.1430 crore for signalling and safety, Rs.2525 crore for machinery and workshops and Rs.1136 crore for bridge and electrical works.[39]

A major component of policy content in the NTPC Report, of which special note must now be taken, related to the composition of IR freight anticipated in the future projection. It had earlier been seen that the policy statement, implemented in parts over the 6FYP and 7FYP, led to important changes in direction for IR, including a gradual write-off of steam traction and MG operations, and reorientation of traffic capacity towards the needs of bulk freight. Whether these write-offs represented an entirely technological adaptation by IR to emerging traffic trends, or a surrender to continuing consequences of the resource crunch has considerable bearing on the current traffic position of IR, and it will hence be interesting to apply hindsight in examining the roots of the policy change later in this chapter.

To round off the present discussion, it may be noted that the NTPC Report, using data for 27 years commencing from the 1FYP, had estimated the then-current traffic density on IR's BG operations at 86.4 percent of total railway freight tonne-km and 76 percent of passenger-km.[40] Considering that the BG network constituted 51 percent of total IR routes at the time, the overwhelming importance that BG operations held in total traffic realisation by IR would become easily apparent. Moreover, freight traffic on IR was spatially concentrated on the so-called 'golden quadrilateral' of route-sectors linking the four metropolises of Bombay (Mumbai), Calcutta, Delhi and Madras (Chennai), which comprised 25 percent of total IR route-km but accounted for 75 percent of railway freight movements and 55 percent of passenger traffic. In further expostulation of the need for policy change, the NTPC Report further stated that while carriage by road proved economical on short traffic hauls with leads of upto 300-350 km, railway transportation held a definite cost advantage for traffic leads beyond that. However the tendency for high-rated freight like cotton goods, perishables, etc. to move by road even at leads of just over 350km was noted as depriving IR of a valuable component of transport revenues.[41] Projections of total freight traffic by all modes equalled 550 billion tonne-km by the year 2000 out of which IR was projected to singly carry 463 billion tonne-km. Analysis in the previous chapters has shown however that while the present freight tonnages carried by IR do not diverge so dramatically from the tonnages implied by the NTPC estimate, the major loss to IR has been of its share of traffic in net tonne-km terms.

Considering the level of renewal arrears just stated, it is not unlikely that the losses in traffic sustained by IR were at least partly the result of capital inadequacy and consequent capacity shortage. The next section shall therefore examine capital investment in IR over the planning period.

5.2 The Capital Determinants

As seen in the literature on *non-market* or *public* goods, as also in the comparative history of railway development over the long timeframe, the issue of capital finance remains a critical area both as an instrument as well as a determinant of transportation policy. In India, the institution of planning, which coincides almost exactly with the takeover and nationalisation of the old railway companies, forms a watershed as far as railway finance is concerned. While capitalisation stress in the prior period had been laid primarily on the mobilisation of private capital - either through guaranteed company investments or through direct borrowing by the state, the trickle that capital flows had been reduced to from their grand scale during the first phase of railway development meant that more dependable sources of funding would have to be assured if IR were to meet the transportation requirements for fulfilment of national economic aspirations in independent India. As such, the option exercised by the sovereign Indian state - and not only within railway planning - was to go in for public provision of all infrastructural services in keeping with the public utility school of thought. A study of Indian railway finance through the modus of the FYPs therefore holds considerable importance, and is attempted in this section.

5.2.1 Railway Capitalisation during the Plans

Railway capital is generally drawn from three principal sources, namely, capital from the *general exchequer*; capital from *internal sources;* and capital from *market borrowings.*[42] Although all three means have been commonly adopted to mobilise railway finance in India, their relative importance as components within total railway capital has changed over time. Capital drawn from the general exchequer, which represents outlays from government revenue surpluses towards the provision of railway capital, is the equivalent of participation by the state in railway equity. While this source of funding first came to the fore after the Separation Convention of Railway and Government Budgets under recommendations of the IRC (Acworth Committee), the commitments of government to new railway capital remained marginal till Independence, since the purpose of such provision till then was to ensure the maintenance of operational levels by the railway companies. However, with the commencement of planning, state capital grants soon became the principal means of financing the large autonomous injections made into IR capital-at-charge, against which dividend earnings with perpetual liability were to accrue to the exchequer. In more recent times, reduction in the level of government commitments has laid the onus on IR to find other means of outsourcing capital requirements. Although like any other commercial enterprise, the railways too can conceivably reinvest operating surpluses into capital accumulation, in practice the potential mobilisation from internal sources remains limited because of the traditionally low returns that accrue to infrastructural investment. A similar limitation also restricts the potential of market borrowings because of lower returns when these are invested in railway capital.

As such, provision of budgetary support to IR has been an affirmation of the public utility character of its operations and has remained an important means of financing the expansion of services. Nevertheless, with restriction on the level of budgetary capital over time, greater pressure has come to bear on other capital sources as means of funding railway plans. While the compulsion to raise resources internally might in this sense be welcomed as a positive move towards improving the operating efficiency of IR, in practice this pressure has been revenue-expanding rather than cost-reducing, leading to several upward revisions of IR tariffs during and after the 1980s. At the same time, the recourse to market borrowing which has been made through bond finance, particularly since the Indian Railway Finance Corporation [IRFC] was incorporated in 1986, is indicative of a return to the older modes of railway financing prevailing in the past which had relied considerably on mobilisation of capital from private sources. While the capital raised in such cases has to be repaid with interest instead of remaining at the permanent charge of railways, the costs of debt repayment incurred are obviously much higher than mere dividend payments and can only be sustained if the operating revenues therefrom show considerable elasticity. As a means for raising railway capital, the later advent of leasing (equity) schemes like OYW for railway rolling stock and BOLT for new railway lines and facilities marks the turning of a full circle to the principles of Indian railway finance in the 19th century, minus the sweetener of an interest guarantee.

In nominal terms, Railway Plan outlays in India have increased nearly thirty-fold between the 1FYP and 8FYP, emphasising the importance which has vested with IR as prime mover of the economy. However, adjustments for effective inflation in the value of the rupee and allowance for the considerable outgo now made to railway maintenance and replacement because of the expansion of railway capital-at-charge would imply that the real rate of growth of railway capital is considerably lower. A bird's-eye view of the growth and distributional pattern of railway plan outlays between the 1FYP and the early years of the 8FYP is provided in Tables 5.2*(a & b)* and 5.3*(a & b),* which reveal essential features of state finance as it applies to IR. It may be noted in connection that plan finance does not signify the collective entirety of IR expenditure but rather its *development* component. The operational component of IR expenditure which is represented in the annual Railway Budget may have capital content within it if a modicum of surpluses are expected to be earned; in other cases, it is basically a statement of operational costs (labour, inputs, etc.) against operational revenues. Because of the low margins within which infrastructural services have to operate, railway budget appropriations to capital are usually very limited and thus the plan allocation from general revenues of the Government of India has generally been the dominant constituent of new railway capital.

The major capital heads on which railway capital outlays are traditionally made, *i.e.* route & track expansion and network maintenance, rolling stock and other railway inventories, and amenities for railway personnel and passengers which involve civil construction, are seen to be well reflected in IR plan outlays. In addition however, a head of capital expenditure that has attained fairly credible levels throughout most of the Indian plan experience is railway investment, implying investments by IR in its auxiliaries such as Indian Railway Construction Corporation [IRCON], Rail India Technical & Economic Services [RITES], and the various metropolitan transportation projects. Because of changes in the mode of railway finance after the 7FYP, a new component within capital investment is *leasing*, which is sourced from market lending by the IRFC and partially from OYW and BOLT schemes. In broad terms therefore, capital outlays by IR can be broken down for different plans or years over these components.

Quite obviously the most intensive capital demand on railway finance emanates from the track and equipment heads, particularly because railways, as a transportation service, have a distinct spatial distribution within

Table 5.2a: IR Expenditure against Capital Allocations under the Indian Five-Year Plans

[in Rs.crore]

Expenditure Head	1st FYP 1951-56	2nd FYP 1956-61	3rd FYP 1961-66	Interregnum 1966-69	4th FYP 1969-74	5th FYP 1974-78	Rolling Plan 1978-80	6th FYP 1980-85	7th FYP 1985-90
Route Expansion	33.35	77.83	211.95	56.21	66.58	76.96	75.72	324.31	915.52
Track & Network Renewals	68.03	186.28	243.15	104.77	184.67	178.54	148.65	1202.82	3832.97
Line Doubling	-	-	-	-	-	-	53.91	285.40	823.43
Gauge Conversion	-	-	-	-	-	-	64.58	308.70	271.98
Electrification Projects	-	52.89	80.71	36.14	70.04	78.81	41.41	422.61	961.13
Total Route & Track	**101.38**	**317.00**	**535.81**	**197.12**	**321.29**	**334.31**	**384.27**	**2543.84**	**6805.03**
Terminal & Handling Facilities	68.10	190.89	358.26	160.59	285.85	282.61	84.25	329.86	1272.32
Workshop & Maintenance	14.06	76.37	90.38	42.02	69.03	100.85	79.15	683.06	1586.94
Total Maintenance & Handling	**82.16**	**267.26**	**448.64**	**202.61**	**354.88**	**383.46**	**163.40**	**1012.92**	**2859.26**
Rolling-Stock & Inventories	**228.02**	**401.27**	**622.75**	**335.02**	**674.75**	**685.61**	**584.45**	**2527.63**	**3328.25**
Staff & Passenger Amenities	**13.24**	**63.89**	**75.66**	**37.02**	**66.19**	**54.91**	**45.51**	**127.70**	**312.27**
Investment in Roadways	-	5.34	7.65	4.71	13.16	32.49	37.10	84.88	-
Investment in Railway PSUs	-	-	-	-	-	0.20	0.20	3.00	251.46
Total Investments	**-**	**5.34**	**7.65**	**4.71**	**13.16**	**32.69**	**37.30**	**87.88**	**251.46**
Total	424.80	1054.76	1690.51	776.48	1430.27	1493.78	1214.93	6299.97	13556.27
Other Credits	-	-10.93	-4.66	-13.77	-10.61	-1.85	-	-	-
TOTAL + CREDITS	**424.80**	**1043.83**	**1685.85**	**762.71**	**1419.66**	**1491.93**	**1214.93**	**6299.97**	**13556.27**
Metro Transport Projects	-	-	-	-	8.66	33.29	36.89	285.48	-
Bonds	-	-	-	-	-	-	-	-	-
TOTAL PLAN OUTLAY	**424.80**	**1043.83**	**1685.85**	**762.71**	**1428.32**	**1525.22**	**1251.82**	**6585.45**	**13556.27**
IRFC Investment in Rolling Stock									

(b) *Percentage to Total Plan Outlay*

Expenditure Head	1st FYP 1951-56	2nd FYP 1956-61	3rd FYP 1961-66	Interregnum 1966-69	4th FYP 1969-74	5th FYP 1974-78	Rolling Plan 1978-80	6th FYP 1980-85	7th FYP 1985-90
Route Expansion	7.85	7.46	12.57	7.37	4.66	5.05	6.05	4.92	6.75
Track & Network Renewals	16.01	17.85	14.42	13.74	12.93	11.71	11.87	18.26	28.27
Line Doubling	-	-	-	-	-	-	4.31	4.33	6.07
Gauge Conversion	-	-	-	-	-	-	5.16	4.69	2.01
Electrification Projects	-	5.07	4.79	4.74	4.90	5.17	3.31	6.42	7.09
Total Route & Track	**23.87**	**30.37**	**31.78**	**25.84**	**22.49**	**21.92**	**30.70**	**38.63**	**50.20**
Terminal & Handling Facilities	16.03	18.29	21.25	21.06	20.01	18.53	6.73	5.01	9.39
Workshop & Maintenance	3.31	7.32	5.36	5.51	4.83	6.61	6.32	10.37	11.71
Total Maintenance & Handling	**19.34**	**25.60**	**26.61**	**26.56**	**24.85**	**25.14**	**13.05**	**15.38**	**21.09**
Rolling-Stock & Inventories	**53.68**	**38.44**	**36.94**	**43.92**	**47.24**	**44.95**	**46.69**	**38.38**	**24.55**
Staff & Passenger Amenities	**3.12**	**6.12**	**4.49**	**4.85**	**4.63**	**3.60**	**3.64**	**1.94**	**2.30**
Investment in Roadways	-	0.51	0.45	0.62	0.92	2.13	2.96	1.29	-
Investment in Railway PSUs	-	-	-	-	-	0.01	0.02	0.05	1.85
Total Investments	**-**	**0.51**	**0.45**	**0.62**	**0.92**	**2.14**	**2.98**	**1.33**	**1.85**
Total	100.00	101.05	100.28	101.81	100.14	97.94	97.05	95.66	100.00
Other Credits	-	-1.05	-0.28	-1.81	-0.74	-0.12	-	-	-
TOTAL+ CREDITS	**100.00**	**100.00**	**100.00**	**100.00**	**99.39**	**97.82**	**97.05**	**95.66**	**100.00**
Metro Transport Projects	-	-	-	-	0.61	2.18	2.95	4.34	-
Bonds	-	-	-	-	-	-	-	-	-
TOTAL PLAN OUTLAY	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
IRFC Investment in IR Rolling Stock	-	-	-	-	-	-	-	-	-

Source: Adapted from *RFFC [1993]: Railway Fare & Freight Committee Report,* 1(3):71-72, Annexure 3R

Table 5.3a: Annual Allocations to Railway Plan Expenditure (1985-1994)

[in Rs.crore]

						Interregnum	8th Plan		
Expenditure Head	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93RE	1993-94BE
Route Expansion	77.99	127.56	187.72	254.04	268.21	289.25	267.10	238.98	200
Track & Network Renewals	548.74	629.12	834.57	870.35	950.19	970.80	1163.59	1083.42	1090
Line Doubling	74.61	99.01	170.36	219.37	260.08	274.30	283.38	170.10	220
Gauge Conversion	31.26	43.91	53.01	57.18	86.62	86.40	27.39	541.44	810
Electrification Projects	167.19	177.19	196.05	184.84	235.86	233.27	230.75	235.00	280
Total Route & Track	**899.79**	**1076.79**	**1441.71**	**1585.78**	**1800.96**	**1854.02**	**1972.21**	**2268.94**	**2600**
Terminal & Handling Facilities	121.36	201.61	283.95	317.32	348.08	337.83	332.33	281.90	325
Workshop & Maintenance	164.88	244.24	316.05	402.45	459.32	377.86	295.32	420.01	445
Total Maintenance & Handling	**286.24**	**445.85**	**600.00**	**719.77**	**807.40**	**715.69**	**627.65**	**701.91**	**770**
Rolling Stock & Inventories	**635.53**	**988.59**	**436.17**	**589.84**	**678.12**	**855.68**	**820.02**	**1454.88**	**1940**
Staff & Passenger Amenities	**33.48**	**51.47**	**70.94**	**69.16**	**87.22**	**80.60**	**85.59**	**100.10**	**120**
Investment in Roadways	-	-	-	-	-	-	-	-	-
Investment in Railway PSUs	1.47	50.00	50.15	64.84	85.00	80.33	115.00	52.00	-
Total Investments	**1.47**	**50.00**	**50.15**	**64.84**	**85.00**	**80.33**	**115.00**	**52.00**	-
Total	1856.51	2612.70	2598.97	3029.39	3458.70	3586.32	3620.47	4577.83	5430
Other Credits	-	-	-	-	-	-	-	-	-
TOTAL + CREDITS	**1856.51**	**2612.70**	**2598.97**	**3029.39**	**3458.70**	**3586.32**	**3620.47**	**4577.83**	**5430**
Metro Transport Projects	85.07	84.36	99.90	99.97	103.54	135.46	169.49	170.00	170
Bonds	-	-	720.00	800.00	1000.00	1092.14	1503.31	962.17	900
TOTAL PLAN OUTLAY	**1941.58**	**2697.06**	**3418.87**	**3929.36**	**4562.24**	**4813.92**	**5293.27**	**5710.00**	**6500**
IRFC Investment in IR Rolling Stock	-	-	43.98	61.66	85.36	-	-	-	-

(b) *Percentage to Total Plan Outlay*

						Interregnum	*8th Plan*		
Expenditure Head	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93RE	1993-94BE
Route Expansion	*4.02*	*4.73*	*5.49*	*6.47*	*5.88*	*6.01*	*5.05*	*4.19*	*3.08*
Track & Network Renewals	*28.26*	*23.33*	*24.41*	*22.15*	*20.83*	*20.17*	*21.98*	*18.97*	*16.77*
Doubling	*3.84*	*3.67*	*4.98*	*5.58*	*5.70*	*5.70*	*5.35*	*2.98*	*3.38*
Gauge Conversion	*1.61*	*1.63*	*1.55*	*1.46*	*1.90*	*1.79*	*0.52*	*9.48*	*12.46*
Electrification Projects	*8.61*	*6.57*	*5.73*	*4.70*	*5.17*	*4.85*	*4.36*	*4.12*	*4.31*
Total Route & Track	***46.34***	***39.92***	***42.17***	***40.36***	***39.48***	***38.51***	***37.26***	***39.74***	***40.00***
Terminal & Handling Facilities	*6.25*	*7.48*	*8.31*	*8.08*	*7.63*	*7.02*	*6.28*	*4.94*	*5.00*
Workshop & Maintenance	*8.49*	*9.06*	*9.24*	*10.24*	*10.07*	*7.85*	*5.58*	*7.36*	*6.85*
Total Maintenance & Handling	***14.74***	***16.53***	***17.55***	***18.32***	***17.70***	***14.87***	***11.86***	***12.29***	***11.85***
Rolling Stock & Inventories	***32.73***	***36.65***	***12.76***	***15.01***	***14.86***	***17.78***	***15.49***	***25.48***	***29.85***
Staff & Passenger Amenities	***1.72***	***1.91***	***2.07***	***1.76***	***1.91***	***1.67***	***1.62***	***1.75***	***1.85***
Investment in Roadways	-	-	-	-	-	-	-	-	-
Investment in Railway PSUs	*0.08*	*1.85*	*1.47*	*1.65*	*1.86*	*1.67*	*2.17*	*0.91*	-
Total Investments	***0.08***	***1.85***	***1.47***	***1.65***	***1.86***	***1.67***	***2.17***	***0.91***	-
Total	*95.62*	*96.87*	*76.02*	*77.10*	*75.81*	*74.50*	*68.40*	*80.17*	*83.54*
Other Credits									
TOTAL + CREDITS	***95.62***	***96.87***	***76.02***	***77.10***	***75.81***	***74.50***	***68.40***	***80.17***	***83.54***
Metro Transport Projects	*4.38*	*3.13*	*2.92*	*2.54*	*2.27*	*2.81*	*3.20*	*2.98*	*2.62*
Bonds	-	-	*21.06*	*20.36*	*21.92*	*22.69*	*28.40*	*16.85*	*13.85*
TOTAL PLAN OUTLAY	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***
IRFC Investment in IR Rolling Stock	-	-	*1.29*	*1.57*	*1.87*	-	-	-	-

Source: Adapted from *RFFC [1993]: Railway Fare & Freight Committee Report,* 1(3):71-72, Annexure 3R their capital needs. Curbs on funding therefore drastically affect transportation capacity on railway networks and thus their levels of operational efficiency. This is in fact a marked peculiarity of railways as opposed to other means of transportation, since both the transport vehicle as well as the path on which it is propelled place heavy capital demands on the same outlay - the essential argument for locating railways in the public sector. While the means to capital adequacy are, obviously, profitable operations in the long-run, questions of *sunk capital*, etc., complicate the picture and impart a lumpiness to railway investment. Although growing trends in IR plan outlays attest to the importance of railway transportation in India, a study of the long-term behaviour of investment magnitudes defines critical capital determinants of freight capacity.

As seen in the tables, outlays on route & track and rolling stock & inventories have always constituted the bulk of railway capital investment, ranging at levels between 65-70 percent of total railway plan outlays throughout the planning period. The ratio between the two has however fluctuated, with increases in the proportion of the former in the late 1970s and after being a reflection of transport policy changes that favoured line doubling and gauge conversion as a means of focusing IR freight operations towards bulk traffic on the BG network. A natural consequence of the shift in stress within an overall situation of capital shortage has been reduced rolling stock acquisitions during FYPs where route & track expenditure has been particularly high. Another point clearly relating to this is the build-up of alternating backlogs in either track or rolling stock renewal-related expenditure because of plan focus on the other head, which necessitates refocusing of the plan-stress after some interval of time. Quite evidently, such alternating behaviour relates to the materialisation of traffic bottlenecks either because existing rolling stock inventories are inadequate to service the railway route network, or because track inadequacies reduce the efficiency of utilisation of existing rolling stock. As would be anticipated, such bottlenecks emerge through the 1960s and 1970s, with spillover effects in the subsequent plans.

The true extent of such backlogs is in fact understated by the extent of plan allocations after the 1970s because of the policy decision to phase out MG operations on IR, substantially reducing the backlog investments to be made in one fell swoop as it were. However, if consideration is given to the fact that IR's BG routes and stocks would as a consequence of this have to supplant MG operations, the apparent increases in quantum and proportion of plan outlays on these heads during and after the 6FYP would appear quite inadequate and would point to truncation of traffic as a consequence rather than as a cause of insufficient capitalisation. This is borne out also in the pattern of subsectoral allocations made towards route technology involving line doubling, gauge conversion and electrification since the same period. While each of these increases potential utilisation of the BG network, the associated allocations would appear to have been on the low side considering that BG freight would eventually have to make up for route and traffic losses on the MG network. It has been critically noted elsewhere that the UNIGAUGE policy has remained a perennial 'caprice' of the Railway Ministry,[43] with periodic rise in allocations towards it telling ultimately as a 'throwforward' on other railway development programmes - most seriously on electrification targets, double-tracking and the construction of new lines.[44] A conceptual problem also relates to the traffic effect of such policy changes. While electrification and double-tracking involve very little gestation lag in raising traffic-handling capacity on busy trunk lines, the alternative of gauge conversion or the building of new lines may cause a hiatus before adequate traffic materialises. Gauge conversion in itself cannot increase railway traffic, particularly if requisite downstream investments on the raw material and industrial base of the economy have not been simultaneously planned.[45] Under present prescriptions, construction of new lines now has to have yield-adequacy of a recommended 12 percent returns on capital invested, which at current tariff rates against costs of rolling stock acquisition and IR operating ratios, can only be sustained by a few areas in the country such as those rich in minerals.[46] From such perspectives, policy shifts of this nature from fleet consolidation to upgradation of line capacity impose both immediate direct costs and opportunity costs on IR.

It is most noteworthy of the period after the 6FYP that physical allocations under the two major capital heads have been raised substantially, indicating realisation on the part of the planners that IR transportation capacity had been placed under tremendous inventory and technology squeezes in the prior period. The serial increase of these allocations from levels of around Rs.1000 crore in the 4FYP and 5FYP to Rs.5071.47 crore (6FYP) and Rs.10133.28 crore (7FYP) - the magnitude in real terms being sufficient to outweigh inflation - is both an indicator of the new resolve to wipe out the backlog, at least on BG, and to allow massive infusion of new railway technology while doing so. Not as much emphasis appears to have been placed however after the early plans on increasing physical and spatial capacity of the IR network, so that the proportion of outlays on route expansion and maintenance & handling do not again touch the high levels recorded during the 3FYP when the thrust had been on building capacity ahead of demand. The larger size of annual railway plans during and after the 7FYP period would nonetheless attest to physical growth of railway capital stock, albeit increasingly through exercise of the more expensive option of market borrowing (bond finance and leasing) which have imposed heavy interest and repayment obligations on subsequent IR revenues. As such, the proportion of capital funds sourced from general and internal revenues never substantially cross four-fifths of the total plan requirements in the later period and have tended to decline in more recent years.

Metropolitan railway transportation, even after being separated from IR zonal suburban operations, is also funded out of the Railway Plan appropriation. Since the lines, routes and inventories on this account are committed and unavailable for other use, plan investments on metro projects do not add to general freight or passenger-handling capacity on IR. The growing involvement of IR - directly or indirectly- in suburban and inner-city passenger operations, coupled with the substantial operating losses incurred against hidden subsidies on them, thus imposes a drain on IR capital realisations, leading to a call in recent years for delinking of IR's inter-city operations from suburban transport so that more realistic pricing policies can be adopted.[47]

Overall, the tables show the extent and phases of emergence of the resource crunch which has affected railway planning in India. It will be noticed that the traffic trends commented upon in Chapter 3 follow the patterns of IR plan investment, especially after the 3FYP, with the 'plateau' phase of IR operations being closely coincident with the investment slowdown between 1965 and 1980 during which a massive backlog of rolling stock and track replacement gradually built up. Although the position appears to have eased somewhat since the 6FYP, it is to be noted that the pickup in investment is associated with a planning shift towards bulk freight and the BG network. As a result a substantial portion of the then existing MG capacity has had to be written off since. The change in policy has however also induced a change in traffic handled by IR because the BG routes that now carry the bulk of traffic are spatially separated from the MG feeder region and are moreover not equipped with equivalent rolling stock and wagons.

As to the reasons for the resource crunch, several causes might be ascribed, primary among which is the high cost of technology induction on the BG network. However, larger issues are also at play here. While the 1FYP, for instance, was largely an infrastructural plan and thus allowed the transportation sector to claim the highest percentage share of investments made, the subsequent direction of economic policy in India made direct participation of the state in economic activity its primary plank. With proliferation of public sector units, plan support to transportation infrastructure dwindled accordingly, partly also because of the inability of IR to raise its revenues and its internal generation of resources. Therefore the reliance on market borrowing in the later plans represents both a realisation of the extent to which development of IR has been circumscribed by the resource crunch, and an admission that substantial state funding is not likely to be forthcoming within the foreseeable future. The option for IR in these circumstances was either to raise internal surpluses or to avail of capital credit. From a longer perspective, these alternatives were really no alternative at all. Whether raised directly (through internal investment) or indirectly (through bond finance), the higher rates of railway investment in the 1980s and the 1990s eventually had to be financed through commitments from IR revenues and increased tariffs, without collateral gains in traffic and reduction in costs. Loan capital therefore appears to be an extremely short-term means of viably raising capital funding for the IR. Since the observations just made are of compelling importance in judging the present predicament and financial future of IR, it will be useful to probe them further.

5.2.2 Capital Financing Modes

Tables 5.4*(a)* & *(b)* examine financing aspects of railway plans between 1FYP and 8FYP. It is seen very clearly that IR mobilisation from internal revenues stood at a credible 66 percent of the Railway Plan during the 1FYP period, although in absence of any pronounced technological takeoff, IR capital requirements during the plan period were low at Rs.422 crore. Integrated transportation planning in India began in earnest from the 2FYP, during which internal sourcing of capital resources dwindled immediately to 45 percent of the railway plan despite increasing substantially in absolute terms from Rs.280 crore to Rs.467 crore. The balance of funding required was provided by government from the general budget and rose further to 68 percent in the 3FYP. Thereafter, however, capital support from general revenue did not show much absolute progress until the 6FYP, while its apparently high proportionate share was attributable to extremely low internal resource generation of well below 30 percent during the 1970s rather than to any remarkable change in government policy. A reversion to high-growth governmental funding only occurred in the 1980s with the commencement of the 6FYP, as a matching outlay to increased internal mobilisation by IR. Midway through the 7FYP, after it became difficult for government to finance the large capital outlays made by the Plan to IR, recourse was made for the first time after Independence to market borrowing, which hovered below or just around Rs.1000 crore p.a. in the three closing years of the Plan. After another plan-holiday between 1990-92, the 8FYP began with a substantial increase in the annual plan outlay, partially met through increased budgetary support. The 8FYP period is of special interest because of the launching of economic reforms in India, accompanied by the downscaling of government tax mobilisation and opening up of several avenues for investment by the private sector. Bond finance since 1987-88 had been raised for IR by the IRFC. Through most of the 8FYP years however, the quantum of bond finance remained low and shrank appreciably from 7FYP proportions. With budgetary support also having been diluted, the brunt of the capital financing effort fell on IR's internal resources which were accordingly raised through the mechanism of upward tariff revision, supported by direct capital leasing through the OYW scheme commencing from 1994-95 to supplement market borrowing, and the BOLT scheme for capital projects commencing from 1996-97. While the two schemes represent financial innovation on the part of IR, the gross capital mobilised by them over the 8FYP was just Rs.596 crore or just 1.8 percent of the total plan outlay - considerably lower than had been anticipated.

Table 5.4: Budgetary Support to IR Capital Expenditure

PLAN	Internal IR Mobilisation [Rs.crore]	%	Bond Finance [Rs.crore]	%	Total Internal & Extra-Budgetary Mobilisation [Rs.crore]	%	Government Budgetary Support [Rs.crore]	%	Total IR Capital Finance [Rs.crore]
1st FYP	280	*66*	-	-	280	*66*	142	*34*	422
2nd FYP	467	*45*	-	-	467	*45*	576	*55*	1043
3rd FYP	545	*32*	-	-	545	*32*	1140	*68*	1685
1968-69	320	*42*	-	-	320	*42*	442	*58*	762
4th FYP	397	*28*	-	-	397	*28*	1031	*72*	1428
5th FYP	384	*25*	-	-	384	*25*	1141	*75*	1525
1978-80	316	*25*	-	-	316	*25*	935	*75*	1251
6th FYP	2783	*42*	-	-	2783	*42*	3802	*58*	6585
7th FYP	7089	*43*	2520	*15*	9609	*58*	6940	*42*	16549
1990-92	4225	*41*	2595	*26*	6820	*67*	3388	*33*	10208
8th FYP	18830	*58*	6161	*17*	24991	*77*	7311	*23*	32268
					(b) **Annual Plan Outlays during & after the 7th Plan**				
1985-86	1065	*55*	-	-	1065	*55*	877	*45*	1942
1986-87	1318	*49*	-	-	1318	*49*	1379	*51*	2697
1987-88	1331	*39*	720	*21*	2051	*60*	1368	*40*	3419
1988-89	1586	*41*	800	*20*	2386	*61*	1543	*39*	3929
1989-90	1789	*39*	1000	*22*	2789	*61*	1773	*39*	4562
1990-91	2091	*43*	1092	*23*	3183	*66*	1632	*34*	4815
1991-92	2134	*40*	1503	*27*	3637	*67*	1756	*33*	5393
1992-93	2548	*41*	1025	*17*	3573	*58*	2589	*42*	6162
1993-94	4030	*69*	856	*15*	4886	*83*	974	*17*	5860
1994-95	3582	*65*	779	*14*	4361	*80*	1145	*21*	5472
1995-96	4208	*65*	1118	*15*	5326	82	1138	*18*	6464
1996-97	4462	50	2383	*24*	6845	82	1465	18	8310

Source: Compiled from GOI [1998]: *Status Paper on Indian Railways,* Ministry of Railways, Government of India, New Delhi, pp7-8

As noted earlier, tariff setting is by far the most controversial area in railway literature because of its bearing on the nature of railway monopoly and railway pricing. This position originates both from social utility considerations and from the standard infrastructural pricing principles of 'second-best' pricing, or pricing according to 'what the market can bear'. Thus the mechanism of tariff revision which has increasingly been adopted by IR as an almost desperate means of circumventing the capital crunch has to be explored in this light. Summary investigation of the recent fallouts of tariff revision on IR is therefore in order.

Table 5.5 below examines the crossrelation between IR traffic and revenue trends between 1979-92. Average tariff rates realised per tonne-km traffic, which can be computed as a simple quotient of trend values for any given year, have increased more than three-fold over the period from 09.6 paise in 1979-80 to 37.1 paise in 1991-92 against a less than two-fold traffic increment, showing that a considerable proportion of IR's improved revenue performance through the 1980s and 1990s originates from tariff increases. Since the traffic increment per year can also be easily computed, the incremental revenue earned each year can be split up into traffic-related and tariff-related components.

Gross as well as break-up trends in incremental revenue generally show sharp increase through most of the period considered. Provided that such increases are attributable to operational improvement (attraction of more traffic by IR), they would be considered creditable. If on the other hand, they more or less emanate from frequent hikes in railway tariff rates and are moreover unaccompanied by parallel effort towards reducing railway costs, they would tend in the long run to be offset by traffic losses on the overrated freight segment and hence would be subject to diminishing returns. That IR has had to resort so frequently to monopoly pricing of its freight services is the result of budgetary pressure on it to increase internal resource mobilisation to fund its own capital outlays. But the high proportions assumed by tariff-related incremental revenues through most of the 1980s and 1990s becomes sufficient cause for concern. Conversely, the ostensibly healthy revenue trends over the period are not backed by the order of traffic gains which would have rendered them stable. The adverse fallout of severe tariff hikes in the year 1982-83 and between 1985-88 becomes immediately apparent. On the first occasion, traffic increment fell from a buoyant 16.60 billion net tonne-km in the preceding year to just 3.53 billion net tonne-km and remained depressed until 1985-86, when the 7FYP commenced. The sharp hike in IR capital outlays made over that FYP was however being increasingly financed from tariff-related internal revenue generation, leading to a severe traffic slump in the mid-plan years. It is also noticed from the table that improvements in traffic realisation have only occured over years when average tariffs remained relatively stable, pointing out the negative portents of unpredictable pricing behaviour. While it had been noted elsewhere in this chapter that IR tariff-setting is strictly the preserve of specifically-empowered tariff committees rather than of the annual Railway Budget exercises, increasing departure is being made from this practice over recent years. The reasons for this course of events are self-evident, and contribute significantly both to losses of general traffic and increasing proportions of bulk traffic on IR. Tariff volatility and capital shortages together have reduced the ability of IR to attract high-rated traffic which has consequently switched over to the roadways. At the other end of the commodity spectrum, tariff hikes and pressures for revenue mobilisation have steeply increased transportation costs for higher-rated bulk traffic such as iron & steel and POL which cannot shift over to other transportation modes, the spillover of such increases leading to cascading costs throughout the economy.

Table 5.5 : Traffic & Tariff Origins of Incremental IR Revenues

Year	Total Traffic *million NTKm*	Traffic Increment *NTKm*	Tariff-rate Realised *Paise/TKm*	Freight Earnings *Rs.crore*	Freight Increment *Rs.crore*	Revenue Increment from: Δ Traffic Earnings *Rs.crore*	Revenue Increment from: Δ Tariff Earnings *Rs.crore*	*% Traffic-related Increase*	*% Tariff-related Increase*	*Traffic ELASTICITY OF EARNINGS*	*Tariff ELASTICITY OF EARNINGS*
1979-80	144559	-	9.6	1394.1	-	-	-	-	-	-	-
1980-81	147652	3093	10.5	1550.9	156.8	29.8	127.0	*19.02*	*80.98*	***5.26***	***1.26***
1981-82	164253	16601	13.7	2250.3	699.4	174.4	525.0	*24.93*	*75.07*	***4.01***	***1.48***
1982-83	167781	3528	17.1	2865.9	615.6	48.3	567.3	*7.85*	*92.15*	***12.74***	***1.11***
1983-84	168849	1068	19.2	3234.3	368.4	18.2	350.2	*4.95*	*95.05*	***20.19***	***1.06***
1984-85	172632	3783	20.1	3465.0	230.7	72.5	158.2	*31.41*	*68.59*	***3.18***	***1.49***
1985-86	196600	23968	21.5	4232.2	767.2	481.1	286.1	*62.71*	*37.29*	***1.59***	***3.05***
1986-87	214096	17496	23.3	4990.7	758.5	376.6	381.9	*49.66*	*50.34*	***2.01***	***2.16***
1987-88	222528	8432	26.2	5839.2	848.5	196.6	651.9	*23.16*	*76.84*	***4.32***	***1.35***
1988-89	222374	-154	27.9	6196.7	357.5	-4.0	361.5	*-1.13*	*101.13*	***-88.47***	***0.99***
1989-90	229602	7228	32.5	7460.8	1264.1	201.4	1062.7	*15.93*	*84.07*	***6.28***	***1.23***
1990-91	235785	6183	35.0	8247	786.2	200.9	585.3	*25.56*	*74.44*	***3.91***	***1.38***
1991-92	250238	14453	37.1	9293.1	1046.1	505.5	540.6	*48.32*	*51.68*	***2.07***	***2.05***

Source: RFFC [1993]: Railway Fare & Freight Committee Report, 1(10):240, Annexure 10A, with additional computations

Although the proclivity to raise IR revenues through tariff rather than traffic means is witnessed throughout the 1980s and after, the computed traffic and tariff elasticities of IR revenues in the table show that much larger revenue increments can be drawn against traffic increases rather than tariff increases, with decrements in traffic also causing a sharp downward revenue swing as in 1988-89. Although in the table, composition of IR freight for the given years remains transparent, variability patterns in the elasticity coefficients provide some indication of the compositional change, with variability being observably higher in case of the traffic-elasticity coefficients. Since it is the traffic (*i.e.* net tonne-km) variable that is being considered within these, sharp traffic increases may reflect both rising tonnages and/or rising traffic leads, depending on whether the traffic increment is in the bulk or non-bulk freight segment. The crossrelationship between traffic increments and traffic-elasticities in the table would suggest that high elasticity coefficients occur over years where there has been pickup in the higher-rated non-bulk traffic. Conversely, traffic-elasticity of revenues is lower in years where the traffic increment has been fairly substantial, implying that incremental traffic in those years has been drawn both from longer leads as well as higher bulk-traffic loading.

Overall, the elasticity analysis indicates tariff increase as a principal cause for shifting freight composition on IR. Two other observations might also be noted. Firstly, tariff hikes during annual railway budgets appear to have frequently been made to compensate IR for traffic shortfalls incurred in the preceding year through shiftovers of non-bulk freight and lowered loadings of bulk freight, implying an extremely short-term pricing strategy. Secondly, because of the lag between movements of bulk raw materials and downstream production in the economy, tariff increases have tended to impact on the economy during periods when production of non-bulk commodities has been on the rise, leaving IR little scope to augment revenues through higher traffic realisation from this segment, despite the higher traffic-elasticities associated with such years. IR tariff policy over the period thus appears to be killing the proverbial goose with the golden eggs, while overtly appearing to aid IR's resource mobilisation effort.

5.3 The Capacity Determinants

The preceding discussion establishes that the transportation crisis in India owes its genesis to slowdown of plan investment in IR during the mid-1960s and 1970s, and subsequent cuts in the extent of state support to the railway plans even after investment picked up again from the 1980s. While sluggishness in railway development has been compensated in part by development of roadways, it had been shown earlier that road and rail transportation services are not pure substitutes for each other. Major differences between the two result from differences in optimum leads and loads and differences in breakeven points. Thus, despite the integrated statement of policy made in the NTPC Report which has sought to restore intermodal complementarity to transportation in India by restricting the operational role of IR to bulk haulage of BG freight, several potential areas for intermodal skirmishing are created by the high costs and high tariffs that attach to railway transportation, progressively rendering it uncompetitive in the transportation of high-rated low-bulk freight that had been the primary source of IR operating profits in the past.

Table 5.6: Transportation Sector Outlays over the Five-Year Plans
[brackets % shares]

Plan Period	Duration	Outlay on Railways *(Rs.crore)*	Total Transport Outlay *(Rs.crore)*	Total Plan Outlay *(Rs.crore)*	***Ratio of Rail: Non-Rail Transport Outlay***
1st FYP	1951-56	217 *(11.1)*	434 *(22.1)*	1960	***1.00***
2nd FYP	1956-61	723 *(15.5)*	1100 *(23.5)*	4672	***1.92***
3rd FYP	1961-66	1326 *(15.5)*	1983 *(23.1)*	8577	***2.02***
4th FYP	1969-74	934 *(5.9)*	2522 *(16.0)*	15779	***0.59***
5th FYP	1974-78	1523 *(6.0)*	4078 *(14.1)*	28991*	***0.74***
6th FYP	1980-85	6585 *(5.2)*	12412 *(12.7)*	97500*	***0.70***
7th FYP	1985-90	16715 *(6.9)*	22971 *(12.8)*	180000*	***1.18***
8th FYP	1992-97	27202 *(6.3)*	53966 *(12.4)*	434100	***1.02***

**including DRF component*

Source: Adapted from *IRYB*, various years, Directorate of Statistics & Economics, Railway Board, Ministry of Railways, Government of India, New Delhi, and FYP documents

Transportation bottlenecks became evident in the country during the industrial recession that occurred while the 3FYP was nearing a close, and have at least in part been linked to the subsequent slowdown in the economy and deceleration in industrial development. Evidence in the literature on the industrial economy substantiates the lack of headway between 1965-66 and 1975-76, as an aberration from the high-growth period between 1950-51 and 1964-65, and the rising-growth period after 1975. Averaged trend rates of growth of production for three industrial sectors, namely mining & quarrying, manufacturing and electricity, are observed to have declined from 6.7 percent p.a. between 1951-65 to 4.7 percent p.a. between 1966-85.[48] The worst-affected period, in terms of non-fulfilment of targeted rates of growth, was the 4FYP which has consequently been described as both the most overtargeted and most underachieved plan.[49] Various causes have been ascribed for the long and drawn-out recession which began in 1965-66. Prominent observers show some concurrence in their identification of causal factors like slowed rates of public investment and infrastructural constraints; disproportionate development of capital-goods industries relative to consumer-goods industries; inherent inefficiency in Indian industry as shown by low use of capacity, high prices, poor quality of output, and technological backwardness; and slowdown in import substitution and indifferent foreign trade policy in India, as having contributed to the recession.[50] Infrastructural bottlenecks arising from underinvestment have however been accorded highest significance in explanations of the industrial recession between the 1965-76, since infrastructure-sectors like railways and power disproportionately bore the brunt of the slowdown in net public investment - the share of infrastructure (railways, electricity, mining, etc.) in total public investment declining from 36 percent in the early 1960s to 29 percent over the recessionary decade.[51] Table 5.6 summarises manifestations of the infrastructural slowdown over the plans in terms of outlays made to the transportation sector.

Indication of declining infrastructural priority accorded by Indian planners to railway transportation is also evident from continuous decline in the IR share of total plan-outlays following the prominent infrastructural thrust of the 2FYP. The lowest IR share of barely 5.9 percent coincides with the 4FYP, during which marked shift of priorities towards the roadways was also indicated. Other evidence also suggests that actual IR capital expenditure has fallen far short of targeted outlays in real terms through almost every FYP, resulting in the carrying-forward of projects. This recurrent problem has surfaced partly because later Indian FYPs have lacked the planning foresight to anticipate that initial increases in *per capita* income arising from transport expansion require further augmentation of infrastructural facilities over time for economic development to be sustained into the long term. In the present case, the fallouts of poorly-sustained Indian infrastructure are felt by all economic sectors in the country. Insufficiency in railway wagonfleet numbers to cater to the rising demand for freight services, along with the generally low priority given to the creation of advance transportation capacity leaves an onus on freight demand to adjust itself to freight supply over the long term, through alarming curtailments of traffic.

5.3.1 The Roots of Freight Capacity Inadequacy

The foregoing discussion has already investigated the infrastructural linkages of the persistent economic slowdown experienced by India between 1965-76, which relate particularly to the transportation of freight. It is thus hypothesised that the industrial recession was at least partly the result of inability on the part of the transportation system in the country to provide swift, efficient and cost-effective transit to industrial inputs and manufactures on the required scale, and that shortages in freight-carrying capacity during the period resulted from planning pessimism in providing capital support to IR, leading eventually to relative unresponsiveness of freight capacity to trends in industrial and aggregate economic indicators such as GDP. It may be noted in passing that while the basic quantitative dimensions of demand for railway freight services are the freight tonnages to be carried and the total distances to be covered, user-demand for railway freight services is manifested as the wagon requirement for delivering particular shipments of goods to predefined destinations within a specified period of time. Fulfilment of user-demands depends on IR's ability to provide railway wagons to meet the stated delivery schedule. Since capitalisation needs for providing wagons in adequate numbers generally draw support from transportation-sector appropriations in the FYPs, the Plans as such present both a quinquennial review of transportation needs in the economy as well as a five-year timeframe for their fulfilment.

A useful study can thus be made of various railway transport indicators in this five-year setting, with the objective of tracing relationships which emerged during the recessionary period and later precipitated major freight policy redirection on IR during the 1980s. As just noted, the most important change in the transport policy frame was wrought by the NTPC Report, which recommended among other things, that IR reorient itself towards the carriage of BG bulk consignments over long leads and decided the induction of specialised wagons and upgraded technology accordingly. However, with hindsight, it may also be observed that the NTPC projections of traffic and freight-mix noted earlier were made on IR traffic trends through the plateau period, when a large proportion of low-bulk and general goods traffic shifted to the roadways for no better reason than IR's inability to provide wagons in sufficient number. It would seem pertinent therefore to retrace ground covered in the NTPC Report and make an econometric evaluation of the railway transportation situation over the recessionary period. Since it was this experience which moulded later intermodal freight policy in India, the exercise would also provide a review the appropriateness of policy changes, in view of later inflexibilities in IR freight capacity which have prevented the railways from meeting the freight targets projected by different expert committees.

5.3.2 Freight Capacity Modelling

Theoretically the railways, as an integral part of infrastructure, could counter unforeseen freight situations by building freight capacity ahead of demand. A change in tonne-km traffic would thus induce them to go in for either one-period capacity adjustment, *i.e. instantaneous adjustment*, or for capacity adjustment with a time-lag, *i.e. lagged adjustment.* Of the two processes, the latter would seem more applicable to IR, for two reasons. Firstly, IR investment decisions have largely depended on plan allocations made every five years. Hence an instantaneous adjustment that involves unforeseen investment cannot be made autonomously. Secondly, changes in freight traffic composition which entail subsequent modification in the railway wagonfleet can be brought about only after wagon-production lags have been accounted for.

Thus the investigative methodology adopted in this section seeks to establish the lagged capacity relationships that determine wagon output and IR wagonfleet in India, via an Almon polynomial distributed-lag model developed over the original database of the NTPC[1980] study, supplemented by other pertinent railway statistics for the period. The projections from this model are then tested against the future freight experience. Essentially, the relationships being modelled pertain to a restricted demand situation, with IR responses being determined primarily by the level of capital-appropriations for railway hardware, and the allocation of a certain component within these to acquisitions of freight stock. Since a lag structure of five years is suggested by the FYP context, analysis is made of distributed changes in the wagon stock resulting from changes in freight hauled. Prior to analysis of modelling results, the modelling procedure is briefly outlined below.

The Almon model[52] offers an alternative to the Koyck approach to the distributed lag model. Basing itself on Weierstrass' Theorem, the Almon procedure assumes that lag-coefficients b_i for a finite distributed lag can be approximated by a polynomial of suitable degree in 'i', the length of the lag. The lagged estimating equations in linear form for the Almon polynomial five-year lag model are:

$$\hat{Y}_t = \hat{\beta}_0 X_t + \hat{\beta}_1 X_{t-1} + \hat{\beta}_2 X_{t-2} + \hat{\beta}_3 X_{t-3} + \hat{\beta}_4 X_{t-4} \quad \ldots\ (5.1)$$

where the regressand Y_t is, alternatively, wagon output and wagonfleet, with X_{t-j} as the chosen regressor, *(j=0,1,2,3,4)*. The two alternative semi-log forms of the lagged estimating equations are:

$$\log \hat{Y}_t = \hat{\beta}_0 X_t + \hat{\beta}_1 X_{t-1} + \hat{\beta}_2 X_{t-2} + \hat{\beta}_3 X_{t-3} + \hat{\beta}_4 X_{t-4} \quad \ldots\ (5.2)$$

and

$$\hat{Y}_t = \hat{\beta}_0 \log X_t + \hat{\beta}_1 \log X_{t-1} + \hat{\beta}_2 \log X_{t-2} + \hat{\beta}_3 \log X_{t-3} + \hat{\beta}_4 \log X_{t-4} \quad \ldots\ (5.3)$$

with regressors and regressands as above.

Double-log forms were also experimented with, but it was found that nonlinearities in the data are best taken care of by either one of the semi-log fits, as applies to the regressand being considered. Thus in semi-log analysis, the dependent variable in the first 'log-lin' form *(equation 5.2)* is assumed to be lognormally distributed for an explanatory variable with linear specifications, and the converse is assumed for the second 'lin-log' form *(equation 5.3)*. Lognormal forms are found particularly useful for modelling skewed series with a long, almost asymptotic RHS tail. When applied for example to the regressand wagon output in the log-lin equation, the lognormally distributed output values imply that output log-values are normally distributed. Valid economic justification also exists for applying the lognormal form to lag analysis of wagon output. Since wagon outputs are necessarily positive and entail indivisible production costs, output fluctuations are more frequent at the lower end than at the high end. Hence wagon output series is positively skewed.

The Almon *Approximation Polynomial*, which follows from Weierstrass' Theorem, defines a system of lag-weights (here called the 'β-system') as linear combinations of polynomial coefficients α_i in the 'α-system', with *i* as the degree of the polynomial approximation. The weights of the 'β-system' can be written as:

$$
\begin{aligned}
\hat{\beta}_0 &= f(0) = (\hat{\alpha}_0) \\
\hat{\beta}_1 &= f(1) = (\hat{\alpha}_0+\hat{\alpha}_1+\hat{\alpha}_2+\hat{\alpha}_3) \\
\hat{\beta}_2 &= f(2) = (\hat{\alpha}_0 + 2\hat{\alpha}_1+ 4\hat{\alpha}_2+ 8\hat{\alpha}_3) \\
\hat{\beta}_3 &= f(3) = (\hat{\alpha}_0 + 3\hat{\alpha}_1+ 9\hat{\alpha}_2+ 27\hat{\alpha}_3) \\
\hat{\beta}_4 &= f(4) = (\hat{\alpha}_0 + 4\hat{\alpha}_1+ 16\hat{\alpha}_2+ 64\hat{\alpha}_3)
\end{aligned}
\qquad \text{....} \quad (5.4)
$$

where

$$
f(z) \approx \alpha_0+\alpha_1 z^1+\alpha_2 z^2+\alpha_3 z^3 \qquad \text{....} \quad (5.5)
$$

is the assumed Approximation Polynomial of cubic degree required for a five-yearly distributed lag. Under the model assumption that the degree of the polynomial is less than the length of the maximum lag, four α's are thus generated that define the five required β-coefficients.

5.3.2*(i)* Model Estimation Procedures

OLS is applied to the transformed model where Y_t is regressed on the constructed variables 'W_i' and not on the original X variables, to estimate the form

$$
Y_t = \alpha_0 W_0 + \alpha_1 W_1 + \alpha_2 W_2 + \alpha_3 W_3 + u_t \qquad \text{....} \quad (5.6)
$$

The W's in the estimating equation above are linear combinations of lagged X's according to the scheme below:

$$
\begin{aligned}
W_0 &= X_t + X_{t-1} + X_{t-2} + X_{t-3} + X_{t-4} \\
W_1 &= X_{t-1} + 2\,X_{t-2} + 3\,X_{t-3} + 4\,X_{t-4} \\
W_2 &= X_{t-1} + 4\,X_{t-2} + 9\,X_{t-3} + 16\,X_{t-4} \\
W_3 &= X_{t-1} + 8\,X_{t-2} + 27\,X_{t-3} + 64\,X_{t-4}
\end{aligned}
\qquad \text{....} \quad (5.7)
$$

After the W-transformation, the lagged function can be written as

$$
\begin{aligned}
Y_t = {} & \alpha_0 X_t + (\alpha_0 + \alpha_1 + \alpha_2 + \alpha_3)\,X_{t-1} \\
& + (\alpha_0 + 2\alpha_1 + 4\alpha_2 + 8\alpha_3)\,X_{t-2} \\
& + (\alpha_0 + 3\alpha_1 + 9\alpha_2 + 27\alpha_3)\,X_{t-3} \\
& + (\alpha_0 + 4\alpha_1 + 16\,\alpha_2 + 64\,\alpha_3)\,X_{t-4} + u_t
\end{aligned}
\qquad \text{....} \quad (5.8)
$$

Rewriting,

$$\begin{aligned} Y_t = \alpha_0(X_t + X_{t-1} + X_{t-2} + X_{t-3} + X_{t-4}) \\ +\alpha_1(X_{t-1} + 2X_{t-2} + 3X_{t-3} + 4X_{t-4}) \\ +\alpha_2(X_{t-1} + 4X_{t-2} + 9X_{t-3} + 16X_{t-4}) \\ +\alpha_3(X_{t-1} + 8X_{t-2} + 27X_{t-3} + 64X_{t-4}) + u_t \end{aligned}$$

or,

$$Y_t = \alpha_0 W_0 + \alpha_1 W_1 + \alpha_2 W_2 + \alpha_3 W_3 + u_t \qquad \text{....} \qquad (5.9)$$

which is the estimating equation after W-transformation.

Intercept suppression has necessarily to be made in estimating polynomial coefficients since the polynomial approximation is made on the assumption of proportionality, the implication being that we regress on the actual W-variables rather than their deviations. The estimates of α_i thus obtained have all the desirable statistical properties provided the stochastic disturbance term u satisfies the assumptions of the classical linear regression model. Once the α-coefficients have been estimated, the original lag-coefficients or β_i's can be estimated from the α-system mentioned earlier. Comparison of R^2 for linear and log-linear fit provides assessment of which variables are linearly related to the regressands wagon output and wagonfleet, and which are not. Computed *t*-values provide a necessary test of significance.

For α-coefficients, *t*-values are defined by the ratio $\hat{\alpha}_i/\text{s.e.}(\hat{\alpha}_i)$ and for β-coefficients, by $\hat{\beta}_i/\text{s.e.}(\hat{\beta}_i)$. In the case of estimated α_i, comparison of computed *t*'s with theoretical values of *t* under the chosen level of significance and given degrees of freedom (*df*) provide a two-tailed test of significance for the polynomial coefficients, and in the case of the estimated $\hat{\beta}_i$, for the distributed-lag coefficients, under the null hypothesis that the coefficient being so considered is not significantly different from zero. Significance testing of the α-coefficients provides a first-order test of the degree of the approximation polynomial, in this case the cubic approximation of f(z). In case of computed $\hat{\beta}_i$'s, the *t*-test provides a test of the order of the fitted lag. In the absence of an autoregressive lag-structure, the Durbin-Watson *d*-test can be used for detecting auto-correlation. The adjusted R^2 is also computed, which is independent of the number of α_i's estimated.

5.3.2*(ii)* Modelling Results

Using timeseries data for the sample period between 1960-61 and 1976-77 which is covered by the NTPC freight study, the estimating equations above were estimated by the OLS technique. The regression results are given in Tables 5.10 to 5.17. Each column in these tables contains the estimated coefficients for the regressor considered with their respective *t*-ratios. A summary is provided in Tables 5.8 and 5.9 below of the regression results obtained under linear and semi-log estimation from modelling wagon output and IR wagonfleet trends on the augmented NTPC dataset using the polynomial distributed lag procedure. Details of the intermediate results from the estimating procedure and computed values of the lag-coefficients, along with the dataset are provided in Tables 5.10 to 5.17 in the chapter-appendix. While the values for R^2 and adjusted $\bar{R}^2$ (the *coefficient of determination* adjusted for *df*) given in Tables 5.8 & 5.9 indicate the explanatory strength of respective railway variables as determinants of IR freight capacity, the relevant Durbin-Watson *d*-statistic provides an evaluation of serial correlation characteristics in the data . Inconsistent values of R^2 and R^2 have arisen in a few isolated cases because of the intercept suppression that is necessitated by the Almon lag-estimation procedure.

Table 5.7: Lag Modelling of IR Freight Capacity Adjustment:
The Augmented NTPC Dataset

Year	Wagon Fleet [lakhs]	**Net Wagon Additions [lakhs]	**Wagon Repla-cements [lakhs]	*Empty Wagon Km [mill]	*TAT [days]	*NTKM/ Route Km	Rail Tonne Km [mill]	Road Tonne Km [mill]	All Tonne Km [mill]	Rail Pass. PKM [mill]	All Pass. PKM [mill]	GDP	IND	AG	TP [mill]	PCI [Rs.p.a.]
1960-61	3.08	-	-	30.4	11.2	2.76	87.7	87.7	122.7	77.6	57	140.7	28.7	67.5	439	305.6
1961-62	3.19	0.111	0.008	31.1	11.5	2.31	91.2	91.2	131.2	81.9	59	146.1	31.0	68.1	448	309.2
1962-63	3.31	0.120	0.072	30.7	11.2	3.08	100.7	100.7	144.7	84.0	65	149.9	33.8	66.4	458	308.2
1963-64	3.44	0.130	0.130	31.3	11.0	3.25	106.8	106.8	154.3	88.6	69	158.0	36.9	68.1	468	318.3
1964-65	3.58	0.140	0.176	31.8	11.9	3.15	106.9	106.9	157.9	92.9	76	170.1	39.7	74.4	479	335.1
1965-66	3.70	0.120	0.225	31.5	11.8	3.4	116.9	116.9	171.9	96.3	95	162.7	41.0	63.8	489	311.0
1966-67	3.76	0.060	0.275	31.0	12.3	3.41	116.7	116.7	173.5	102.1	106	164.5	41.6	63.0	500	307.4
1967-68	3.78	0.020	0.192	31.6	12.6	3.49	118.9	118.9	177.9	107.2	124	177.9	43.0	72.8	512	325.4
1968-69	3.82	0.040	0.136	30.9	12.7	3.59	125.2	125.2	189.2	106.9	140	182.9	45.1	73.4	523	327.0
1969-70	3.84	0.020	0.145	31.6	12.6	3.66	127.4	127.4	192.4	113.4	156	194.6	49.0	78.1	535	340.6
1970-71	3.84	-0.000	0.149	30.9	13.3	3.61	127.4	127.4	193.4	118.1	169	205.9	50.2	84.5	547	343.0
1971-72	3.82	-0.015	0.127	31.6	13.5	3.71	133.3	133.3	199.3	125.3	190	208.2	50.8	82.8	559	349.0
1972-73	3.84	0.016	0.070	30.3	13.5	3.81	136.5	136.5	203.5	133.5	196	206.0	52.7	76.8	571	337.1
1973-74	3.88	0.040	0.068	29.3	15.0	3.42	122.4	122.4	189.4	135.6	208	216.5	53.7	83.7	583	349.1
1974-75	3.91	0.030	0.092	28.6	14.6	3.77	134.3	134.3	205.3	126.3	219	216.7	54.8	80.4	595	343.2
1975-76	3.95	0.043	0.070	29.8	13.5	4.17	148.2	148.2	221.2	148.8	225	221.1	56.0	84.6	606	365.9
1976-77	3.98	0.027	0.097	29.9	13.0	4.35	156.8	156.8	232.8	163.8	235	229.6	58.4	87.9	618	362.3

Source: Compiled from NTPC [1980]; *columns marked [*] added from* Rao & Sriraman [1985]; *columns marked [**] on net wagon additions and wagon replacements are computed within the data*

The dataset for the regression comprised timeseries in the following variables:

WAGONUNITS	=	wagonfleet in standardised BOX wagons
NETADDITIONS	=	annual additions to rolling-stock (excluding traction and coaching)
REPLACEMENTS	=	annual fleet renewals
EWAGONKM	=	journey kilometres on account of wagons running empty
TAT	=	turnaround time of wagons
NTKM/RKM	=	track-utilisation intensity in terms of net tonnages carried per route-kilometre
RAILTKM	=	rail freight traffic in tonne-km
RDTKM	=	road freight traffic in tonne-km
ALLTKM	=	total freight traffic in tonne-km
RAILPKM	=	rail passenger traffic
ALLPKM	=	total passenger traffic
GDP	=	Gross Domestic Product
IND	=	aggregate industrial output
AG	=	aggregate agricultural output
TP	=	total population
PCI	=	per capita income

some of which are the transportation and development indicators used by the NTPC study while most others are added railway variables which reflect the trend of IR freight and passenger operations. Wagon production trends are also added to the NTPC dataset. Inclusion of timeseries on specific economic variables allows an examination of whether a match had been maintained over the period of study between IR freight capacity and the development needs of the economy.

The results of lag-regression were encouraging on several counts. The coefficient of determination or regression coefficient was found to be large for most data relationships and the parameter estimates were statistically significant at the 5 percent level with few exceptions. While the signs of the lag coefficients were not always internally consistent, most lag-relationships did not exhibit serial correlation. Major multicollinearity problems were not encountered in most cases. The few instances of serial correlation were presumably the result of exclusion of other variables in the lagged regressions which were run on a single regressor and single regressand to simplify modelling and parametric estimation. A more rigorous modelling procedure which included multiple lagged regressors could conceivably eliminate this problem while extending the results of the present investigation.

Table 5.8: IR Freight Capacity Model under Linear & Semilog Estimation: R^2 & Adjusted $\bar{R}^2$ Values & Serial Correlation Characteristics for Wagon Output

Regressand: Wagon Output: Table of R^2 & Adjusted $\bar{R}^2$ Values & Durbin-Watson *d*-statistic

	Linear Estimates			Semilog Estimates		
	D-W *d*	Adj. $\bar{R}^2$	R^2	R^2	Adj. $\bar{R}^2$	*D-W* *d*
WAGONUNITS	*1.003038*	0.934	0.956	0.975	0.962	*3.212047*
NETADDITIONS	*1.001753*	0.551	0.701	-10.022	-15.534	*1.346535*
REPLACEMENTS	*1.011403*	0.151	0.434	-0.941	-1.911	*1.540457*
EWAGONKM	*1.009578*	0.080	0.387	0.365	0.048	*1.001632*
TAT	*1.010697*	-0.182	0.212	0.515	0.272	*1.621815*
NTKM/RKM	*1.007382*	0.465	0.644	0.832	0.748	*2.229619*
RAILTKM	*1.010209*	0.397	0.598	0.770	0.655	*2.057832*
RDTKM	*1.007884*	0.463	0.642	0.925	0.887	*2.312275*
ALLTKM	*1.009288*	0.439	0.626	0.812	0.719	*2.036578*
RAILPKM	*1.007452*	-1.154	-0.436	0.635	0.452	*1.553119*
ALLPKM	*1.011135*	-1.432	-0.621	0.918	0.877	*3.090632*
GDP	*1.007948*	-1.017	-0.344	0.614	0.421	*1.487814*
IND	*1.007189*	0.307	0.538	0.732	0.598	*1.531073*
AG	*1.008078*	-0.709	-0.139	0.527	0.290	*1.572672*
TP	*1.013282*	-0.221	0.186	0.574	0.362	*2.101179*
PCI	*1.007171*	-0.620	-0.080	0.275	-0.088	*1.332724*

Table 5.9: IR Freight Capacity Model under Linear & Semilog Estimation: R^2 & Adjusted $\bar{R}^2$ Values & Serial Correlation Characteristics for Wagonfleet

Regressand: Wagon Output : Table of R^2 & Adjusted $\bar{R}^2$ Values & Durbin-Watson *d*-statistic

	Linear Estimates			Semilog Estimates		
	D-W *d*	Adj. $\bar{R}^2$	R^2	R^2	Adj. $\bar{R}^2$	*D-W* *d*
RAILTKM	*2.945167*	0.334	-0.501	0.930	0.907	*2.357344*
TAT	*1.511661*	1.969	-1.727	0.810	0.747	*1.693891*
WAGONOUTPUT	*1.386219*	199.283	-149.712	-29.752	39.336	*1.807870*
ALLTKM	*2.834123*	0.189	-0.392	0.935	0.914	*2.312912*
GDP	*1.179840*	12.787	-9.840	0.701	0.602	*1.000932*
ND	*1.917056*	5.125	-4.094	0.784	0.713	*1.001442*
*NETADDITIONS	*3.805418*	0.993	0.995	0.994	0.992	*3.592057*
*REPLACEMENTS	*2.367691*	0.625	0.719	0.888	0.851	*2.498294*

**on WagonFleet*

Theoretical values of the *t*-statistic at 9*df* are 2.262 at 5% level of significance and 1.833 at 10% level. Reviewing results of the polynomial fit, it can be seen that the cubic form of the approximation polynomial is only justified for the regressor WAGONUNITS in Table 5.12, and for the reversed regressands NETADDITIONS and REPLACEMENTS in Table 5.13 with WAGONFLEET as the regressor. In other cases, the α-significances decay beyond $\hat{\alpha}_0$, thus indicating that the first-order test of the degree of the approximation polynomial is invalid beyond the simple proportional relationship between regressand and regressor.

Both R^2 and $\bar{R}^2$ serve as indicators of the goodness of polynomial fit. In the case of net additions and replacements, linear fits are indicated, while for wagon units, rail and road tonne-kilometerages and total passenger kilometres, the log-lin fits yield higher $R^2/\bar{R}^2$. All acceptable fits for the regressand wagon units are lin-log, so also for the regression of replacements on wagonfleet; only for net additions is the regression on the wagonfleet of lin-lin type. The lin-log fits relate absolute change in the regressand to relative changes (or growth) in the regressor, whereas the log-lin fit relates relative changes in the regressand to absolute changes in the regressor. Obvious multicollinearity, expressed in high $R^2/\bar{R}^2$ and low α-significances, is explicit for the regressors NTKM, RDTKM, RAILTKM, ALLTKM, GDP, IND, AG and TP, in Table 5.12, and once again for GDP and partially for TAT in Table 5.13.

Theoretical *t*-values for β-significances remain identical, although, as in α-significances, the degree of significance is often found to be stronger than 5% or 10% percent for good fits. The order of lags is however less than five or skips intermediate time periods if significances are taken into account, except when net wagon additions are regressed on wagon units. Under statistical hypotheses, a low β-significance for a particular time period may also be the result of some degree of multicollinearity which vitiates estimation of the periodic response without negating its existence.

Taking only significant lag-coefficients into account and eliminating all regressions where multicollinearity seems to be explicitly present on the thumb-rule test of high $R^2/\bar{R}^2$ and high standard errors of coefficient estimates, the following regression results held good over the period of the study:

i) The rate of growth of railway wagon production and acquisition was determined by the current size of the IR wagonfleet, scaled downwards by wagonfleet inventory levels over the immediately preceding lag-period. Quite obviously, high initial levels of wagon acquisition at the commencement of each plan were thus quickly succeeded by a slowdown, so that the resulting patterns of wagon production remained cyclical.

ii) The level of wagon output was determined primarily by current net addition to railway rolling stock (exclusive of traction and coaching units) and less so by replacement-acquisition of wagons. In such circumstances, a replacement backlog became inevitable if current financing of net wagon acquisitions remained low over successive plan years.

iii) The rate of wagon output and acquisition was inversely scaled by IR freight traffic levels achieved at the commencement of the plan horizon, implying the prevalence of traffic pessimism whenever traffic realisation appeared to be fairly high at the commencement of any plan.

iv) The rate of wagon acquisition by IR was also inversely related to the rate at which freight traffic on the roadways had grown over the course of the plan, so that lower *pro rata* fleet augmentation targets were set by each successive plan as a response to growing roadways competition.

v) The rate at which IR wagonfleets were augmented was influenced by current IR passenger traffic realisations, as a consequence of which IR wagon acquisition underwent a slowdown following the growth of passenger traffic volumes.

vi) Current levels of IR wagonfleet inventories were tagged to the rate of freight traffic growth at the commencement of each plan. A failure of freight traffic to maintain its earlier momentum over the plan appreciably slowed the rates of subsequent wagonfleet augmentation.

vii) Current wagonfleet requirements for IR were decided after mid-plan review of the growth of wagon turnaround, so that IR wagon acquisitions became a short-period adjustment device for circumventing immediate bottlenecks to achieve current traffic targets, rather than a longterm transport development device.

viii) Current IR wagonfleet levels were pessimistically scaled by the rate at which freight traffic had previously grown, with sustained increase in traffic over the previous period being expected to be followed by traffic decline in the immediate future.

ix) Net IR wagon acquisition levels in any current year were part of a lagged adjustment in wagonfleet inventory levels spread over a large number of preceding years, with readjustment being made to the initial projection of the required wagonfleet during mid-plan and end-plan years.

x) Wagon replacements by IR were a current adjustment to the growth trends of wagonfleet inventories in the immediately preceding period. Higher adjustment to take care of the mounting replacement backlog was undertaken in alternate lag-years, whenever traffic growth was found to have remained consistent over successive years.

Summarising, the determinants of the level of wagon output in India over the period of study were found to be the rate of growth of wagonfleet, the levels of rolling-stock acquisition and replacement by IR, the rates of growth of rail and road freight traffic and, inversely, the level of passenger traffic within the lag structures implied above. Wagonfleet levels were found to be determined on the other hand by the growth rates of railway freight traffic, wagon turnaround and total freight traffic, with the expectation of some incursion from road-transport operators, and were not significantly related to the growth rates achieved by industry and GDP in India. It is this latter lack of responsiveness that substantiates the existence of transportation bottlenecks, which were observed by many commentators[53] to be contributing to the recessionary trends that prevailed in the Indian economy over the study period.

5.3.3 Freight Policy Consequences

Before going into an evaluation of the policy impact of this freight situation, it becomes necessary to briefly reenter the scenario of post-Independence transportation planning, taking note of railway plan objectives and their relationship for IR capital investment decisions. The main transportation objective during each FYP was to carry the traffic forecast for the plan period. While IR concentrated mainly on the replacement of overaged railway assets during the 1FYP, railway development was accelerated considerably by the 2FYP, although transportation demand at times still outstripped IR freight capacity. The objective of the 3FYP was to accordingly develop sufficient infrastructural strength so that IR freighting capacity would not become a bottleneck to the industrial development of the country. While the main thrust continued to be the augmentation of IR asset stocks, a start was provided to the process of technological upgradation through the induction of modern traction and signalling equipment. By the end of the 3FYP, IR freighting capacity on given sections of the BG network was observed to have risen to levels slightly ahead of demand, particularly for streams of programmed BG traffic in coal, ores, heavy industrial raw materials and finished steel, where the PSU production targets had not been realised. On the MG network, freighting capacity maintained an overall balance with transportation demand. Thus during the interplan years between 1966-69, transportation and capital planning on IR began to shift its focus to meeting more immediate freight demands, while staying within sight of the longterm objective of adding freight capacity to meet the needs in the future. A major redirection of these objectives during the 4FYP was embodied in the planning shift from routine augmentation of IR capacity to maintain its parity with freight demand, to upgrading the technological efficiency of IR freight handling through railway modernisation. Because of the pervasive resource shortages of the time, the financial requirements for the modernisation plan resulted in a cutback on wagon acquisition and thus on the physical rate of growth of IR freight capacity.

Although the volume of IR freight traffic had increased appreciably over the first three FYPs in line with growth trends in the national economy, the rate of growth of freight operations slowed down thereafter. Thus while IR freight handling increased by 6 percent in terms of originating tonnages and by 6.5 percent in traffic terms over the duration of the 3FYP, subsequent freight tonnages over the next decade tended to stagnate around the 200MT mark reached in 1965-66. The slow rise in traffic upto 1972-73 mainly reflected the augmentation of freight leads arising from IR's growing specialisation in bulk-traffic. Hidden from view behind this specialisation was the running down of IR's ageing fleet of general-purpose wagons because of low replacement rates and negligible acquisition. Another consequence of increasing wagon specialisation was the loss of freighting elasticity by IR increasing its vulnerability to PSU production shortfalls. Thus the 1973-74 freight setback was principally caused by stagnation in producer-goods production, most notably in coal, cement and steel, which restricted the freight volumes available for transit, besides the unforeseen event of the Railway Strike. Thus, while upto 1965-66 IR freight increased at a rate distinctly faster than the expansion of the economy, growth of freight during the recessionary period from 1966-67 to 1974-75 was distinctly slower, imposing a drag on economic growth. Only after 1975 did IR freight traffic begin to recover.

Given this historical experience, credence is imparted to the regression findings, emphasising the analytical utility of the lag-fitment exercise. The regression relation of wagon output to wagonfleet over the recessionary period establishes that whenever existing rolling stock proved adequate for meeting current haulage needs, IR was reluctant to invest in wagon capacity in the succeeding year, despite the need foir advance planning of freight capacity to preclude the formation of transportation bottlenecks. Sluggish industrial growth and the failure of IR to achieve its slated freight targets over the period relevant to the NTPC study greatly contributed to cyclic wagonfleet augmentation. Since the semilog regressions relate wagon output and IR wagonfleet nonlinearly to other growth rates in the economy, the high degrees of serial correlation found therein are accounted for by the autocorrelated influence of low industrial growth rates and consequent slowness in the growth of producer goods demand, as well as by tardy rates of fleet replenishment which led to the growth of roadways competition in the shorthaul non-producer goods segment. Cross-dependence between IR's capital investment decisions and the public investment decision embodied in each FYP is also revealed by the lag-analysis. Wagon acquisition decisions by IR are taken only after emerging traffic trends and roadways competition have been closely monitored, and hence tend to cluster in the transitional years of each planning horizon instead of being evenly spaced. The resulting cyclicity in the growth of freighting capacity has adverse impact on the subsequent growth rates of the economy.

Thus the *increasing returns* scenarios that characterise the building of infrastructure have largely vanished from IR, and each spurt in freight demand calls for substantial outlay of new funds on building transportation capacity. In the absence of adequate advance capacity development by IR which would have provided it with a competitive buffer, competition from the roadways is strong since capital investment in these has shorter gestation. Over the years, this investment mismatch has been siphoning a growing proportion of non-bulkfreight traffic away from IR and has significantly affected its market share. Negative coefficients in the regression of IR wagon acquisitions on roadways freight traffic also assert that the growth of roadways has had an adverse impact on railway rolling-stock investments, and consequently on IR's acquisition and

Figure 5.2: Wagon Fleet regressed on Rail Tonne-Kilometerage Almon Distributed-Lag Weights

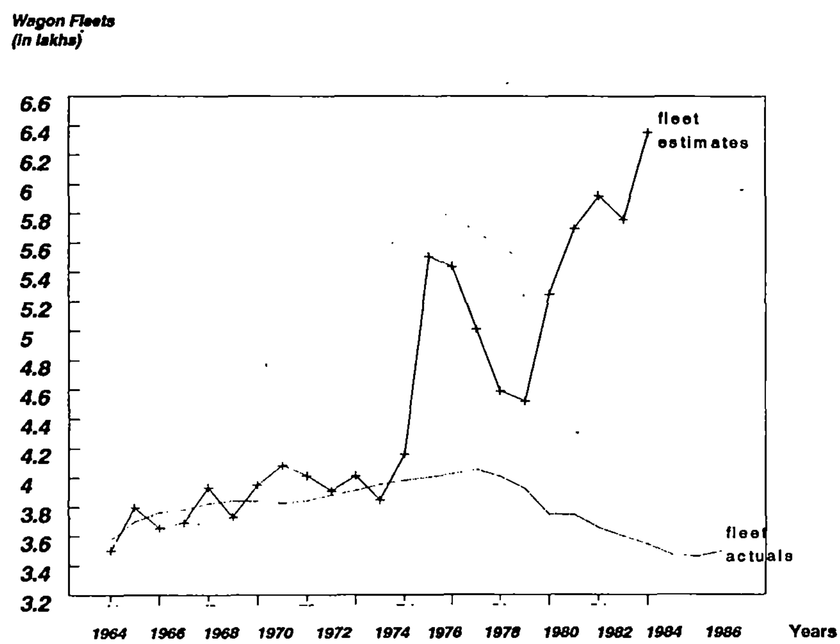
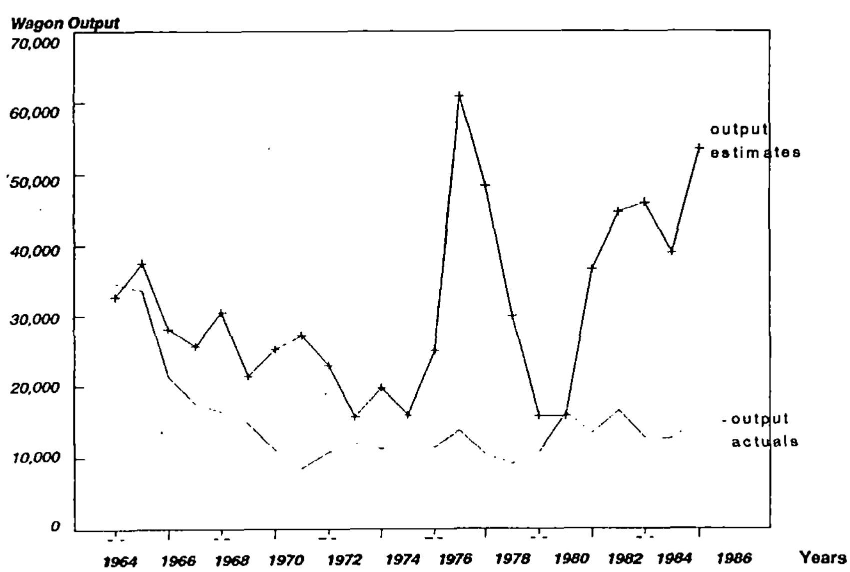


Figure 5.3: Wagon Output regressed on Rail Tonne-Kilometerage Almon Distributed-Lag Weights



deployment of freight wagons. Comparing the economics of freight between railways and roadways, both NTPC[1980] and RTEC [1980][54] concede that the latter derive competitive advantage from greater flexibility in their capital structure and mode of organisation and have been able to offer serious competition to IR in contestable freight segments. Thus while IR has been gaining bulkfreight over the years, it has surrendered a substantial proportion of the more profitable general freight segment to the roadways.

Viewing IR freight transportation trends beyond the timeframe of the NTPC study, further specialisation is noted. Bulkfreight now constitutes around 90 percent of revenue-earning tonnages on IR, while other freight has been steadily surrended[55] Because of this changing freight-mix, traffic growth on IR has continually outstripped the growth of freighting tonnages because of the rising proportion of longhaul freight. In spite of this apparently high order of freight specialisation, studies of freighting capacities vis-a-vis producer-goods volumes shows that IR's bulk haulage capacity has not grown apace with the potential availability of bulkfreight traffic,[56] clearly indicating that capacity constraints have limited producer-goods operations as well, constraining potential growth rates of the Indian economy. With plan allocations to IR undergoing continuous decline in proportionate terms over the years since the 3FYP, a slowdown has consequently been induced in engineering industry[57] accompanied by rising slack in the wagon industry.

Evidence of this is carried in Fig 5.2 and 5.3. These depict plots generated for IR wagonfleet and wagon output relation by applying lag-coefficients from their estimated regression relationships with IR freight traffic over the study period. It is seen from both figures that regression estimates are a reasonable approximation to actuals, particularly for wagonfleets, over the timeframe used by the NTPC study, but diverge dramatically when the projection is extended into the succeeding decades. It may be recalled that freighting capacities over the beginning of the study period were still heavily influenced by the high-growth philosophy of the 3FYP, although significant slack developed in subsequent years.

With the planning thrust in the post-3FYP period consequently being directed towards railway modernisation, rather than towards blanket expansions of wagonfleet and running track, the patterns of growth in IR freighting capacity underwent inevitable revision. If the momentum of the early-1960s had been sustained, and freight capacity had been created ahead of freight demand, wagonfleet requirements by the 7FYP period would have amounted to nearly 6.4 lakh FWUs [*4-wheeler units*]. Actual IR wagonfleets are only around half of this for the relevant years. Such sluggishness in the growth of freight capacity contributed to the cyclic pattern of wagon production evident in Fig 5.3. Recessionary slowdowns in freight traffic realisation curtailed the procurement of new wagons uptil 1971. The recovery that followed scaled up wagon production thereafter, until the end of the 5FYP. But spillover shortfalls in freighting capacity slowed the recovery in IR freight realisation, also causing the slumps in lag-estimates of wagon output observed at end-plan years. The post-1975 industrial recovery, when carried into the lagged estimation procedure, should have seen wagon output rise to nearly 60,000 wagons p.a., if unrestricted wagonfleet requirements had been fully met and freight capacity had been created ahead of demand. However, actual wagon outputs over the relevant period stagnated at well below 20,000 wagons p.a. While a part of the observed gap between the distributed-lag estimates of wagonfleet requirements and wagonfleet actuals has been filled by wagon modernisation and by the phasing out MG freighting capacity in favour of BG, it is unlikely that the gap has been fully covered. It remains to be noted that the persisting gap is indicative of the resource-shortages that have afflicted IR not only by limiting the expansion of freighting capacity, but also by cutting the rate of capital investment on track development and other modernisation measures which would have allowed a wagonfleet of over 6.4 lakhs to be online.

The lag-analysis has contributed to an understanding of the underlying causes. The root of the infrastructural problem lies in the failure of public policy to adequately capitalise railway plans. Investment constraints force IR to scale haulage capacity to the past trends in railway tonnages rather than to total anticipated freight movements in the country as a whole. Over extended periods of time, this reinforces further slackening in the growth rates of IR freight operations, opening avenues for roadways competition to enter, especially in selected traffic sectors such as the lucrative 'other goods' segment. The relation between IR freight capacity and GDP becomes progressively weaker as the transportation bottleneck becomes constrictive. Tremendous capital and freighting inefficiency is created by capacity mismatch between the road and railway sectors adding to high cost levels in the Indian economy, despite the energy considerations which dictate that progressively larger proportionate shares of overland freight should be transported on the railways. For a reversal of this situation, competitiveness has to be returned to IR through rapid wagonfleet augmentation which can once again widen the spectrum of its freight services and restore increasing returns to railway infrastructure in India.

5.4 Critical Evaluation of IR Freight Policy

Strong evidence has emerged from the distributed-lag analysis that structural inconsistencies such as adhesion to backward focus and an incremental approach to railway freight capacity planning in India[58] have gradually eroded the competitiveness of IR freight services in the transport market. The narrowing of IR's freight focus to a few bulk commodities and to a few high-density traffic corridors is as much the consequence of the inability of IR to make capital investment on the required scale for maintaining an adequate and diversified wagonfleet, as of the technological advantages that accrue from freight specialisation. Decisions on the acquisitions of new railway wagons, as the lag analysis has shown, are no longer been guided by the manifestations of new traffic demands in the Indian economy. As pointed out in the 9FYP document, the decline in IR's freight share from 89% in 1951 to 40% in 1995 has thus been inevitable, because of the failure of railway freight operations to grow annually at a rate that matches the recent growth rates of the economy.[59] The resulting slack in the freight market has thus spurred the acquisition of new freight capacity by the roadways.

In principle, the increasing acquisition of specialised wagons by IR reflects the larger choice of a new railway technology that is geared towards improving the efficiency of IR freight operations. Specialised wagons are an important constituent of IR's new freight focus on moving faster and heavier trains drawing uni-product rakeloads. While this technological decision is conceptually sound in terms of improving freight handling efficiency, it represents the engineering view of railway efficiency and is not necessarily prudent from the viewpoint of the economics of transportation. Since expanding transportation demands of the economy reflect the expansion of the country's economic space, extension of new railway technologies to cover IR's huge route network would involve prohibitive capital costs which could only be funded through a programme of massive external investment on the railways. With the attitudes of the state towards meeting the new public investment needs of the IR infrastructure having been decidedly lukewarm since the end of the 3FYP, the new railway technologies are being applied only on limited HDC sections of the IR network, where congestion costs have begun to adversely affect the speed of traffic handling and movement. [*see Map* 2] But despite their limited spatial focus, these new high-cost railway technologies have magnified the resource squeeze on many other critical segments of railway operation including replacement and renewal, reflecting problems of moral hazard and adverse project selection closely associated with the whims of IR's bureaucratic and political masters.

Since the 6FYP, IR has been asked to meet its need for new railway capital mainly from internally generates resources. Increasing stress is accordingly being laid by IR on frequent tariff rationalisations, so that the annual Railway Budgets can show operating surpluses to finance its capital needs. Even then, the internal resource flow has been too meagre to match IR's need for project funds, as a result of which its short-term funding needs after the 6FYP are being met through increased market borrowing. The new burden of debt servicing costs that has consequently been added further erodes IR's capacity for new capital investment, perpetuating a vicious circle. During the 1990s, railway debates in India thus moved towards the possibility of restoring IR to financial health through organisational and managerial restructuring. At the heart of such debates, were concurrent organisational reforms being carried on many major railway systems across the world, involving the unbundling of monolithic railway service organisations into more compact and more efficient entities, and also the alternative of either corporatising or privatising the railways. These debates thus shifted the focus towards the possibility of rationalising the costs of railway operation, providing a counterpoint in the debate within India on how IR's capital needs should best be met.

As noticed during the planning review, the central focus of Indian railway planning in the era following the 3FYP has been on technological upgradation of the IR network, through route-improvements like electrification, line-doubling and gauge conversion, as well as the acquisition of specialised freight capacity. Although the large fund outlays on such IR development projects have involved a new dose of 'sunk capital', the proportion of routes that have been upgraded pales into relative insignificance when compared to the size of the entire IR network. Consequently, a shrinkage of the railway freight-base has inevitably occurred, with IR having to concentrate on the movement of its captive long-lead bulk traffic which mainly serves the core sectors of the economy. As several reviews have since noted, this narrowing in the freight focus has made IR freight performance rather vulnerable to the productivity cycles of the core sectors and also to the locational shifts in core-sector activity which have occurred over time.[60] The non-core segment of the freight market catering to low-bulk and piecemeal traffic has thus been rendered contestable, with the roadways gaining advantage both from flexibility and convenience-of-service, as well as from IR rate-setting strategies which have priced IR freight services out of this segment of the market. Meanwhile, freight specialisation by IR has also led to congestion on the HDCs where large investments had been made on upgraded railway technology, leading to route saturation and falling freight productivity. The visible results of such phenomena are well reflected in freight cyclicity and longterm change in IR's commodity freight-base, which will be examined closely in the next chapter.

Chapter References:

1. John B.Lansing [1966]: *Transportation and Economic Policy*, Free Press & Collier-Macmillan, New York & London, p159
2. P.C.Stubbs, W.J.Tyson & M.Q.Dalvi [1980]: *Transport Economics*, George Allen & Unwin, London, p147
3. RFFC [1993]: *Railway Fare & Freight Committee Report*, Railway Board, Ministry of Railways, New Delhi, 1(2):791-792
4. CTPC [1966]: *Committee on Transport Policy and Coordination: Final Report*, Ministry of Planning, Government of India, Delhi
5. 'Extracts from the Report of the Expert Group on the Capital Structure of Indian Railways - 1978', RFFC [1993] *op.cit.* 1(2):48-49, Annexure 3.1
6. *ibid.*
7. NTPC [1980]: *National Transport Policy Committee Report*, headed by B.D.Pande, Planning Commission, Government of India, New Delhi, p2
8. *ibid.* p19
9. *ibid.* p3
10. *ibid.* p5
11. *ibid.* p6
12. *ibid.* p7
13. RFFC [1993] *op.cit.* 1(2):776-777
14. *ibid.*
15. *Report of the Railway Freight Structure Enquiry Committee,* Ministry of Railways, Government of India, para 314, quoted *ibid.* p778-779
16. sec.37, Railways Act [1989]
17. RFFC [1993] *op.cit.* 1(2):776
18. re-endorsed by sec.32, Railways Act [1989]
19. RFFC[1993]: *op.cit.* 1(1):95
20. *ibid.*
21. RFFC [1993]: *op.cit.* 1(2):823
22. RFFC[1993] *op.cit.* 1(1):116-117
23. *ibid.* pp168-169
24. *ibid.* p1
25. *ibid.*pp167-169
26. *ibid.*
27. RFFC[1993] *op.cit.* 1(2):551-557
28. *ibid.*pp546-547 & Table 21.1
29. *ibid.* pp556-557 & clause 236, p892
30. *ibid.*
31. *ibid.*pp783-784

32. NTPC [1980] *op.cit.* p17
33. *ibid.* p58
34. computations on *ibid.* p59, Table 3.27
35. *ibid.* p57
36. *ibid.* p68
37. GOI [1988]: *Report of the Committee on Perspective Planning for Transport Development,* Planning Commission, Ministry of Planning, Government of India, New Delhi, Table 6.1
38. RFFC [1993] *op.cit.* 1(1):15
39. *ibid.* 1(1):156-157
40. *ibid.* 1(1):p147
41. NTPC [1980]: *op.cit.* p139
42. GOI [1998]: *White Paper on Railway Projects*, Railway Board, Ministry of Railways, New Delhi, pp6-7
43. EPW [1997]: 'Railways: Stop-Go Policies', Editorial Comment, *Economic & Political Weekly*, 32(11):498-99]
44. GOI [1998] *op.cit.* p9 & p27 *Annexure 2*
45. R.K.Jain [1992]: "Development of Transport Network", Paper presented at the *National Seminar on Rail Transport Pricing and Economic Development* organised jointly by the Railway Fare & Freight Committee [RFFC] and JNU, Jawaharlal Nehru University, New Delhi, 14-15 December 1992, quoted RFFC [1993] *op.cit.* vol3: Seminars & Studies, p126
46. *cf.*Y.M.Garg [1992]: "Economics of New Railway Lines", Paper presented at the *National Seminar on Rail Tariff and Economic Development* organised jointly by the Railway Fare & Freight Committee [RFFC] and ISEC, Institute for Social & Economics Change, Bangalore, New Delhi, 27-28 December 1992, quoted RFFC [1993] *op.cit.* vol3: Seminars & Studies, p125
47. *cf.*S.Sriraman, Pradeep Amte [1992]: "Role of Railways in Metropolitan Areas with reference to Bombay Metropolitan Region", Paper presented at the *National Seminar on Rail Tariff and Economic Development* organised jointly by the Railway Fare & Freight Committee [RFFC] and ISEC, Institute for Social & Economics Change, Bangalore, New Delhi, 27-28 December 1992, quoted RFFC [1993] *op.cit.* vol3: Seminars & Studies, p125.
48. J.C.Sandesara [1992]: *Industrial Policy and Planning (1947-91)*, Sage, New Delhi, p24
49. K.L.Krishna [1987]:'Industrial Growth and Productivity in India', in P.R.Brahmananda, V.R.Panchamukhi *(eds)* [1987]: *The Development Process of the Indian Economy*, Himalaya, Delhi, p352
50. *cf.*A.Desai [1982]: 'Factors underlying the Slow Growth of Indian Industry', *Economic & Political Weekly*, Annual Number, **1982**, Krishna[1987] *op.cit.*, G.Rosen [1988]: *Industrial Change in India (1970 - 2000)*, Allied, Bombay, Isher Judge Ahluwalia [1992]: *Industrial Growth in India: Stagnation since the mid-Sixties*, OUP, Delhi, A.K.Lahiri [1984]:'The Industrial Sector in India: A Quantitative Analysis', *Economic & Political Weekly*, Annual Number, **Aug.1984**
51. Isher Judge Ahluwalia [1987]: 'The Role of Policy in Industrial Development', in P.R.Brahmananda, V.R.Panchamukhi *(eds)* [1987]:*The Development Process of the Indian Economy*, Himalaya, Delhi, p76
52. *cf.*Shirley Almon [1962]: 'The Distributed Lag between Capital Appropriations and Expenditures', *Econometrica*, 30:407-423
53. S.Roy Mukherjee [1993]:'Capacity Determinants in the Transportation Sector: A Study of Rail Freight Operations', paper presented at the 29th Conference of the Indian Econometric Society [TIES], *TIES Conference Volume,* IIT Kanpur, 20-22 March
54. *cf.*RITES[1991]: *Indian Railways Corporate Plan (1985-2000)*, Rail India Technical Services, New Delhi, p5
55. *cf.IRYB[1983-84]*, p64
56. *cf.*T.K.Dasgupta[1991]: 'Investment in Railways & its Impact on the Growth of Engineering Industry', *Steel Scenario,* 1(Oct):62]
57. *ibid.*p47
58. NCAER[[2001]: *The Indian Railways Report 2001: Policy Imperatives For Reinvention And Growth*, [Rakesh Mohan Committee Report], Executive Summary, Expert Group on the Railways, National Council for Applied Economic Research [NCAER] & Infrastructure Development Finance Compay Ltd. [IDFC], New Delhi
59. GOI []: *Ninth Five Year Plan*, Planning Commission, Ministry of Planning, Government of India, New Delhi, sec.7.1.48
60. *ibid.* sec.7.1.49

Table 5.10: IR Freight Capacity Model: Linear Estimation
α-system for Wagon Output

Regressand: Wagon Output : Table of Polynomial Coefficients & α-significances

Linear Estimates	W_0 $\hat{\alpha}_0$	W_1 $\hat{\alpha}_1$	W_2 $\hat{a}_2$	W_3 $\hat{a}_3$
WAGONUNITS	1.300 **	-4.389 **	2.543 **	-0.389 **
t-comp	6.269392	-3.78654	3.244224	-3.00430
NETADDITIONS	1.961 **	-2.618	1.038	-0.117
t-comp	3.351395	-1.24171	0.773650	-0.53996
REPLACEMENTS	1.259 **	-2.087	0.984	-0.139
t-comp	2.739332	-1.06613	0.766805	-0.65604
EWAGONKM	0.040	-0.062	0.034	-0.006
t-comp	1.293659	-0.46571	0.385320	-0.40801
TAT	0.012	-0.087	0.012	0.005
t-comp	0.331675	-0.65675	0.135389	0.315231
NTKM/RKM	0.034	0.341	-0.186	0.020
t-comp	0.418734	1.43511	-1.34757	0.941979
RAILTKM	0.005 *	-0.003	0.004	-0.001
t-comp	1.842129	-0.3715	0.691228	-1.14883
RDTKM	0.022 *	-0.056	0.032	-0.005
t-comp	2.111971	-1.17372	1.026834	-1.00458
ALLTKM	0.003	-0.003	0.003	-0.001
t-comp	1.547519	-0.39131	0.609363	-0.93433
RAILPKM	0.004	-0.003	0.003 *	-0.001
t-comp	0.512877	-0.11306	0.186881	-0.28517
ALLPKM	0.005	-0.013	0.006	-0.001
t-comp	0.949427	-0.38223	0.256403	-0.19959
GDP	0.001	0.003	-0.003	0.001
t-comp	0.308478	0.200546	-0.30306	0.321837
IND	0.037 *	-0.095	0.056	-0.009
t-comp	2.140138	-1.20247	1.076854	-1.07400
AG	-0.002	0.005	-0.003	0.001
t-comp	-0.44802	0.332092	-0.33463	0.374541
TP	0.059	-0.068	-0.020	0.010
t-comp	1.469847	-0.35888	-0.16104	0.480021
PCI	-0.001	0.005	-0.003	0.001
t-comp	-0.38205	0.581053	-0.58488	0.576311

Table 5.11: IR Freight Capacity Model: Linear Estimation
α-system for Wagonfleet

Regressand: Wagonfleet : Table of Polynomial Coefficients & α-significances

Linear Estimates	W_0 $\hat{\alpha}_0$	W_1 $\hat{\alpha}_1$	W_2 $\hat{\alpha}_2$	W_3 $\hat{\alpha}_3$
RAILTKM	0.013 **	-0.005	0.012	-0.004
t-comp	2.238909	-0.2268	0.95786	-1.68874
TAT	0.120	-0.214	0.056	0.002
t-comp	1.421423	-0.69437	0.275594	0.046444
WAGONOUTPUT	12.018	-9.321	-2.000	1.124
t-comp	1.053096	-0.18923	-0.06198	0.212483
ALLTKM	0.009 *	-0.004	0.010	-0.003
t-comp	1.913467	-0.22267	0.91829	-1.60172
GDP	0.018	-0.007	-0.002	0.001
t-comp	1.059633	-0.12729	-0.05146	0.098246
IND	0.177 **	-0.435	0.268	-0.045
t-comp	2.438426	-1.32682	1.23572	-1.26037
€NETADDITIONS	0.902 **	-3.051 **	1.698 **	-0.249 **
t-comp	24.08986	-14.5731	11.99008	-10.6640
€REPLACEMENTS	-0.568 *	3.625 **	-2.285 **	0.352 *
t-comp	-2.17572	2.483807	-2.31534	2.158154

€Reversed regression on Wagonfleet

Note: *Theoretical t-values at 9df are $t_{(0.05,\,9)} = 2.262$ at 95% confidence (**) and $t_{(0.1,\,9)} = 1.833$ at 90% confidence (**)*

Table 5.12: IR Freight Capacity Model: Semilog Estimation
α-system for **Wagon Output**

Regressand: Wagon Output :	Table of Polynomial Coefficients & α-significances			
Semilog Estimates	W_0 α_0	W_1 α_1	W_2 α_2	W_3 α_3
WAGONUNITS	2.039 **	-7.541 **	4.510 **	-0.703 **
t-comp	*5.844883*	*-3.86487*	*3.418121*	*-3.22968*
NETADDITIONS	-5.596	7.046	-1.405	-0.100
t-comp	*-0.70770*	*0.2473*	*-0.07754*	*-0.03420*
REPLACEMENTS	-1.299	-2.364	2.882	-0.620
t-comp	*-0.68600*	*-0.29310*	*0.545287*	*-0.71232*
EWAGONKM	0.081	-0.145	0.090	-0.006
t-comp	*1.139514*	*-0.48059*	*0.445660*	*-0.40801*
TAT	-0.021	-0.053	-0.004	0.007
t-comp	*-0.33685*	*-0.22783*	*-0.02632*	*0.265920*
NTKM/RKM	0.086	0.219	-0.156	0.018
t-comp	*0.695003*	*0.60285*	*-0.73949*	*0.546078*
RAILTKM	0.005	-0.005	0.003	-0.001
t-comp	*1.211675*	*-0.33285*	*0.28092*	*-0.41539*
RDTKM	0.028 **	-0.043	0.006	0.001
t-comp	*2.675336*	*-0.88801*	*0.202756*	*0.145904*
ALLTKM	0.004	-0.005	0.002	0.000
t-comp	*1.282447*	*-0.40970*	*0.209125*	*-0.20212*
RAILPKM	0.002	-0.014	0.009	-0.001
t-comp	*0.214909*	*-0.57334*	*0.4955*	*-0.43503*
ALLPKM	-0.006 *	0.014	-0.010	0.002
t-comp	*-2.18676*	*0.830785*	*-0.78419*	*0.831258*
GDP	-0.003	0.005	-0.003	0.001
t-comp	*-0.54826*	*0.23304*	*-0.22703*	*0.247386*
IND	0.028	-0.110	0.065	-0.010
t-comp	*0.946636*	*-0.82447*	*0.73177*	*-0.68463*
AG	0.008	0.006	-0.003	0.001
t-comp	*-1.08417*	*0.23861*	*-0.17977*	*0.223197*
TP	0.055	-0.072	-0.027	0.013
t-comp	*0.854594*	*-0.23767*	*-0.13502*	*0.380922*
PCI	-0.003	0.008	-0.005	0.001
t-comp	*-0.59951*	*0.52155*	*-0.52783*	*0.539083*

Table 5.13: IR Freight Capacity Model: Semilog Estimation
α-system for **Wagonfleet**

Regressand: Wagonfleet :	Table of Polynomial Coefficients & α-significances			
Semilog Estimates	W_0 α_0	W_1 α_1	W_2 α_2	W_3 α_3
RAILTKM	0.626	-1.131	0.430	-0.029
t-comp	*1.622709*	*-0.89563*	*0.53484*	*-0.21657*
TAT	0.433	1.176	-0.499	0.045
t-comp	*0.625162*	*0.46835*	*-0.30335*	*0.162062*
WAGONOUTPUT	-4.260	5.224	-0.922	-0.079
t-comp	*-2.07789*	*0.57323*	*-0.15347*	*-0.07990*
ALLTKM	0.992 *	-1.499	0.458	-0.020
t-comp	*2.114291*	*-0.90812*	*0.435381*	*-0.11688*
GDP	0.311	-0.168	0.075	-0.005
t-comp	*0.935283*	*-0.16012*	*0.11247*	*-0.04125*
IND	2.610	-7.161	4.474	-0.734
t-comp	*1.637769*	*-0.9784*	*0.92637*	*-0.92436*
€NETADDITIONS	7.385 **	-24.844 **	13.774 **	-2.017 **
t-comp	*22.04139*	*-13.2785*	*10.90329*	*-9.68313*
€REPLACEMENTS	-5.729 **	33.577 **	-20.938 **	3.212 **
t-comp	*-2.64421*	*2.77535*	*-2.5632*	*2.384414*

€Reversed regression on Wagonfleet

Note: *Theoretical* t-*values at* 9*df are* $t_{(0.05,\,9)}$ *= 2.262 at 95% confidence* (**) *and* $t_{(0.1,\,9)}$ *= 1.833 at 90% confidence* (**)

Table 5.14: IR Freight Capacity Model: Linear Estimation
β-system for Wagon Output

Regressand: Wagon Output : Table of Computed Lag Coefficients & β-significances

Linear Estimates	X_t $\hat{\beta}_0$	X_{t-1} $\hat{\beta}_1$	X_{t-2} $\hat{\beta}_2$	X_{t-3} $\hat{\beta}_3$	X_{t-4} $\hat{\beta}_4$
WAGONUNITS	1.300 **	-0.935 **	-0.417	0.522	-0.450
t-comp	*6.269392*	*-2.97298*	*-0.22474*	*0.035185*	*-0.05078*
NETADDITIONS	1.961 **	0.263	-0.062	0.280	0.587
t-comp	*3.351395*	*0.466044*	*-0.4005*	*0.53689*	*1.501794*
REPLACEMENTS	1.259 **	0.017	-0.088	0.112	-0.213
t-comp	*2.739332*	*0.034186*	*-0.5119*	*0.225334*	*-0.51548*
EWAGONKM	0.040	0.007	0.005	0.000	-0.047
t-comp	*1.293659*	*0.197764*	*0.40076*	*-0.00405*	*-1.37111*
TAT	0.012	-0.059	-0.077 **	-0.014	0.157 *
t-comp	*0.331675*	*-1.42568*	*-3.7678*	*-0.39375*	*2.046561*
NTKM/RKM	0.034	0.209 **	0.134* *	-0.070	-0.281**
t-comp	*0.418734*	*3.270844*	*4.9980*	*-1.29983*	*-4.02804*
RAILTKM	0.005 *	0.004	0.005 **	0.001	-0.014 **
t-comp	*1.842129*	*1.805612*	*4.40662*	*0.398261*	*-4.27770*
RDTKM	0.022 *	-0.007	-0.002	0.005	-0.018 *
t-comp	*2.111971*	*-0.51938*	*-0.3827*	*0.372707*	*-1.90729*
ALLTKM	0.003	0.002	0.003 **	0.001	-0.009 **
t-comp	*1.547519*	*1.194682*	*3.0405*	*0.345625*	*-4.09235*
RAILPKM	0.004	0.003	0.004	0.001	-0.012
t-comp	*0.512877*	*0.580384*	*0.9357*	*0.099832*	*-0.75431*
ALLPKM	0.005	-0.002	-0.003	0.000	0.000
t-comp	*0.949427*	*-0.27133*	*-0.581*	*-0.00724*	*-0.02392*
GDP	0.001	0.002	0.000	-0.002	-0.001
t-comp	*0.308478*	*0.477930*	*-0.095*	*-0.49255*	*-0.10376*
IND	0.037	-0.011	-0.001	0.009	-0.035
t-comp	*2.140138*	*-0.51467*	*-0.2245*	*0.436798*	*-2.14394*
AG	-0.002	0.000	0.000	0.000	0.005
t-comp	*-0.44802*	*0.050566*	*-0.1035*	*-0.00667*	*0.884500*
TP	0.059	-0.019	-0.078	-0.058	0.098
t-comp	*1.469847*	*-0.35323*	*-2.980*	*-1.12688*	*1.665708*
PCI	-0.001	0.001	0.000	-0.001	0.001
t-comp	*-0.38205*	*0.551678*	*0.1834*	*-0.40542*	*0.355827*

Table 5.15: IR Freight Capacity Model: Linear Estimation
β-system for Wagonfleet

Regressand: Wagonfleet : Table of Computed Lag Coefficients & β-significances

Linear Estimates	X_t $\hat{\beta}_0$	X_{t-1} $\hat{\beta}_1$	X_{t-2} $\hat{\beta}_2$	X_{t-3} $\hat{\beta}_3$	X_{t-4} $\hat{\beta}_4$
RAILTKM	0.013	0.018	0.025	0.013	-0.040
t-comp	*2.238909*	*3.168843*	*6.02107*	*2.368388*	*-4.95731*
TAT	0.120	-0.037	-0.071	0.028	0.267
t-comp	*1.421423*	*-0.38292*	*-0.87213*	*0.323832*	*1.497408*
WAGONOUTPUT	12.018	1.821	-5.632	-3.593	14.682
t-comp	*1.053096*	*0.14352*	*-0.9978*	*-0.29385*	*1.662893*
ALLTKM	0.009	0.013	0.019	0.010	-0.032
t-comp	*1.913467*	*2.65841*	*5.59243*	*2.100419*	*-6.06952*
GDP	0.018	0.009	0.000	-0.005	-0.004
t-comp	*1.059633*	*0.58425*	*0.02797*	*-0.31941*	*-0.19353*
IND	0.177	-0.035	0.018	0.066	-0.165
t-comp	*2.438426*	*-0.41297*	*0.45566*	*0.78549*	*-2.45069*
€NETADDITIONS	0.902	-0.701	-0.404	0.297	-0.094
t-comp	*24.08986*	*-12.3331*	*-22.801*	*5.41009*	*-2.85720*
€REPLACEMENTS	-0.568	1.124	0.355	-0.764	-0.125
t-comp	*-2.17572*	*2.83661*	*2.87284*	*-1.99982*	*-0.54812*

€Reversed regression on Wagonfleet

Note: *Theoretical* t-values *at* 9*df are* $t_{(0.05,\,9)}$ = *2.262 at 95% confidence* (**) *and* $t_{(0.1,\,9)}$ = *1.833 at 90% confidence* (**)

Table 5.16: IR Freight Capacity Model: Semilog Estimation
β-system for **Wagon Output**

Regressand: Wagon Output : Table of Computed Lag Coefficients & β-significances

Semilog Estimates	X_t $\hat{\beta}_0$	X_{t-1} $\hat{\beta}_1$	X_{t-2} $\hat{\beta}_2$	X_{t-3} $\hat{\beta}_3$	X_{t-4} $\hat{\beta}_4$
WAGONUNITS	2.039 **	-1.695**	-0.631 **	1.012	-0.988
t-comp	*5.844883*	*-3.20068*	*-3.27421*	*0.656791*	*-1.07353*
NETADDITIONS	-5.596	-0.056	2.072 **	0.184	-6.320 **
t-comp	*-0.70770*	*-0.00730*	*6.81648*	*0.18116*	*-8.28171*
REPLACEMENTS	-1.299	-1.400	0.545 **	0.819	-4.297 **
t-comp	*-0.6860*	*-0.66547*	*2.24615*	*1.1578*	*-7.3224*
EWAGONKM	0.081	0.009	0.017	0.003	-0.047
t-comp	*1.13951*	*0.11779*	*0.90852*	*0.0559*	*-1.00632*
TAT	-0.021	-0.071	-0.087 **	-0.028	0.150
t-comp	*-0.33685*	*-0.99337*	*-3.5607*	*-0.62595*	*1.62455*
NTKM/RKM	0.086	0.167	0.043	-0.177	-0.385 **
t-comp	*-0.695003*	*1.70409*	*0.89598*	*-1.83046*	*-3.09172*
RAILTKM	0.005	0.002	0.001	-0.003	-0.013
t-comp	*1.211675*	*0.594025*	*0.45668*	*-0.7967*	*-2.3206*
ALLTKM	0.004	0.001	-0.001	-0.003	-0.006
t-comp	*1.28245*	*0.1949*	*-0.6829*	*-0.8254*	*-1.52823*
RAILPKM	0.002	-0.005	-0.002	0.001	-0.003
t-comp	*0.21491*	*-0.75218*	*-0.57064*	*0.19486*	*-0.23910*
ALLPKM	-0.006 *	0.000	-0.002	-0.003	0.009
t-comp	*-2.18676*	*0.07911*	*-0.5732*	*-0.3141*	*1.244045*
GDP	-0.003	-0.001	-0.001	-0.001	0.002
t-comp	*-0.5483*	*-0.0373*	*-0.5444*	*-0.271*	*0.46534*
IND	0.028	-0.028	-0.013	0.010	-0.017
t-comp	*0.94664*	*-0.7906*	*-1.3008*	*0.3191*	*-0.6679*
AG	-0.008	-0.005	-0.003	-0.001	0.006
t-comp	*-1.0842*	*-0.70145*	*-1.2634*	*-0.1448*	*1.1868*
TP	0.055	-0.031	-0.096 **	-0.065	0.139 *
t-comp	*0.8546*	*-0.4933*	*-3.1258*	*-1.05435*	*2.0042*
PCI	-0.003	0.001	-0.001	-0.002	0.002
t-comp	*-0.59351*	*0.20266*	*-0.6193*	*-0.85006*	*0.7993*

Table 5.17: IR Freight Capacity Model: Semilog Estimation
β-system for **Wagonfleet**

Regressand: Wagonfleet : Table of Computed Lag Coefficients & β-significances

Semilog Estimates	X_t $\hat{\beta}_0$	X_{t-1} $\hat{\beta}_1$	X_{t-2} $\hat{\beta}_2$	X_{t-3} $\hat{\beta}_3$	X_{t-4} $\hat{\beta}_4$
RAILTKM	0.626	-0.104	-0.146	0.327	1.142 **
t-comp	*1.62271*	*-0.30023*	*-0.56822*	*0.958771*	*2.65830*
TAT	0.433	1.155	1.149 *	0.685	0.034
t-comp	*0.625162*	*1.50104*	*1.85793*	*0.999715*	*0.026286*
WAGONOUTPUT	-4.260 *	-0.038	1.868	0.982	-3.169 *
t-comp	*-2.07789*	*-0.01551*	*1.60612*	*0.416249*	*-1.88624*
ALLTKM	0.992 *	-0.069	-0.334	0.074	1.035 **
t-comp	*2.11291*	*-0.15543*	*-1.03196*	*0.164734*	*2.396469*
GDP	0.311	0.214	0.241	0.363	0.554
t-comp	*0.935293*	*0.714508*	*1.13532*	*1.206475*	*1.651336*
IND	2.610	-0.812	0.311	1.573	-1.429
t-comp	*1.637769*	*-0.42618*	*0.36986*	*0.857685*	*-1.07510*
€NETADDITIONS	7.385 **	-5.702 **	-3.343 **	2.359 **	-0.696 **
t-comp	*22.04139*	*-11.2172*	*-21.3201*	*4.835229*	*-2.43558*
€REPLACEMENTS	-5.729 **	10.122 **	3.366 **	-6.727 *	-0.886
t-comp	*-2.64421*	*3.07929*	*3.31919*	*-2.13190*	*-0.47898*

€Reversed regression on Wagonfleet

Note: *Theoretical* t-values at 9*df are* $t_{(0.05,\, 9)}$ *= 2.262 at 95% confidence (**) and* $t_{(0.1,\, 9)}$ *= 1.833 at 90% confidence (**)*

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