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# Railway Reform:
Toolkit for Improving Rail Sector Performance

# Chapter 3:
## Railway Economics and Pricing

# 3 Railway Economics and Pricing

## 3.1 Economic Features of Railways

Railway transport is a subsector of the wider transport industry so it shares many key economic features with other transport modes. This chapter identifies common features, and notes characteristics that are unique to railways.

All modes of transport provide services using vehicles, vessels, or aircraft that rely on a substantial infrastructure network comprising routes, terminals, and controls for the movement of those vehicles. However, railways are unique in that the same entity often provides *both* railway services *and* network infrastructure. Most countries prefer this approach, while others prefer to separate service provision from network infrastructure. Reasons for these choices are explored in Chapter 5 of this toolkit.

For all modes of transport, neither infrastructure nor service capacity can be stored—the *unused* train path, aircraft take-off slot, or shipping berth is lost. Similarly, when trains, ships, aircraft, or trucks travel with only partial loads, the unused capacity is lost. Therefore, higher vehicle productivity is crucial to better commercial performance for transport service providers, just as higher infrastructure utilization is crucial to better commercial performance for the infrastructure provider.[19] For vertically integrated railways, the drive for higher vehicle productivity coexists in a single entity with the drive for higher infrastructure productivity.

In all modes of transport, differences arise in how much competition exists in the market for the transport infrastructure (e.g., the road) and the market for the transport service (e.g., the trucking company). Transport infrastructure investment tends to be location-specific and physically fixed or difficult to move. It is also 'lumpy" (provided in indivisible increments for a range of possible output) so it exhibits economies of density—declining marginal cost—as the intensity of use increases. These various characteristics endow most transport infrastructure, including rail networks, with elements of a natural monopoly. The opposite is true in transport services, where head-to-head competition is the norm within all modes of transport that compete with rail services for freight and passenger business—roads, airlines, barging, and international shipping. Historically, most countries have chosen policies that restrict competition between rail companies. Now, more countries (identified in Chapter 5) are choosing policies that permit competition in the rail freight sector, and more rarely, in the inter-city passenger services sector.

Competition, together with capacity that cannot be stored, points to the importance of service design, marketing strategies, and pricing policies to maintain and increase capacity utilization. Crucially, railway transport should be viewed as a service industry of differentiated products tailored to specific markets, rather than a 'utility.' Railway transport has often been considered to be a 'utility' like water, gas, or electricity supply, which has led to undesirable policy and management outcomes.

[19] For ocean shipping, the route 'network' is free and has vast capacity, but infrastructure utilization is still critical to performance for port providers.

Finally, all modes of transport have external effects on the environment. The costs of impacts such as noise, air, land and water pollution, accidents, and greenhouse gas emissions are rarely paid by the entities creating them. These impacts differ by mode, country, and circumstances and affect overall transport systems sustainability and transport policies. Well-loaded freight trains have proven to incur significantly lower external costs than road or air freight transport; and well-loaded passenger trains incur lower external costs than road transport (cars or buses) or airlines.

Railways' general and specific economic characteristics have many policy and management consequences that are explored in later sections of this toolkit. This section discusses how these characteristics drive the structure of railway costs and the principles of rail pricing; both are crucial to the financial sustainability of railways, discussed in Chapter 4.

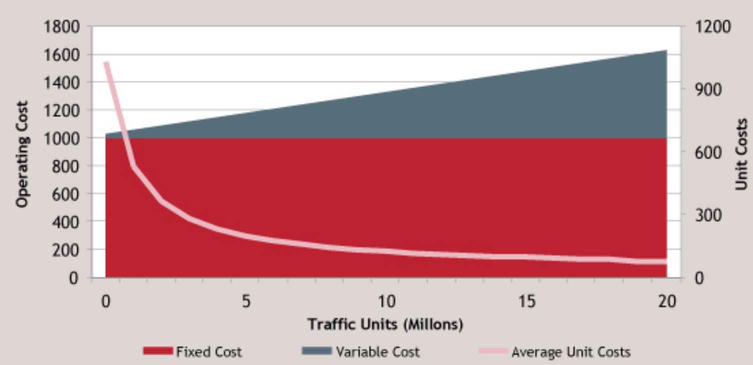
## 3.2 Railway Cost Structures

Generally, costs are classified into rail network infrastructure, train operations, and corporate overheads.

### *3.2.1 Infrastructure network costs*

Most costs for the railway infrastructure network include capital and maintenance costs for track, engineering structures such as bridges and tunnels, train signaling, communications systems, power supply in electrified sections, and terminal infrastructure.

Figure 3.1 Rail Infrastructure Costs




*The higher the utilization, the better the infrastructure economics.*

These infrastructure costs have a component that is essentially fixed or invariant with the level of infrastructure usage[20] and a component that is variable with traffic levels over the long-term (Figure 3.1). The proportion of the 'fixed' cost component will differ by lines and traffic levels but rarely is estimated at less than 70 percent of total infrastructure costs, except on the busiest lines. The variable component,

[20] This component can vary significantly relative to other factors such as engineering standards, terrain, age, climate, and management efficiency.

should vary over the long term by traffic level, but is often 'sticky' (at least downward) in the short and medium term, which are typically used to formulate business plans.

Numerous economic studies have demonstrated that railways exhibit *economies of density*—their long-run average cost curve slopes downward. Unit costs decline as output rises on the railway line as the fixed cost of providing track is spread over more and more traffic units.[21]

These economies of density are substantial on their own. But when combined with the impossibility of storing unused train paths, they create a convincing case that railway infrastructure networks' financial sustainability depends critically on high traffic volumes. Good railway network economics requires high infrastructure utilization—the higher the utilization, the better the infrastructure economics[22].

This is true whether the infrastructure network is part of a vertically integrated railway, or provided by a separate rail infrastructure authority or company. Vertical separation of train operations from railway infrastructure is insufficient to improve railway financial sustainability, although it may facilitate other policies that help (see Chapter 5). However, a vertically separated track authority or company will face much higher fixed costs across its total business than a vertically integrated railway company. This has implications for track access pricing that is explored later in this chapter.

The infrastructure cost curve is largely fixed in relation to traffic volume, but can be shifted downwards by management actions that improve efficiency in infrastructure provision and maintenance.

A company exhibits *economies of scale* if its long run average cost curve slopes downwards as the size of the company increases. Economic studies suggest that economies of scale may exist when railways are very small; realizing further economies of scale is harder when the railways become larger perhaps because of greater management complexity and loss of corporate agility.[23]

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[21] Caves, Christiansen, and Tretheway, "Flexible Cost Functions for Multiproduct Firm," in *Review of Economics and Statistics*, (August 1980), 477-481. Griliches, "Cost Allocation in Railroad Regulation," *Bell Journal of Economics and Management Science*, (1972, vol. 3) 26-41. Charney, Sidhu and Due, "Short Run Cost Functions for Class II Railroads," *Logistics and Transportation Review*, (1977, vol. 17), 345-359. Friedlaender and Spady, *Freight Transport Regulation: Equity, Efficiency and Competition in the Rail and Trucking Industries,* (MIT Press, 1981). Harris, "Economics of Traffic Density in the Rail Freight Industry," *Bell Journal of Economics*, (1977, vol 8) 556-564.

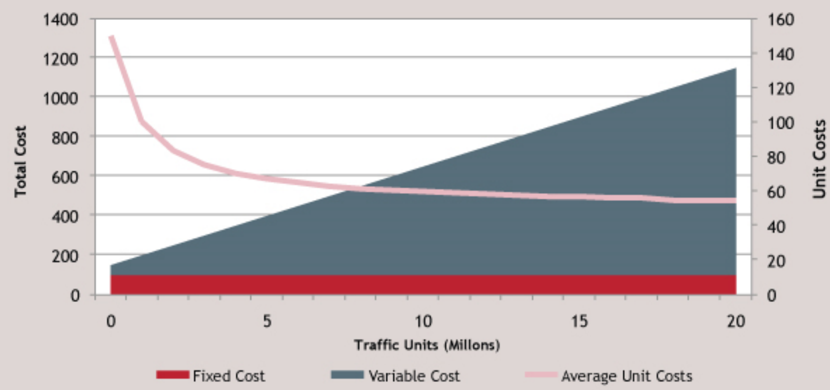
[22] Except at the point when capacity is reached and incremental traffic requires a major capacity enhancement; but once the capacity increment is made, the general rule usually again applies.

[23] Caves, Christiansen and Tretheway, "Flexible Cost Functions for Multiproduct Firm," *Review of Economics and Statistics*, (August 1980), 477-481. Griliches, "Cost Allocation in Railroad Regulation," *Bell Journal of Economics and Management Science*, (1972, vol. 3) 26-41. Charney, Sidhu and Due, "Short Run Cost Functions for Class II Railroads," *Logistics and Transportation Review*, (1977, vol. 17), 345-359. Friedlaender and Spady, *Freight Transport Regulation: Equity, Efficiency and Competition in the Rail and Trucking Industries,* (MIT Press, 1981).

### *3.2.2 Train operating costs*

Train operating costs include: (i) diesel fuel or electrical energy; (ii) locomotive capital depreciation or leasing cost; (iii) locomotive maintenance; (iv) driving crew; (v) on-board crew for passenger trains; (vi) rolling stock wagons or railcars depreciation or leasing cost; (vii) rolling stock maintenance; and (viii) terminal operations; and (ix) commercial costs (passenger ticketing, freight booking, etc.).

Figure 3.2 Train Operating Costs




Most train operating costs vary substantially in the long run with traffic volume (Figure 3.2), although some joint costs may exist (discussed below). In general, greater traffic volume requires more trains and more operational resources. In the shorter term, this relationship is not proportional, except perhaps for fuel/electrical energy. In the medium term, say 6-12 months in a well-run railway, managers can adjust operating resources such as crew costs, locomotive and rolling stock requirements, or maintenance to match demand volumes.

Train operating costs are variable with traffic levels, but the overall operating cost/output curve can be shifted downward by management action. In particular, three variables affect how train operating strategy translates into train operating economies: higher net-to-tare ratio for freight services[24] or higher passengers-per-car; more time in commercial service per unit of equipment; and larger passenger and freight train sizes—providing the market's required minimum service frequency is met.

### *3.2.3 Corporate overhead costs*

These include most railway headquarters functions such as Board and executive management, finance, legal, security, and personnel functions. More complex and bureaucratic railway structures that are less commercially streamlined require higher levels of costly 'corporate glue' to remain cohesive.

Over the long-term, with good management, corporate overheads can vary with the broad scale of the railway. In public sector railways, adjustments to overhead

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[24] Tare is the weight of the empty wagon. Net is the weight of the load.

costs tend to occur in sporadic upheavals caused by organizational restructuring, rather than through gradual changes that adapt to the traffic task.

However, management action can reduce corporate overheads dramatically by decentralizing decision making to business units, controlling finances and budgets, seeking opportunities for competitive outsourcing of corporate services, and generally running a leaner corporate entity.

### *3.2.4 Summary: costs and comparative advantage*

Railways cost structures are at their most highly competitive when railways can operate large trains, well-loaded with traffic, over a heavily used network, by organizations with a lean and market-oriented corporate management. Train size and payload provide train operating economies; train density plus heavy network use provide infrastructure economies; and corporate structure yields administrative overhead economies. Although this seems obvious, many countries maintain railway policies and business models that openly defy this reality.

## 3.3 Costing Railway Services and Traffics

A railway service is most competitive when it delivers a better price and service mix to its customers than its competitors. Costs incurred in producing these services will dictate the lowest possible prices that will sustain the overall financial sustainability of the railway entity. Therefore, cost levels are critical, and a well-run railway will devote considerable attention to measuring and controlling costs.

Railway financial accounts will reveal total costs, which are essential to analyze overall financial viability. Benchmarking total costs against other similar railways will highlight areas for seeking cost efficiencies. However, most national railways provide a range of freight and passenger services. For freight customers, services might be tailored, for example, to bulk freight customers, container forwarders, and general freight. Passenger services might include inter-city, regional and suburban services. Each broad freight or passenger group will contain multiple market segments.

In a well-run railway, commercial managers need to know costs and financial performance for each market segment, disaggregated by route and other factors, sometimes even a specific train or freight customer. In a multi-product railway, these costs cannot be derived directly from general corporate accounts. They require application of costing techniques (see Annex 3 on costing). But understanding rail business management and pricing requires a general understanding of the main costing concepts. Two of the concepts are *common costs* and *joint costs,* which can be either fixed or variable with regard to traffic levels.

### *3.3.1 Common costs*

In the railway industry, most common costs are associated with infrastructure and corporate overhead functions that support all users and services. Lines for mixed-use railways are usually built, maintained, and controlled to standards that can serve all types of passenger and freight trains[25]. Some design elements and some management characteristics are more specific to either passenger services or freight services, but most infrastructure network costs are common among all users on a mixed-use, multi-product railway.

If costs were variable with usage, they could be attributed to specific services that are provided with facility capacity, or to specific traffic. However, most rail infrastructure network costs are common and fixed, so a 'relative usage' formulation is technically arbitrary, not based on cost causality.

Also, many operations costs are 'technically common' such as train crews or locomotives, but over the medium term, these costs vary—more traffic equals more trains, more locomotives, more crews. Therefore, these costs can be attributed to specific services and traffic segments.

### *3.3.2 Joint costs*

In the railways industry, joint costs are largely associated with train operations and occur when producing one good or service produces another good or service. For example, if the wagon can attract a regular load in both directions then the wagon movement cost is *joint* between the two traffics. Similarly, if a locomotive and crew is scheduled to haul a container train in one direction and return with an intercity passenger train, these costs are joint between freight and passenger services.

Joint costs cannot be attributed unambiguously to *each* beneficiary service or traffic because reverse movement is still required and costs are incurred even if one service or traffic is no longer operated. Fortunately, joint costs are becoming rare. Now, passenger services are more segmented into service types and fixed-formation trains operate services in both directions. Similarly, a much higher proportion of freight services now operate two-way trainloads of specialized wagons for coal, containers, and oil, among other cargoes. Therefore, joint costs can usually be ignored, except in unusual circumstances.[26]

Next, the three main uses of traffic costing are discussed below: *financial contribution analysis; commercial management;* and *railway pricing policy*. Each is important to the financial sustainability of railways.

## 3.4 Financial Contribution Analysis

This technique of railway management accounting measures service- or traffic-level financial performance. Total revenue is compared with costs for each service or traffic to establish whether the revenue from the service covers the cost.

Three main cost thresholds that are commonly measured and compared with revenue are below. These thresholds are defined in Box 3.1, which indicates their significance and primary uses.

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[25] Most new high-speed passenger lines and some heavy-haul freight lines are for dedicated use.

[26] For example, unless costing is undertaken at a micro level such as a specific train, or freight customer movement.

- Short-run variable (avoidable or incremental)[27] costs
- Long-run variable (avoidable or incremental) costs
- Fully allocated costs (FAC) (sometimes referred to as 'fully distributed')

The most important of these thresholds for guiding railway commercial service- or traffic-level decisions is long-run variable cost because it includes any and all costs relevant to the decision. Long-run variable costs are the costs that *should* vary depending on the decision to be made, which may be related to time period to which that decision relates (such as the duration of a particular traffic contract).

The word *should* is significant because some variable costs are rendered invariant through institutional rigidities. For example, restrictive labor agreements may prevent management from matching human resources to demand, or management deficiencies may sustain the mismatch of resources to changing activity levels. Should-be long-term variable cost should always be included in long-run variable cost estimates to avoid the risk that any management rigidities will become self-reinforcing and distort commercial decision making.

In some state railways, the short-run variable cost threshold is the standard used in commercial decision making. This leads to a proliferation of services/traffics that make a positive contribution above short-run costs but consistently fail to recover their long-run costs. Box 3.1 spells out this warning.

The FAC threshold is a benchmark rather than an actual 'cost', as it includes an allocation without basis in cost causality. However, if all individual railway services and traffics cover *only* long-run variable costs, a revenue shortfall will still occur in total railway costs. Reviewed across all traffics, FAC indicates the overall revenue necessary for the railway service mix to recover total costs. The FAC threshold is useful in certain situations, such as to negotiate government compensation for meeting public service obligations (Chapter 8). This begs the question as to how pricing policy should actually 'allocate' these costs, a question addressed in 3.6 below.

[27] Avoidable cost is relevant to an existing service or traffic and incremental to a new service or traffic being contemplated, but the basic cost concept is otherwise the same.

## Box 3.1 Railway Costing Thresholds and Their Main Uses

| Costing concept | Cost description | Uses |
|---|---|---|
| Long-run variable (avoidable or incremental) cost | Costs that could be avoided in the long-term if a specified existing service or traffic were discontinued *or* incremental costs that would be incurred if a new specified service or traffic were added to existing operations.<br>Includes the costs of all the capital, material, and human resources that could be saved *or* resource increments that would be incurred, allowing for a reasonable period for resource adjustment. | Long-run variable cost is for an individual service or traffic the key financial performance threshold, which, when compared to revenue, indicates whether and how much the service or traffic is making as a positive long-term financial contribution to the railway.<br>Individual components of long run variable cost indicate to commercial management where operating efficiencies can be sought that will reduce cost of that service or traffic, thereby improving its long-term financial contribution.<br>When the most efficient long run variable cost is attained, it is the normal floor price to be applied to a traffic or service. |
| Short-run variable (avoidable or incremental) costs | Costs that could be avoided in the short-term if a specified existing service or traffic were discontinued *or* incremental costs that would be incurred if a new specified service or traffic were added to existing operations.<br>Short-run variable costs include only costs that vary in the short-term with traffic level, typically fuel/energy and materials costs. | In limited and specific circumstances, may be used as the floor price for a service or traffic that is available to the railway only for a short period; typically one that would have little or no impact on railway capital or labor resources.<br>*Warning:* Short run variable cost should not be used for normal business planning or pricing decisions; this leads to the accretion of traffics at prices that erode long-term profitability, and sustain institutionalized management myopia. |
| Fully allocated (or fully distributed) costs<br><br>(FAC) | Long-run avoidable or incremental costs of a specified existing service or traffic, *plus* an allocated share of those joint and common costs so the sum of the costs allocated to each service add up to total railway costs. | Useful in compensatory pricing situations, such as PSO negotiations, to indicate the average markup required to add to long-run variable costs to ensure the service or traffic contributes to railway joint and common costs. |

## 3.5 Commercial Management Actions

Contribution analysis can improve railway financial sustainability. The long-run variable cost schedule generated by costing and financial contribution analysis can help railway managers identify areas of potential improvement in financial performance. Typically, the analysis contains three types of information:

- amount of each resource attributable over the long run to operating the service or traffic (a)
- unit costs of each resource (b)
- total cost of each resource used (a*b)

Knowing the cost structure of a service or traffic enables railway managers to identify potential cost efficiencies for improving financial performance. The analysis highlights where cost efficiency gains can be achieved by reducing the resources used (a) or reducing unit costs of those resources (b), or some combination of the two. Chapter 11 of the toolkit identifies many of the ways in which railways can seek to improve financial performance through these means.

Assuming revenue remains unchanged, management action to reduce the cost will increase the positive financial contribution of profitable services and may turn unprofitable services to profitable. Pricing policies can also influence the contribution from the revenue side.

## 3.6 Railway Pricing

According to pure economic theory, to maximize overall economic welfare for the whole community, the most economically efficient pricing approach would be for prices to equal the marginal social costs of railway services. As a practical matter, no railway in the world does this for the following reasons.

- In economic theory, the concept of 'margin' is a very small unit of output, such as a single passenger seat-km, or wagon-km of freight. In practice, the increments of output in which prices can realistically be set are much greater, i.e. for a class of service, a class of trains, a regular commodity movement, or a particular freight shipper;
- Railway costs that are variable, particularly in the short term, are less than total costs, so that pure marginal cost pricing will lead to financial losses. Even long-run marginal cost pricing is insufficient to recover all railway running costs when all fixed common and joint costs are included.
- In virtually all countries, railways' main transport competitors *do not* include external costs in their prices. This negates the assumption underlying the economic theory—to charge social costs *only* in the rail sector would create perverse outcomes.

Therefore, the pure economic theory has little practical application in railway management. In practice, there is no prescribed or standard form of market-based pricing for railways. Good railway managements adapt pricing practices to their markets, customers, institutional arrangements, pricing regulations, and the social and economic norms in which they operate.

Nevertheless, the economic concepts are important in guiding workable principles that can contribute to railway financial sustainability in freight and passenger markets.

### *3.6.1 Freight pricing*

Competition should be the primary determinant of rail freight pricing strategies, not costs. As indicated in Section 3.2, most railway infrastructure costs are fixed in relation to an individual traffic movement during the currency of rail freight contracts, so any infrastructure cost allocation to individual customers is largely technically arbitrary. More than a century ago, railway economist William Acworth observed:

> *'Volumes have been written to show that railway rates ought to be based on the costs of carriage…such a basis is impossible, as no one knows, or can know, what the cost of carriage is. Cost of carriage of a particular item may mean the additional cost of carrying that item; this is normally so small as to be negligible. It may mean the additional cost plus a fair share of the standing costs of the organization… an arbitrarily estimated proportion of a sum that can only be ascertained very roughly.'*[28]

Basic principles of commercially efficient rail freight tariff setting are well established and have been used by competent railway managers since the nineteenth century. The rate set should be the highest that the market will bear, taking account of prices charged by actual or potential competitors, except under special circumstances, such as the need to nurture a new service. This rate should at least cover a price-floor of the long-run variable costs of carrying specific traffic for the duration anticipated.[29]

The economic formulation of this practical and already established approach to railway pricing was provided in 1927 by mathematician Frank Ramsey. [30] To paraphrase, *the railway should mark up its long run variable costs to individual customers in inverse proportion to their price elasticity of demand.*[31] So customers with a low elasticity of demand (such as coal producers) will be charged a higher markup than the customers with high elasticity of demand (such as container shippers).

Railway marketing managers cannot know the precise elasticity of demand for each customer, but railway marketing staff should have sufficient information on customers and competition to *estimate* the effect of prices on customer volumes.

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[28] W. Acworth, *The Elements of Railway Economics*, (Oxford University Press, 1905).

[29] Avoidable cost for an existing traffic, incremental cost for a new traffic.

[30] F. P. Ramsey F.P., "A Contribution to the Theory of Taxation," *Economic Journal*, (Vol. 37, No 145, 1927) 47–61.

[31] Elasticity of demand is measured as the percent change in the quantity of demand divided by the percent change in the price. A customer that is sensitive to the price and will reduce the quantity demanded by more than the change in price has an elasticity of demand greater than 1. A customer that will reduce the quantity demanded by less than the change in price has an elasticity of demand less than 1.

The general principle of commercial pricing is to establish a price that will maximize the service's contribution to railway fixed costs; the corollary is that the railway should not price below long-run variable costs.

By contrast, 'average cost pricing'[32] in rail freight distributes fixed common and joint costs over all traffic. However, average cost pricing can depress demand in some traffic segments, thereby reducing overall traffic and creating higher fixed cost burdens for remaining traffic. In (exceptional) cases, where the railway does have significant market power, the 'market' may be a regulatory body. The railway freight provider's general market-based pricing philosophy should still prevail. Typically, the railway will attempt to allocate as many costs as possible, but ultimately, the regulatory body decides on which costs the user industries will bear.

### 3.6.2 Passenger service pricing

The so-called 'Ramsey pricing' matched to individual customers or commodity groups has practical application in most freight markets, which comprise an identifiable and limited number of customers. However, in passenger markets, railway market pricing aggregates customers by pricing options based on individual features such as service class, travel times, or ticket purchase restrictions, and passengers select for the cheapest prices that fit their traveling needs. Railways can set price offerings by considering load factors for each train and station pair—sometimes using airline-style yield management software—and conducting extensive market research to respond to customer demand levels with desirable ticketing packages that maximize revenues from seat sales. Thus, most passenger pricing is highly centralized by the service provider and service offerings are analyzed intensely to determine overall revenue and ridership impacts.

However, underlying this very pragmatic system of continuous adjustment, the economic concepts that support financial sustainability in passenger services remain the same: pricing above long run variable costs should be inversely related to demand elasticity, and price-service packages should be tailored to meet customer needs more effectively than competing alternatives. Therefore, railway passenger marketing managers must fully understand the competitive environment and the demand elasticity of passenger sub-markets within market segments. Tariff structures should be designed to maximize overall revenue yield from the seat capacity on offer.

Typically, railway passenger services can be divided into major segments for service planning and management—inter-city, regional (sometimes segmented by sub-region) and suburban services (sometimes segmented by city). Each segment may have a different tariff structure, and within each segment, individual trains may carry passengers travelling at first class premium fares and those travelling in more basic accommodation or with less flexible ticket types at discount or concession fares. To be financially sustainable, the schedule of services for major service segment should aim to recover their long-run variable costs, and collectively, all the segments must recover overall fixed costs allocated to the passenger sector.

[32] Also known as fully distributed or fully allocated cost pricing.

If this were always feasible, it would be convenient. However, railway passenger financial modelling indicates that it is rare for passenger train services to operate without long-term budgetary support, even at efficient input-cost levels and with optimal pricing circumstances.[33] Inter-city railway passenger services often fail to recover their long-run variable costs (a negative financial contribution) and rarely cover their FAC from the fare-box alone, except on the densest inter-city rail corridors. The cost-recovery challenge is even greater for heavily 'peaked' suburban services or less heavily utilized regional services. In many countries, it is impossible for a single passenger railway route to make a positive contribution above long-run variable costs and many barely cover short-run costs.

As a result, for most passenger and mixed-use railways in the world, financial sustainability depends on receiving some budgetary support. Chapter 8 of this toolkit discusses effective implementation of government support that is justified or politically necessary for social or other reasons.

### 3.6.3 Infrastructure network access pricing

If the railway network owner is separate from the train operator, the railway-pricing paradigm alters somewhat. The paradigm alters even more if competition exists among freight train operators because train operating companies have less opportunity to distribute access charges among customers according to their ability to pay. Competition eliminates the operating company's ability to mark up the track access charge if customers have a choice of train operating companies, or the ability to run their own trains. Therefore, the economic challenge of recovering railway fixed costs rests entirely on the infrastructure company, for whom most costs are fixed.[34]

Infrastructure charges differ by country, but the system is most well developed in the EU where charges are a legal requirement. Multiple approaches share common components: (i) capacity-utilization based on train path use; (ii) gross-tonnage over the track to reflect infrastructure wear and tear; and (iii) ancillary charges for infrastructure company services such as power supply, stabling, or rescue. Charges usually differ by train type and route standards, generally reflecting cost and market considerations that are difficult to disaggregate.

In Germany, for example, passenger and freight train track access is subject to a common basic tariff framework; pricing 'factors' result in different tariff rates. DB Netz terms and conditions for network access are published in the German Federal

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[33] Amos and Bullock, *The financial performance of non-urban passenger rail services*, (World Bank, 2007). http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/03/24/000333038_20080324074100/Rendered/PDF/430250NWP0Pass10Box327344B01PUBLIC1.pdf

[34] So-called 'network access price' is a misnomer if the network and train operations are separated but under common public ownership without real competition in train operations. The 'price' is often simply a politically determined budgetary allocation of the infrastructure company's costs between freight and passenger sectors; the level and pattern of services provided bears no relation to the 'price' of access; and if the sectors cannot afford to pay their allocation, it is paid by the government to the companies, or picked up as an infrastructure company deficit by the government.

gazette and on the Internet, and include a detailed list of tariffs for train paths and for the other facilities and installations.[35]

German track access charging policy aims to recover a high proportion of railway infrastructure costs from train operating companies. The train-path tariff system has a three-part modular design:

a. *Basic price for route category and utilization level:* 12 route categories are grouped by infrastructure performance standard and transport importance. Basic prices are increased by a 20 percent premium on routes with very high utilization.
b. *Train path products (product factor):* the 'basic' price may be multiplied by other factors that depend on whether the company is operating freight or passenger train service or seeking to purchase other service features or levels (that differ for passenger and freight services).
c. *Special factors:* a series of multiplicative, additive, or regional factors such as those for steam trains, extra heavy freight trains, or tilting passenger train technology.

The tariff system imposed by DB Netz and approved by regulatory authorities is designed to reflect the costs of providing and maintaining infrastructure, train path standards for performance levels, degree of utilization, and market differences between passenger and freight trains' ability to pay. Using the tariff tables above, tariff calculations are straightforward for any train operating company track access for a specific train type or service on a particular route.

The Australian Rail Track Corporation (ARTC) publishes a list of reference tariffs for track access on each of its routes. The reference tariffs are based on a fixed component (referred to as a 'flagfall') per train for each route, plus a variable element that depends on the gross ton-km of the train. Since the fixed element reflects route length, it is distance-related rather than a true 'flagfall'. As in Germany, this distance-based component is affected by train speed. The fixed component is for a reserved train path and is payable by the customer regardless of whether they use the train path.

The reference tariffs relate to a specified service performance standard. Individual customers can negotiate for specific needs or service characteristics that vary from the reference assumptions on axle loads, speed, train length, origin/destination, stops, and operating timetables. However, ARTC has committed to the Australian Competition and Consumer Commission that it will not charge different prices to different clients for similar service characteristics; or if applicants operate within the same end-market. ARTC agrees not to discriminate pricing between privately owned or government owned train operators. All negotiated tariffs are published.

While there are many models to choose from, this toolkit generally supports the simplest system that is compatible with a country's aims and circumstances. Some fundamental questions are: how much to collect from railway users and how much from budgetary support; how much of the fixed infrastructure cost burden should

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[35] http://www.db.de/site/bahn/en/business/infrastructure__energy/track__infrastructure/prices/prices.html

be borne by the freight sector as opposed to the passenger sector without creating an effective tax on one sector to support the other; whether the parts of the network being priced are operating at or near capacity; how far to impose 'take-or-pay' on train paths that are reserved but not used; and how to design charges for international train movements so that each country involved obtains a fair share of the overall access charge and avoid creating incentives for each country to maximize its position and so collectively to discourage international traffic.[36]

In theory, the economic benefits of Ramsey pricing apply to a separated rail infrastructure company as much as to a vertically integrated railway. But, the practicality of Ramsey pricing is greatly reduced with a separate infrastructure company. Infrastructure companies deal with train operating companies *not* freight customers, and are remote from the detailed market information that would allow managers to price to market.

Moreover, Ramsey pricing may also now be less acceptable. Most separated railway infrastructure companies do not apply Ramsey pricing in any substantive form. In other words, a freight train hauling same number of gross tons of coal or general freight on a given train path often pays *exactly the same,* even though demand elasticity with regard to track access prices is likely to be much lower for coal than for container trains.

Indeed, since marginal cost to the infrastructure company is so similar, it is unclear whether regulatory authorities would permit differentiated charges.[37] Furthermore, using Ramsey pricing, the price-to-cost ratio in less elastic markets would be much greater for infrastructure than in an integrated company because track-access charges are a fraction of total freight charges. Where economists may see justifiable price differentiation, regulators may see price discrimination.

Therefore, the venerable principle of Ramsey pricing may be weakened by placing its full burden on rail infrastructure charges rather than the total freight rate. If so, and other things being equal, vertical separation may have made it more difficult to maximize infrastructure utilization and to recover infrastructure fixed costs. Countries that pursued vertical separation are hoping that separation allied to greater competition in rail service will generate greater use and revenue for the railway network. Will potential economic benefits from competition in services outweigh the dilution of economic benefits from Ramsey price differentiation and the transaction costs of separation? This remains to be seen.

[36] These issues are explored more fully in Louis S Thompson, *Railway Access Charges in the EU: Current Status and Development since 2004.* http://www.international-transportforum.org/Pub/pdf/08RailCharges.pdf

[37] In the UK, track access charges for freight reflect cost differentials by axle-load, wagon type etc but the variations are not that large, except for coal, and in any case are cost-based not market-based variations.