Report
April 2022

PR23 Charges Review Market Can Bear Analysis – Passenger services

Office of Rail and Road
Our ref: 24131401
Client ref: ORR/CT/21-32

steer

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C **Cost analysis spreadsheet (ORR PR23 MCB Passenger Services Cost Analysis v1.00) [Confidential].**

Executive Summary

Overview

The Office of Rail and Road (ORR) is currently undertaking the 2023 Periodic Review (PR23). This will ultimately determine what Network Rail must deliver during Control Period 7 (CP7, which will cover the period from April 2024 to March 2029), as well as determining the track access charges paid for use of the rail network over this control period.

Prior to PR18, open access operators only paid variable charges and station charges. In PR18, ORR introduced an Infrastructure Cost Charge (ICC) for open access operators for the first time, to contribute towards Network Rail's recovery of fixed costs.

The scope and level of this ICC was underpinned by the application of a "market-can-bear" test for passenger services. Based on the market-can-bear analysis undertaken, ORR levied an ICC on new interurban services in CP6 of £4 per train mile (in 2017/18 prices). ORR defined an interurban service as one for which:

(a) At least one station served has average annual entries/exits above 15 million passengers per year, or the station served is within two miles (straight-line distance) of a station meeting that criterion;

(b) at least one other station served has average annual entries/exits above 10 million passengers per year, or it is within two miles (straight-line distance) of a station meeting that criterion; and

(c) two of the stations served meeting the demand thresholds, or within two miles of those meeting the demand thresholds (above), are at least 40 miles apart.

To inform its PR23 charges review, the ORR has commissioned Steer to review and update the market-can-bear analysis for passenger services. This will inform whether any changes need to be made to the open access ICC in CP7 – specifically to the market segmentation exercise (which determines which open access services are liable for this charge) and assessment of ability to bear for relevant services - and what form any required changes should take. This report sets out our methodological approach to this work, and our analysis and findings.

The focus of this study is on open access passenger operators. ORR is separately reviewing the ICCs paid by passenger services within the framework of a public service contract, and the ICCs for freight operators. These services are not considered within the scope of this study.

Summary of PR18 market-can-bear analysis

As part of its PR18 review of Network Rail's charges, ORR developed a framework for a market-can-bear test for passenger services. A key part of this framework was an assessment of operating surplus (or 'net revenue') for different passenger services across GB rail.

This assessment was carried out by first estimating revenues and costs for passenger services at a service code level, for the 2015/16 financial year. These estimates of cost and revenue were then used to estimate net revenue by service code according to the formula below:

Net revenue by service code = Passenger fare revenue by service code - Costs by service code

The fare revenue by service code was estimated using MOIRA1 data, which provided fare revenue generated from each individual service code within a TOC. Final estimates of fare

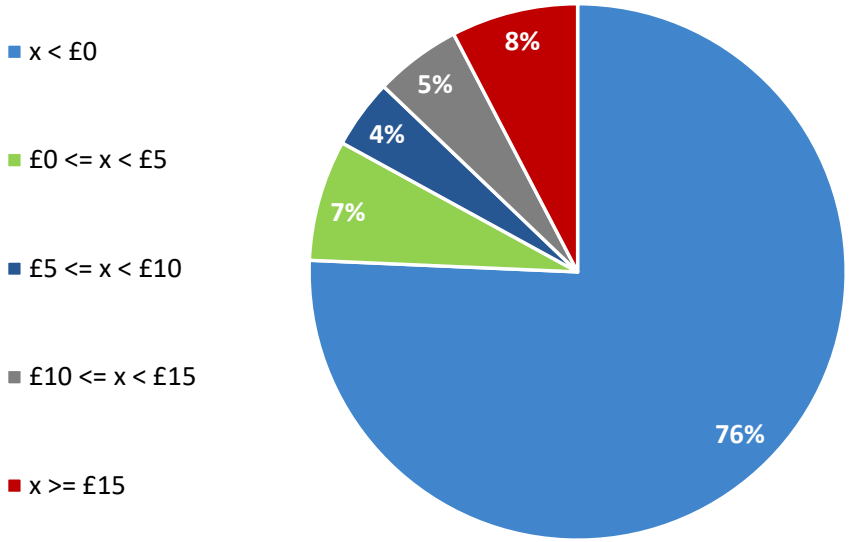
revenue were calibrated to ensure that the total fare revenue for each TOC aligned with the TOC total reported by ORR.

As there was no cost data available at a service code level, it was necessary to estimate these costs. This was carried out by estimating simple linear cost functions for each key cost type (staff costs, fuel costs, rolling stock and other costs) using TOC-level cost data for 2015/16. The estimated model parameters and characteristics of each service code were then used to obtain predicted costs for each service code.

The predicted costs from each of the four individual cost regressions were calibrated at a TOC level to ensure that the sum of service code level predicted costs from each regression for each TOC was equal to the ORR individual total cost at the TOC level.

The figure below shows the estimated distribution of service codes by net revenue per train mile in the PR18 analysis. This indicated that the majority of service codes, when only considering fare revenue, operated at a net revenue deficit (76%). However, there remained a significant proportion of services that operate on a net revenue surplus in excess of £5 per train mile (17%).

PR18 net revenue analysis proportion of service codes by net revenue per train mile (x)



By examining the types of services that exhibited the highest net revenues, the PR18 net revenue analysis revealed that the highest net revenues were generally achieved on:

- *Major intercity routes*, for example, services between London and other large UK cities like Birmingham, Manchester, Leeds and Liverpool; and
- *Highly utilised, long-distance commuter routes*, for example, services between London and Colchester, Southampton and Cambridge.

By examining some of these services in more detail, the analysis indicated that intercity and long-distance commuter services could bear an ICC in the range of £6-7 per train mile.

Market-can-bear analysis for PR23

To update the PR18 market-can-bear analysis for PR23, we have:

i. Reviewed (and where appropriate refined) the methodology used to estimate net revenues; and then

ii. Updated the analysis based on more recent data (and forecasts) to take account of changes in expected costs and revenues since PR18, such that it reflects the market situation in CP7.

The overarching methodology we have followed to estimate net revenues for PR23 is based on that used for the corresponding PR18 analysis outlined above. However, we have made some changes to the data sources and to some specific aspects of the methodology. The key changes are as follows:

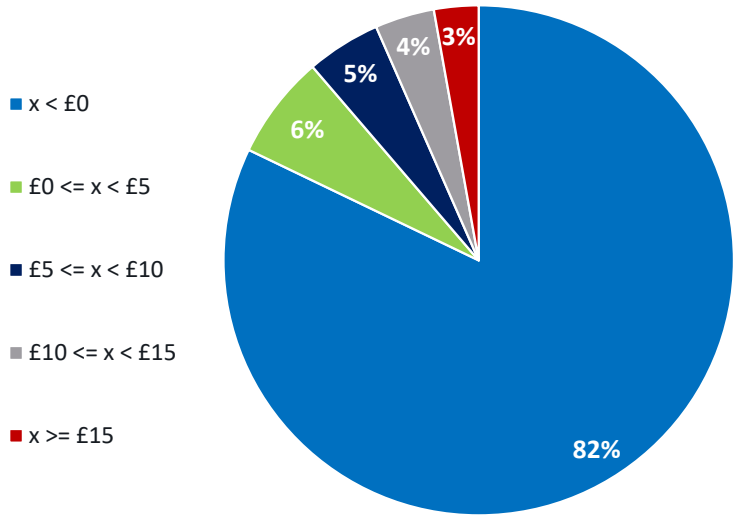
- Net revenue results are now based on 2024/25, derived using net revenue analysis for 2019/20 (the base year) and assumed net revenue growth to 2024/25
- Passenger fare revenue by service code is now primarily sourced from LENNON rather than MOIRA
- Some additional cost adjustments to TOC costs have been applied to more accurately reflect the costs that open access operators face
- Some revisions to the linear cost regression specifications have been made, including:
    - Adjusting the number of TOCs included in the regressions (now 20 instead of 19 TOCs)
    - Using train operating company (TOC) costs for two years' worth of data
    - Estimating staff costs using train hours, rather than train miles.

In order to forecast the growth in net revenue from 2019/20 to 2024/25, we have separately forecast growth in costs and fare revenue over this period.

- TOC costs are assumed to increase at the rate of CPI between 2019/20 and 2024/25.
- To forecast the growth in revenue between 2019/20 and 2024/25, we need to take account of both expected underlying (or "background") revenue growth over this period, and the impact of the Covid-19 pandemic. We have derived forecasts in line with latest industry assumptions about the long-term impact of Covid-19 on passenger demand, focusing on three scenarios (low; medium; and high demand recovery) to reflect the uncertainty in this area.

The figure below shows our estimates of net revenue per train mile by service code for 2024/25. This indicates that 6% fewer service codes are estimated to be profitable in the first year of CP7, compared with the analysis undertaken in PR18 (57 out of 319 service codes, compared to 68 out of 283 for PR18).

Estimated net revenue per train mile (x) pie chart (2024/25 levels, 2019/20 prices)



Market segmentation

We have examined the revised distribution of estimated net revenues by service type, to understand how it compares with the previous analysis undertaken in PR18. We find that the services we have identified as being the most profitable in the updated net revenue analysis are broadly the same types of services as those identified as the most profitable in the PR18 net revenue analysis.

Nevertheless, we have considered whether the updated evidence on net revenue provides a clear basis on which to amend the specific definition of interurban services that currently underpins the scope of the open access ICC, by better distinguishing those interurban-type services which are likely to be able to bear an ICC. We have considered definitions based on the existing assessment measures used to define interurban services i.e. based on distance between stations, and passenger usage (measured by number of entries / exits) at each station. We have also considered the inclusion of an additional assessment measure identifying London-based services. This reflects that the existence of a London stop appears to be a particularly significant characteristic of passenger services, with a significant proportion of services with the highest net revenue either starting or ending in London.

The above assessment measures have been tested in various combinations to try to identify the most appropriate definition of interurban services, for the purpose of setting an ICC. We have considered station usage thresholds of 5, 10 and 15 million entries/exits per year[1], and distance thresholds of 20, 30 and 40 miles. We set aside those that performed poorly, narrowing down to cover three candidate segmentation definitions, as follows:

- *Option 1*: The existing interurban definition, outlined above
- *Option 2*: Amending the existing definition to only capture London-based flows, using a minimum threshold of 20 miles (instead of 40 miles) and a minimum passenger usage threshold of 5 million (instead of 10 million).

[1] These thresholds are based on 2018-19 passenger entry and exit figures (i.e. the last full year before Covid-19), to allow for ease of comparison with PR18.

- *Option 3*: Amending the existing definition to only capture London-based flows, but keeping all other assessment measures the same.

The candidate market segments described above have been assessed against criteria focused on:

- How well the definition identifies the (most) profitable service codes;
- Whether the definition captures predominantly profitable service codes; and
- Identifying how many service codes within this definition are forecast to generate net revenues in excess of the current ICC level of £4 per train mile.

A comparison of how the candidate market segmentation options perform against these criteria is set out below.

Market segmentation assessment criteria

	Market segmentation option		
	1	2	3
The % of 'highly' profitable services that are captured by this definition	39%	64%	25%
The % of services captured by this definition that are 'highly' profitable	44%	52%	53%
The % of services captured by this definition that are marginally profitable	25%	18%	24%
The % of services captured by this definition that are unprofitable	31%	30%	24%

The assessment of possible market segments against these criteria indicates that the existing interurban definition does hold up reasonably well in identifying those interurban-type services which are likely to be able to bear an ICC. It also suggests that the existing interurban definition could be refined to focus on London-based interurban services, potentially including some of the longer distance commuter services to/from London.

Ability to bear

Based on the results of the net revenue analysis, we can draw the following high-level conclusions:

- The ability of the overall GB rail market to bear an ICC has likely declined since the PR18 analysis was completed, and it is not expected to fully recover by the beginning of CP7.
- The analysis demonstrated that the same categories of services are generally the most profitable: long-distance interurban and long-distance commuting to London.
- Our analysis also indicates rail services to/from London have a higher ability to bear than those to/from other cities.
- We have been able to identify candidate market segment definitions which broadly capture these types of services.

Given that the level of other track access charges for CP7 is yet to be determined, it is not possible to determine at this stage exactly what level of ICC can be borne by open access services in a particular market segment for CP7. We also note that, even when these charges are available, the net revenue analysis will inform rather than directly determine the appropriate level for an ICC for the following reasons:

- Time of day/week variation: The net revenue for service codes varies depending on the time of day and the day of the week on which services are operated.
- Dynamic market considerations: Calculating ability to bear from net revenue may also be affected by the open access entry scenario under consideration.
- Economies of scale: The net revenue analysis outputs reflect some economies of scale cost savings for franchised TOCs that may not be applicable to open access operators.

While we have not been able to directly address these issues within the net revenue analysis, in our study we have considered the potential impact of these issues on the ability to bear.

1 Introduction and Context

Introduction and context

Background

1.1 The Office of Rail and Road (ORR) is currently undertaking the 2023 Periodic Review (PR23). This will ultimately determine what Network Rail must deliver during Control Period 7 (CP7, which will cover the period from April 2024 to March 2029), as well as determining the track access charges paid for use of the rail network over this control period. In July 2021 the ORR consulted on its initial proposals for access charging in CP7[2].

1.2 Current legislation **requires** that charges for the minimum access package must be set to reflect "*the cost that is directly incurred [by Network Rail] as a result of operating the train service*"[3]. Network Rail sets its variable charges in accordance with this.

1.3 The legislation then **permits** additional charges (mark-ups), determined according to a market segment's ability to bear that charge on a non-discriminatory basis. Important requirements in the legislation for setting mark-ups include the following[4]:

(a) A mark-up is permitted to secure full cost recovery, and must be efficient, transparent, and non-discriminatory. (Paragraph 2(1))

(b) A mark-up must not exclude from the infrastructure any segments that can pay the minimum access package plus "a rate of return which the market-can-bear". (Paragraph 2(3))

(c) In evaluating the relevance of a mark-up for specific market segments, the ORR must ensure the infrastructure manager considers **at least** the pairs listed below (Paragraphs 2(5) and 2(10)):

(i) Passenger versus freight services;

(ii) Trains carrying dangerous goods versus other freight trains;

(iii) Domestic versus international services;

[2] ORR (2021), PR23 –Review of Network Rail's access charges, Technical Consultation, Initial Proposals, July. Available at: **https://www.orr.gov.uk/sites/default/files/2021-07/pr23-access-charges-review-initial-consultation-july-2021.pdf**.

[3] The Railways (Access, Management and Licensing of Railway Undertakings) Regulations 2016, **https://www.legislation.gov.uk/uksi/2016/645/made.** See Schedule 3, paragraph 1(4) ('Principles of access charging'). The minimum access package is those services set out in Schedule 2 of the 2016 Regulations, essentially the services necessary to access the infrastructure

[4] Schedule 3 (2) of the 2016 Regulations.

(iv) Combined transport versus direct trains;

(v) Urban or regional versus interurban passenger services;

(vi) Block trains versus single wagon load trains; and

(vii) Regular versus occasional train services.

(d) Furthermore, the list of market segments to be considered must contain at least the following three segments:

(i) freight services;

(ii) passenger services within the framework of a public service contract; and

(iii) other passenger services (Paragraph 2(6)).

(e) Further market segments may be considered according to commodity or passengers transported (Paragraph 2(7)).

1.4 At present, Network Rail levies mark-ups on some services for use of its network. These mark-ups are known as Infrastructure Cost Charges (ICCs). As part of PR23, ORR is reviewing how these ICCs should apply in CP7.

1.5 This study focuses on ICCs for 'other passenger services' (i.e. open access operators). ORR is separately considering how mark-ups should apply to passenger services within the framework of a public service contract (i.e. publicly-contracted operators) and freight operators. These market segments are not within the scope of this study.

PR18 and current open access ICC

1.6 Prior to CP6, open access operators only paid variable charges and station charges. In PR18, ORR introduced an ICC for open access operators for the first time. This was subject to the application of a market-can-bear test to assess the ability of different market segments to bear charges above directly incurred costs. ORR developed a framework for this test and concluded, on the basis of analysis carried out, that interurban services would be able to bear such a charge. ORR therefore levied an ICC of £4 per train mile on new interurban services in CP6.

1.7 ORR defined an interurban service as one for which:

(a) At least one station served has average annual entries/exits above 15 million passengers per year, or the station served is within two miles (straight-line distance) of a station meeting that criterion;

(b) at least one other station served has average annual entries/exits above 10 million passengers per year, or it is within two miles (straight-line distance) of a station meeting that criterion; and

(c) two of the stations served meeting the demand thresholds, or within two miles of those meeting the demand thresholds (above), are at least 40 miles apart.

1.8 The analysis and conclusions underpinning ORR's application of the market-can-bear test for PR18 is described in more detail in Chapter 2 below.

Purpose of this study

1.9 This study will be used to inform ORR's review of the open access ICC for PR23. In particular, it is intended to inform whether any changes need to be made to this charge in CP7 and what form any required changes should take. The key objectives of this study are as follows:

1. Reviewing the suitability of the methodological approach to the market-can-bear test carried out in PR18, and proposing any improvements;
2. Updating the 'net revenue analysis' (which underpinned the methodological approach taken in PR18) to estimate expected profitability for open access services in CP7. This involves:
    i. Incorporating methodological improvements following a review of the suitability of the PR18 methodological approach; and
    ii. Taking account of changes in expected costs and revenues since PR18.
3. Considering the implications for setting an open access ICC in CP7, including:
    i. An examination of possible market segmentations for open access services (i.e. the scope of any ICC); and
    ii. High-level implications for the ability to bear an ICC.

Rest of this Document

1.10 The rest of this document is structured as follows:

- Chapter 2 provides a summary of the market-can-bear analysis carried out in PR18;
- Chapter 3 contains details of our approach to the PR23 net revenue analysis, including methodology, data sources and assumptions;
- Chapter 4 describes the implications of the net revenue analysis for segmenting open access services ('market segmentation'); and
- Chapter 5 outlines some high-level implications of the net revenue analysis for ability to bear.

1.11 This document is published alongside ORR's further consultation on the PR23 review of Network Rail's access charges, and therefore includes information on the process that we have undertaken for the PR23 net revenue analysis and overall results. However, the underlying analysis relies upon confidential cost and revenue data that cannot be placed in the public domain. The report is therefore supplemented with three confidential annexes containing spreadsheets that will not be made publicly available, as outlined below:

- Annex A: Net revenue analysis results (ORR PR23 MCB Passenger Services Net Revenue Analysis v1.00);
- Annex B: Revenue analysis (ORR PR23 MCB Passenger Services Fare Revenue Analysis v1.00); and
- Annex C: Cost analysis (ORR PR23 MCB Passenger Services Cost Analysis v1.00).

2 Summary of PR18 market-can-bear analysis

2.1 As set out in Chapter 1, ORR introduced an ICC for open access services in CP6 as part of its PR18 review of Network Rail's access charges. To do this, ORR developed a framework for a market-can-bear test for passenger services – taking account of the relevant legislation governing the application of such charges.

2.2 This chapter summarises how this test was carried out in PR18, and the key conclusions. The analysis and conclusions drawn in PR18 have formed the starting point for this study.

Net revenue analysis

2.3 ORR commissioned consultants Cambridge Economic Policy Associates (CEPA) and Systra Ltd. to support the development of a market-can-bear test. The focus of CEPA / Systra's work was an assessment of operating surplus (or 'net revenue') for different passenger services across GB rail. ORR used this analysis to inform its understanding of the characteristics of different passenger services, and therefore a possible market segmentation of such services for the purposes of setting an ICC. It was also used to inform the level of the ICC, for services identified as being able to bear a charge[5].

2.4 Although the focus of this analysis was on open access services, the analysis covered all Train Operating Companies (TOCs) to provide a large enough dataset for robust analysis. Therefore, it was mainly driven by data from franchised passenger operators, given the greater number of franchised services. The same approach has been adopted for PR23.

General method

2.5 In broad terms, CEPA and Systra first sought to estimate revenues and costs for passenger services. This analysis was carried out *at a service code level*, for the 2015/16 financial year[6]. These estimates of cost and revenue were then used to estimate the **net revenue** by service code, according to the formula below:

Net revenue by service code = Passenger fare revenue by service code - Costs by service code

Data Sources

2.6 The data sources used in the PR18 analysis were as follows:

[5] CEPA / Systra's report setting out this analysis is available **here**.

[6] Service codes are defined for each operator, and they tend to contain a collection of that operators' services running between an origin and a destination (and back), but also calling at any intermediate stations.

- Revenue and costs at a train operating company (TOC) level were sourced from the ORR's February 2017 publication "UK Rail Industry Financial Information 2015-16"[7].
- Data on Fixed Track Access Charges at a TOC level was sourced from Network Rail.
- Passenger fare revenue at a service code level was obtained through the rail industry's MOIRA1 model, which is commonly used to forecast the impact of timetable changes on demand and revenue. CEPA used the national, all operators' version of MOIRA1.
- MOIRA1 also provided train miles and service type (i.e. intercity, commuter or other) at a service code level. Train miles at a service code level were aggregated to obtain train miles at a TOC level, and the most common service type for each TOC was selected to obtain service type at a TOC level.
- Supplementary service code level data on train miles, vehicle miles, capacity charge rates, and traction type were obtained directly from Network Rail. Similarly, TOC level train miles, vehicle miles and capacity charge rates were obtained by aggregating service code level data. The most common traction type for each TOC was selected to obtain traction type at a TOC level.

Revenue

Outline of estimation method

2.7 The total revenue included for rail operators in the "UK Rail Industry Financial Information 2015-16" (released by ORR[7]) was made up of passenger fare revenue, other revenue and government funding (franchised TOCs only). Other revenue included revenue earned from providing services such as station parking and on-train refreshments. For the PR18 net revenue analysis, only passenger fare revenue (henceforth 'fare revenue') was used.

2.8 The fare revenue by service code was estimated using MOIRA1 data, which provided fare revenue generated from each individual service code within a TOC. Final estimates of fare revenue were then calibrated to ensure that the total fare revenue for each TOC aligned with the TOC total reported by ORR.

Cost

Outline of estimation method

2.9 As there was no cost data available at a service code level, it was necessary to estimate the costs at a service code level, as different service code types have different costs. These costs were estimated using a 2 stage process:

1. Determine the 2015/16 costs at a TOC level (adjusting to remove costs which were not considered to be relevant for the purposes of estimating net revenue for open access services); and
2. Based on these 2015/16 TOC level costs, estimate costs at a service code level.

2.10 To estimate costs at a service code level, simple linear cost functions for each key cost type (staff costs, fuel costs, rolling stock and other costs) were estimated using TOC level data. The estimated model parameters and characteristics of each service code were then used to obtain corresponding predicted costs using the same operational characteristics at a service code level.

[7] **https://www.orr.gov.uk/uk-rail-industry-financial-information-2015-16**

2.11 The predicted costs from each of the four individual cost regressions were calibrated at a TOC level to ensure that the sum of service code level predicted costs from each regression for each TOC was equal to the ORR individual total cost at the TOC level. The resulting estimates of the four individual costs were then summed to give the total cost for each service code. This means that the regression estimates were used to allocate TOC-level costs to individual service codes (i.e. to estimate *relative* costs for different types of service), rather than determining the total level of costs that underpin the net revenue estimates.

Estimating costs at service code level

2.12 The 2015/16 costs at a TOC level were taken from ORR's "UK Rail Industry Financial Information 2015-16" publication[7]. The costs used for the PR18 net revenue analysis excluded the following costs which are not relevant to open access operators:

- Capacity Charge;
- Fixed Track Access Charge; and
- Payments to/from government.

2.13 As outlined above, a simple linear regression for each key cost type (staff costs, fuel costs, rolling stock and other costs) was estimated using the TOC level cost data and a set of key operational characteristics that were expected to drive costs. These operational characteristics, which were identified as part of the PR18 net revenue analysis, were:

- Train miles;
- Vehicle miles;
- Service type (intercity, commuter and other); and
- Traction type (electricity and diesel).

2.14 For service type and traction type, dummy variables were used to allocate each TOC/service code into a single service type and traction type category. The dummy variables used in the PR18 net revenue analysis are below:

- Diesel dummy variable - equal to 1 when the traction type is diesel, zero otherwise.
- Intercity dummy variable - equal to 1 when the service type is intercity, zero otherwise.
- Commuter dummy variable - equal to 1 when the service type is commuter, zero otherwise.

2.15 The operational characteristics (including dummy variables) used in the simple linear regressions for each key cost type are summarised in Table 2.1 below:

Table 2.1: Summary of PR18 cost regression metrics

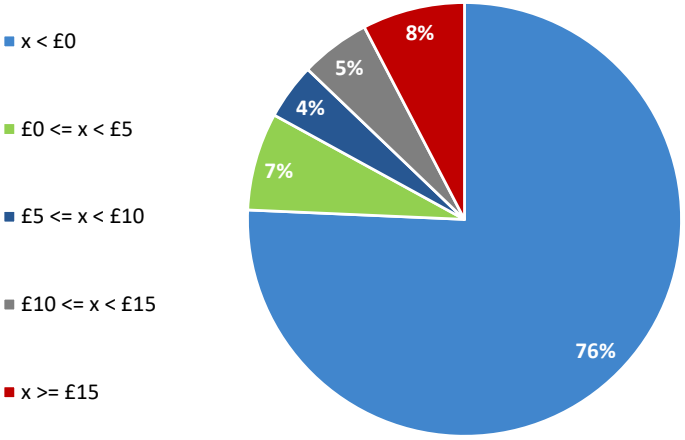
Cost category	Train Miles	Vehicle Miles	Train Miles* Commuter	Train Miles* Intercity	Vehicle Miles* Diesel	Vehicle Miles* Commuter	Vehicle Miles* Intercity
Staff	✓		✓	✓			
Fuel		✓			✓	✓	✓
Rolling Stock		✓				✓	✓
Other		✓			✓	✓	✓

2.16 The final stage of the estimation of the costs at a service code level was the calibration process, as described in paragraph 2.11. This ensured that for each key cost type, the sum of service code level costs for each TOC was equal to ORR reported costs at the TOC level.

Net Revenue Results

2.17 Figure 2.1 shows the distribution of service codes by net revenue per train mile, as estimated by CEPA / Systra in their PR18 analysis. This shows that the majority of service codes, when only considering fare revenue, operated at a net revenue deficit (76%). However, there was a significant proportion of services that generated a net revenue surplus in excess of £5 per train mile (17%).

Figure 2.1: PR18 net revenue analysis proportion of service codes by net revenue per train mile (x) (2015/16)



Market segmentation

2.18 CEPA / Systra examined in more detail the types of services that exhibited the highest net revenue, as given by Figure 2.1. This revealed that the highest net revenues were generally achieved on:

- *Major intercity routes*, for example, services between London and other large UK cities like Birmingham, Manchester, Leeds and Liverpool; and
- *Highly utilised, long-distance commuter routes*, for example, services between London and Colchester, Southampton and Cambridge.

Ability to bear

2.19 CEPA / Systra then looked in more detail at some of those services that were identified as having high net revenue, using some case study analysis of specific flows. This analysis indicated that intercity and long-distance commuter services could bear an ICC in the range of £6-7 per train mile.

2.20 The PR18 net revenue analysis also identified that higher earning areas of long-distance commuter services identified in Stage 1 could bear a mark-up. However, due to the inclusion of less remunerative service obligations and competition with the intermediate calls of longer distance services, it was harder to define the commuter markets in a way that located and isolated where ability to bear was likely to fall.

2.21 The conclusions from the PR18 net revenue analysis were used to inform ORR's final decisions and implementation of the open access ICC for PR18. ORR levied an ICC on new interurban services (as defined in paragraph 1.7) of £4 per train mile, to be phased-in over the first five

years of the operation of new services. No ICC was applied for other services in CP6. More information on the ORR's PR18 determination and the current ICC for open access services can be found in the 2018 Periodic Review Final Determination supplementary documentation[8].

[8] See in particular ORR's PR18 Final Determination **supplementary document – conclusions on ICCs** and its open access ICC implementation **conclusions document**.

3 Approach to PR23 net revenue analysis

3.1 The key focus of this study is updating the net revenue analysis that was conducted in PR18. This chapter describes the process that we have followed to do this, and presents the results of this exercise.

Overall methodological approach

3.2 As set out in Chapter 1, this exercise firstly involves reviewing and, where necessary, amending the methodological approach used in PR18. The overarching methodology we have followed to estimate net revenues is based on that used for the corresponding PR18 analysis, as outlined in Chapter 2. However, we have made some changes to the data sources and to some specific aspects of the methodology, as summarised below (and discussed in more detail in the rest of this chapter):

- Fare revenue by service code is primarily sourced from LENNON rather than MOIRA1;
- Costs are adjusted to also exclude Network Rail Schedule 4 payments;
- Costs are adjusted to re-allocate High Speed 1 Track Access Charges to the specific HS1 service codes;
- The cost estimates are based on two years' worth of data (rather than just one year);
- The cost linear regression has also been revised to include traction energy costs instead of just diesel fuel costs; and
- The specification of key operational metrics for the cost linear regression has been slightly adjusted and now uses train hours rather than miles as the driver of staff costs.

3.3 Secondly, this exercise requires us to update the analysis to estimate expected profitability for open access services in CP7, taking account of changes in expected costs and fare revenue since the analysis was last undertaken (which was for the 2015/16 financial year). To do this, we have sought to first estimate net revenue in 2019/20 (the 'base year'), before forecasting changes in net revenue between 2019/20 and the first year of CP7 (2024/25). Forecasts for 2024/25 have been made using separate revenue and cost growth assumptions between 2019/20 to 2024/25 that take account of both background economic growth and the revenue impact of the Covid-19 pandemic. The growth assumptions used for costs and revenue are described in more detail later in this chapter.

3.4 As with the PR18 analysis, we have conducted the analysis using data from all Train Operating Companies (TOCs), so in practice it is mainly driven by data from franchised passenger operators[9]. The use of franchised TOC data is required in order to both cover all GB rail service

[9] Since the onset of the COVID-19 pandemic, these operators' franchise agreements have been suspended and replaced with concession-style agreements. However, for the purposes of this study,

codes and provide a large enough dataset for robust analysis, noting that there is only one open access TOC for which all the required data for the analysis is available[10]. This also reflects that we are seeking to understand how net revenue (for both existing and prospective open access operators) varies across all routes on the GB network, rather than to estimate net revenue for specific open access operators.

3.5 As such, all TOCs included within the ORR Passenger Train Operator Finances[11] are included within the PR23 net revenue analysis, except the following:

- Caledonian Sleeper (Franchised) - there were operational metrics availability issues and sleeper services were not considered comparable to prospective open access services.
- Eurostar (Non Franchised) - International services are out of scope for the purposes of this study as they mainly operate on parts of the rail network not operated by Network Rail.
- Heathrow Express/Connect (Non Franchised) - there were revenue data availability issues and airport express services were not considered comparable to other open access services.

3.6 Furthermore, as with the PR18 analysis, we have conducted the analysis at service code level. This is considered to be a reasonable proxy for the geography of the service (i.e. the origin and destination of a service), which was identified in PR18 as being an important determinant of ability to bear.

3.7 We recognise that the time-of-day and day-of-week of a given service are also likely to influence the profitability of that service, and consequently the ability to bear a charge. However, we have not separated services on this basis in our analysis. This is because it is hard to source appropriate revenue and cost data to reflect this additional separation of services across GB rail and because of the difficulty of levying an ICC on this basis due to Network Rail billing system constraints. Nevertheless, we recognise that the time profile of demand is relevant to the question of ability to bear, and we consider the issue further in Chapter 5.

Revenue analysis

Data Sources

3.8 There are many different sources of TOC income, only some of which are directly relevant for the purposes of this exercise (i.e. forecasting net revenue for open access services). For this reason, we have concentrated on passenger (rather than 'other') revenue and, within that wider definition, focussed on the fare revenue that is registered in the LENNON ticket sales database (for the majority of passenger revenue, the ORCATS allocation process is able to allocate revenue to the individual service codes which form the building blocks of this analysis). Revenue not associated with passenger services has not been included in this definition of 'fare revenue', whether or not it is included in LENNON. For example, some car

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and to aid comparability with the PR18 study, we continue to refer to these operators as franchised TOCs.

[10] This is Grand Central. Data for Hull Trains for relevant years was not available to a similar level of granularity. Lumo only started operating services in autumn 2021, so data for this operator is not included in this study.

[11] Franchised: **https://dataportal.orr.gov.uk/statistics/finance/rail-industry-finance/table-7226-franchised-passenger-train-operator-finances-since-2015-16-by-franchise/**; Non Franchised: **https://dataportal.orr.gov.uk/statistics/finance/rail-industry-finance/table-7233-non-franchised-passenger-train-operator-finances-since-2015-16-by-operator/**

parking revenue is included in LENNON (and some is not), but because it is not allocated to specific services has not been included. We consider this is a conservative approach to estimating net revenue.

3.9 The fare revenue analysis component of the methodology draws on two key data sources. The primary source is LENNON earnings data, reported by service code and product group for the 2019/20 rail year. This year was chosen as the base year as it was only marginally affected by the Covid-19 pandemic. The impact on periods 12 and 13 of this year is accounted for as part of the forecast revenue growth calculations, described later in this chapter.

3.10 LENNON most accurately reflects the actual fare revenue that TOCs receive through ticket sales and through the ORCATS revenue allocation process. For example, LENNON more accurately reflects the allocation of fare revenue on dedicated tickets than MOIRA1, and is able to differentiate fare revenue between all station pairs, unlike a national, all operators version of MOIRA1 which aggregates demand to the top 20% or so stations. However, LENNON is not able to allocate fare revenue from non-geographically defined products, such as Travelcard fares, to service codes. There is also a need to be consistent with the metrics used to calculate costs. As many of these metrics have been generated using MOIRA1, we have also used MOIRA1 to validate the LENNON data.

Allocation method by service code

3.11 Before undertaking any analysis of fare revenue by service code, it was necessary to define a consistent mapping between the service code definitions in LENNON and MOIRA1. Both systems use a 4-digit service code, with the fourth digit representing PTE areas, which we have chosen to aggregate over, leaving 3-digit service codes. For a large proportion (75.0%) of total rail LENNON fare revenue this is a routine task, but some data cleaning was required:

- Some LENNON service codes were reallocated to different MOIRA service codes to ensure consistency with the cost metric calculations (16.1% of total LENNON revenue).
- In the case of two TOCs, the revenue allocation between significant long-distance service codes within LENNON appears to be inconsistent with the MOIRA1 timetable on which the cost metrics are based. For these TOCs, fare revenue was reallocated between service codes based on the MOIRA1 distribution.
- LENNON service codes with no match in MOIRA due to the aggregation of the National MOIRA1 version were retained, with metrics calculated purely from the Network Rail data source, as described below (0.4% of total LENNON revenue).
- 8.4% of revenue is passenger revenue that cannot be mapped to specific services. Around 80% of this revenue is associated with non-geographical revenue that is not TOC-specific, with around half of that associated with Oyster pre-pay in London. The remaining 20% is miscellaneous income that is registered through LENNON, particularly, but not exclusively, for car parking.
- The data cleaning process was continued by service code on a proportionate effort basis leaving only unmatched service codes with less than 0.1% of total LENNON revenue unresolved.

3.12 This percentage revenue allocation is summarised in Table 3.1.

3.13 Delay Repay compensation payments are not included in LENNON and are not allocated by service, and so are not included in the fare revenue analysis. In principle, this could lead to a slight overestimate of net revenues. However, where readily available, we have cross-checked Delay Repay totals by TOC to understand the scale of this issue. As shown in Table 3.1, these

amounts are very small compared to fare revenue totals, and we are confident that their exclusion does not materially affect the analysis.

Table 3.1: Summary of proportion of 2019/20 LENNON revenue included in PR23 net revenue analysis

	Share of Total
Directly matched in MOIRA1	75.0%
Manually matched with MOIRA1	16.1%
Total matched in MOIRA1	**91.1%**
Service code geography too granular for MOIRA	0.4%
Total used in analysis	**91.5%**
Misc. / parking / other	8.4%
No Match found	0.1%
Total LENNON	**100%**
Delay Repay where available for comparison	*0.8%*

3.14 The download of LENNON earnings by product group was retained for use in the identification of service code by journey purpose, which served two uses:

- In order to separately estimate the impact of Covid-19 on future passenger demand for different journey purposes (as described below)
- In the creation of dummy variables for use in the cost estimation method. In particular, a service code was deemed to be 'Commuter' if more than 20% of 2019/20 revenue was generated by Season ticket products.

3.15 In addition to the Commuter dummy variable, service codes that were not labelled 'Commuter' were manually labelled either 'Intercity' or 'Other', based on a manual review of services codes against a broader Intercity definition.

3.16 Once all discrepancies were resolved, a consistent master list of 361 service codes was created. A fare revenue data set was produced using the master list and the above two data sources, matching using the 3 digit service code described above. The key fields in the final data set were:

- Service code;
- TOC;
- 2019/20 fare revenue; and
- Commuter, Intercity, Other flag.

Forecast growth in fare revenue between 2019/20 and 2024/25

3.17 We are seeking to estimate net revenue analysis in the first year of CP7, 2024/25. As such, we need to forecast how revenue will change between the base year (2019/20) and the first year of CP7.

3.18 In recent years, forecasting future growth in rail passenger revenue has been more difficult than usual due to the impact of Covid-19, the lockdown restrictions imposed and the different travel patterns emerging during the recovery to a 'new normal'. The industry has undertaken a co-ordinated response to forecasting against this background, and work to provide a common view on the impact on demand over this period has been undertaken by DfT.

3.19 We have used this work as the basis for our assumptions about revenue growth between 2019/20 and the first year of CP7. This has allowed us to incorporate a demand factor (capturing the long-term impact of Covid-19 on passenger demand) for business / commuting demand, separately from leisure demand[12]. These factors are then applied to each service code, split by journey purpose based on applying a mapping from LENNON ticket type to journey purpose (as described earlier in this report). The specific factors applied are confidential and so cannot be presented in this report.

3.20 We have used three sets of demand factors corresponding to low; medium; and high passenger demand scenarios. This reflects the uncertainty about the profile of demand recovery in the coming years, as the rail industry recovers from the Covid-19 pandemic. The scenarios presented in paragraph 3.65 of this report are based on these assumptions, with the medium scenario used for our central case estimates of net revenue.

3.21 Furthermore, in the absence of Covid-19, we would expect to see some underlying (or "background") growth in demand and real revenue between our base year of 2019/20 and 2024/25, driven by expected changes in GDP and employment over this period. In line with standard demand forecasting approaches, we have also included expected changes in these factors into our demand (and revenue) forecasts. For this aspect of growth, we have applied a single growth rate across all service codes. This growth rate has also been taken from recent work by DfT.

3.22 Finally, we have assumed for simplicity that fares increase in line with RPI. Because costs have been assumed to increase by CPI (as explained in the next section), the net revenue analysis has been undertaken in CPI deflated prices and an additional growth factor (of 0.9% pa[13]) has been applied to revenue to reflect the difference between RPI and CPI[14].

Metrics (mileage and train hours) analysis

3.23 There are three key metrics involved in the net revenue analysis. The cost analysis is based on **unit vehicle miles** and **train hours**, and the overall results are normalised using **train miles**. This section describes the derivation of these metrics from the available data sources.

Data Sources

3.24 The main data source for these metrics was a spreadsheet supplied by the Track Access Billing team at Network Rail. This spreadsheet includes vehicle and train miles by service code for 2018/19 and 2019/20, the two years used in the cost analysis described below. It also includes information on traction type (Diesel/AC Electric/DC Electric), which is used to classify services by traction type (based on whether more than 50% of 2019/20 vehicle miles used electric traction).

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[12] This is consistent with ORR's recent engagement with open access operators which highlighted a significant change in the profile of passenger demand, with commuting and long-distance business travel remaining below pre-pandemic levels while leisure demand has recovered more strongly.

[13] Based on OBR Economic and fiscal outlook – October 2021 forecast: **https://obr.uk/download/october-2021-economic-and-fiscal-outlook-supplementary-economy-tables/**

[14] We note that we only assume fares increase by RPI (which is different to the assumption in the demand forecasts discussed above), this will have the effect of slightly underestimating revenue growth over this period.

3.25 The other main data source was a national OR02 version of MOIRA1. The MOIRA1 model is designed to forecast the impact of timetable changes on generated demand and the allocation of fare revenue between services. As part of that process, it includes a representation of the national timetable, albeit only including the 400 most significant stations in the model version. For the vast majority of services, this representation will fully reflect the full distance and time between the origin and destination stations, as these stations are included in the most significant stations. However, there are exceptions, including in the case of Cardiff Valley Line services, where all stations are included in a single 'zone' with Cardiff Central.

3.26 Our analysis summarised the timetable on a leg-by-leg basis to give train and vehicle miles by service code for the December 2018 and December 2019 timetables. This analysis delivers **daily** train hours and train miles for Weekday, Saturday and Sunday public timetables which are converted to an annual figure, assuming Saturday Only timetables run on bank holidays.

Allocation method to service codes

3.27 A cost metrics data set was produced using the master list and the above two data sources. The key fields in the final data set were:

- Service code;
- TOC;
- 2018/19 annual train miles;
- 2019/20 annual train miles;
- 2018/19 annual vehicle miles;
- 2019/20 annual vehicle miles;
- 2018/19 annual train hours;
- 2019/20 annual train hours; and
- A dummy variable denoting whether or not the service code is classified as diesel or electric traction.

3.28 For most service codes, the matching process was routine. However, some manual adjustments were needed to reconcile data sources. Furthermore, matches were not found for 42 of the 3-digit service codes from the fare revenue data. These service codes combined accounted for less than 0.1% of the total fare revenue used in this analysis, as shown in Table 3.1, with the largest service code worth less than £750k of fare revenue. These are associated with some form of miscoding. For this reason, the final list of service codes used for the net revenue analysis has been reduced from 361 to 319.

Cost analysis

Data sources

3.29 The cost analysis component of the net revenue analysis draws on a number of data sources, of which the ORR Passenger Train Operator Finances is the key data source. The data sources used for the cost analysis are outlined in Table 3.2 below:

Table 3.2: Costs data sources used for PR23 net revenue analysis

Data	Source

Staff Costs	ORR Passenger Train Operator Finances[15]
Rolling Stock Costs	ORR Passenger Train Operator Finances[15]
Diesel Fuel Costs	ORR Passenger Train Operator Finances[15]
Traction Electricity (EC4T) Expenditure	Network Rail
Network Rail Charges*	ORR Passenger Train Operator Finances[15]
Other Operating Expenditure*	ORR Passenger Train Operator Finances[15]
Financing costs and exceptional expenditure*	ORR Passenger Train Operator Finances[15]
Corporation tax*	ORR Passenger Train Operator Finances[15]
HS1 Track Access Charges	SE Trains Limited (IRC); HS1 Asset Management Annual Statements[16] (OMRC)
Network Rail FTAC	Network Rail
Network Rail Schedule 4 ACS	Network Rail
Network Rail Schedule 4 Income	Network Rail
Network Rail Capacity Charge	Network Rail

* For open access (i.e. non franchised) operators, these items are included in a single Other Expenditure category

Cost by service code estimation methodology

3.30 Consistent with the approach taken in PR18, we have estimated costs at a service code level using a 2 stage process:

1. Determine the 2018/19 and 2019/20 costs at a TOC level (adjusting to remove costs which were not considered to be relevant for the purposes of estimating net revenue for open access services); and
2. Based on these 2018/19 and 2019/20 TOC level costs estimates the 2019/20 cost at a service code level.

3.31 For the second stage, we estimated the costs for each key cost type at a service code level using a simple linear cost function, determined using TOC level cost and operational characteristics data. The estimated model parameters and key operational characteristics for each service code were then used to obtain the predicted cost for each service code.

3.32 The predicted costs from each of the four individual cost regressions were then summed and calibrated to ensure that the sum of service code level costs for each TOC was equal to total cost at the TOC level from the ORR information.

Econometric specification and application to estimate costs by service code

3.33 TOCs incur different types of cost according to the range of goods/services that they need to procure to provide a passenger rail service, with groups of goods/services affected differently by the key operational characteristics of a TOC. We therefore needed to consider the key cost

[15] Franchised: **https://dataportal.orr.gov.uk/statistics/finance/rail-industry-finance/table-7226-franchised-passenger-train-operator-finances-since-2015-16-by-franchise/**; Open access (i.e. non franchised): **https://dataportal.orr.gov.uk/statistics/finance/rail-industry-finance/table-7233-non-franchised-passenger-train-operator-finances-since-2015-16-by-operator/**

[16] Provided to Steer by ORR

types separately when estimating the total cost for each service code. Based on the available data and the assumed relationship between key cost types and the key operational characteristics, and in line with the broad approach taken in PR18, we have used the following costs in the PR23 net revenue analysis:

- Staff costs;
- Traction energy costs (includes both diesel fuel and traction electricity costs);
- Rolling stock costs; and
- Other costs.

3.34 For this analysis, we used both 2018/19 and 2019/20 TOC costs and carried out panel data regression analysis. This is because sample sizes of less than 30 (only 20 observations were available for a single year) were considered insufficient for the purposes of undertaking robust statistical analysis. A panel data regression enabled us to include each TOC's 2018/19 and 2019/20 costs in the overall regression, with a dummy variable added to ensure that any background 2018/19 cost difference could be removed.

3.35 As the focus of this net revenue analysis is open access operators, the costs used needed to exclude those costs that are not relevant to open access operators in CP7. The following costs have therefore been excluded from our analysis:

- Capacity Charge – this was removed in PR18 so is not applicable for CP7;
- Fixed Track Access Charge – this charge is not paid by open access operators;
- Payments to/from government – these are not paid by open access operators; and
- Network Rail Schedule 4 payments – no open access operator currently pays an Access Charge Supplement (ACS) upfront. Open access operators are still entitled to compensation under the Schedule 4 regime, but this is based on evidence of actual costs and revenue losses incurred (so would be expected to offset any revenue loss)

3.36 We note that all access charges, aside from those specifically mentioned in paragraph 3.35 (and Table 3.3 below) as excluded, are included in the TOC costs used for our analysis. This means that the following charges and other payments to Network Rail are included:

- Variable Usage Charge (VUC);
- Electrification Asset Usage Charge (EAUC) and Traction Electricity (EC4T) Charge (though this is included as a traction energy cost);
- Station and depot charges; and
- Network Rail Schedule 8 payments.

3.37 The overall allocation of costs from the ORR Passenger Train Operator Finances to the key cost types for the purposes of the regression analysis is summarised in the table below:

Table 3.3: Allocation of disaggregated cost categories to key cost types

Key Cost Type	Disaggregated Cost Categories	
	Franchised TOCs	Non Franchised TOCs
Staff Costs	• Staff Costs	• Staff Costs
Traction Energy Costs	• Diesel Fuel Costs • Traction Electricity (EC4T) Expenditure	• Diesel Fuel Costs • Traction Electricity (EC4T) Expenditure
Rolling Stock Costs	• Rolling Stock Costs	• Rolling Stock Costs
Other Costs	• Network Rail Charges • Other Operating Expenditure • Financing costs and exceptional expenditure • Corporation tax *Excluding* • Traction Electricity (EC4T) Expenditure • Network Rail FTAC • Network Rail Schedule 4 ACS • Network Rail Schedule 4 Income • Network Rail Capacity Charge* • HS1 Track Access Charges+	• Other expenditure (including access charges) *Excluding* • Traction Electricity (EC4T) Expenditure • Network Rail Capacity Charge*

* Material in 2018/19 only as this charge was removed in PR18; + Excluded from regression analysis and then reallocated to appropriate service codes during calibration

3.38 As outlined above, a simple linear regression for each key cost type has been estimated using the TOC level cost data and a set of key operational characteristics that drive costs. The key operational characteristics, selected based on our understanding of the drivers of TOC costs, are below:

- Train hours;
- Vehicle miles;
- Service type (intercity, commuter and other); and
- Traction type (electricity and diesel).

3.39 Service type and traction type are dummy variables used to allocate each TOC/service code into a single category. In addition, a 2018/19 dummy variable has been included in the regression in line with the panel data approach outlined in paragraph 3.34 above. The dummy variables used in the analysis are below:

- Diesel dummy variable - equal to 1 when the traction type is diesel, zero otherwise.
- Intercity dummy variable - equal to 1 when the service type is intercity, zero otherwise.
- Commuter dummy variable - equal to 1 when the service type is commuter, zero otherwise.
- 2018/19 dummy variable - equal to 1 when the cost figure is from 2018/19, zero otherwise (i.e. when the cost figure from 2019/20).

3.40 These characteristics are largely the same as those used in the PR18 net revenue analysis. However, we have used train hours (instead of train miles) to determine staff costs and the

diesel flag to distinguish between the costs of different types of rolling stock, as we consider this is likely to better reflect the relationship between these characteristics and the relevant cost categories. The key operational characteristics (including dummy variables) used in the simple linear regressions for each key cost type are summarised in Table 3.4 below.

Table 3.4: Key operational characteristics used within each key cost type regression

Cost category	Train Hours	Vehicle Miles	Train Hours* Commuter	Train Hours* Intercity	Train Hours* 2018/19	Vehicle Miles* Diesel	Vehicle Miles* Commuter	Vehicle Miles* Intercity	Vehicle Miles* 2018/19
Staff	✓		✓	✓	✓				
Fuel		✓				✓	✓	✓	✓
Rolling Stock		✓				✓	✓	✓	✓
Other		✓				✓	✓	✓	✓

3.41 It should be noted that Table 3.4 includes some interaction variables:

- Train Hours*Commuter & Train Hours*Intercity- this provides an estimate of the additional impact on (staff) costs per train hour if a service is commuter/intercity rather than another service type.
- Train Hours*2018/19 - this provides an estimate of the additional impact on (staff) costs per train hour if a service is in 2018/19 rather than 2019/20 (this is added in for the panel data regression).
- Vehicle Miles*Diesel - this provides an estimate of the additional impact on costs per vehicle mile if a service is diesel rather than electric.
- Vehicle Miles*Commuter & Vehicle Miles*Intercity - this provides an estimate of the additional impact on costs per vehicle mile if a service is commuter/intercity rather than other service types.
- Vehicle Miles*2018/19 - this provides an estimate of the additional impact on costs per vehicle mile if a service is in 2018/19 rather than 2019/20 (this is added in for the panel data regression).

3.42 The simple linear regression models were specified without an intercept as the model was used to estimate the costs for service codes. Although an intercept would provide an estimate of the fixed cost for each TOC, this could not be allocated in such a way to estimate the fixed cost for a given service code. Therefore, an intercept was not included in the simple linear regression specifications for the key cost types.

3.43 The parameters estimated for each relevant independent variable in each of the key cost type regressions are presented in Table 3.5 below.

Table 3.5: Estimated parameters for key cost type regressions

Independent (explanatory) Variable	Dependent variable			
	Staff Costs	Traction Energy Costs	Rolling Stock Costs	Other Costs
Train Hours	336.49^^^			
Vehicle Miles		0.30^^^	0.88^	1.75^^^
Train Hours * Commuter	54.85			
Train Hours * Intercity	242.62^^^			
Train Hours * 2018/19	-10.83			
Vehicle Miles * Diesel		0.15^^^	0.54^^	1.07^^^
Vehicle Miles * Commuter		0.004	0.49	0.08
Vehicle Miles * Intercity		-0.03	0.60	-0.41
Vehicle Miles * 2018/19		0.01	-0.12	-0.04
Number of Observations	40	40	40	40
R^2	0.97	0.96	0.94	0.95

^ = significant at 90%, ^^ at 95% and ^^^ at 99% using a two tailed hypothesis test

3.44 We note that a number of the explanatory variables in the models are not statistically significant, but we have included these variables given that there is a clear technical justification for their inclusion, and the sign and magnitude of the estimated coefficients appear reasonable. Overall, the explanatory power of the regressions, indicated by an R^2 close to 1, suggests that our chosen regression specifications capture the key drivers of TOC costs.

Calibration process

3.45 Once the estimated costs from each of the four individual cost regressions were derived, a calibration factor was calculated (and applied for each service code) to ensure that for each TOC the total cost for the key cost type from the ORR Passenger Train Operator Finances was equal to the sum for that key cost type across all of the TOC's service codes[17].

3.46 As a sense check, we have examined the size of the calibration factors derived, to assess the accuracy of the cost estimates derived from the regression. This exercise showed that in the case of staff costs, more than 80% of the calibration factors were greater than 0.5 and less than 1.5, while this was the case for roughly two thirds of the calibration factors for the other costs. This demonstrates that a majority of calibration factors did not indicate that there was a significant difference between estimated and actual costs. The cost category with the greatest difference was rolling stock costs, a reflection of the different fleets (with different costs) used by operators running similar types of service.

3.47 At the calibration stage, the addition of the HS1 Track Access charges (which were removed when determining the key cost types for the regressions) to the Southeastern service codes for services on HS1 was also carried out. There are two service codes which contain services

[17] Due to data availability, in the case of Hull Trains only two calibration factors were calculated. One was for the staff costs key cost type and the other for all other costs (and applied to the regression estimates for the traction energy, rolling stock and other key cost types).

on HS1, and the HS1 track access charges are allocated to these by pro-rating based on approximate annual HS1 mileage.

3.48 A fictional example for staff costs is presented in Table 3.6 below to illustrate how the calibration process for this and other cost types was applied to adjust the regression cost estimates.

Table 3.6: Fictional staff costs service code example for intercity service code in 2019/20

	Train Hours	Train Hours * Commuter	Train Hours * Intercity	Train Hours * 2018/19
Estimated coefficient	336.49	54.85	242.62	-10.83
Explanatory Variable	100,000	-	100,000	-
Estimated coefficient * explanatory variable	33,649,000	-	24,262,000	-
Estimated staff costs	£33.649m + £0m + £24.262m + £0m = £57.911m			
Adjustment factor	1.10			
Calibrated predicted staff costs	£57.911m * 1.10 = £63.7021m			

Additional sense checks

Choice of rolling stock

3.49 In our engagement with industry stakeholders on this work, one query raised related to how the rolling stock costs estimated using this regression approach would reflect the costs for modern intercity bi-mode fleets likely to be used to operate any new open access services.

3.50 The rolling stock cost estimates from our regressions are intended to be for generic rolling stock for a given service type (i.e. diesel, or intercity/commuter). Therefore, the regression is based on the fleet types used across GB rail by service type and does not attempt to estimate costs for any particular fleet solution, for example modern bi-modes. We have not therefore made manual adjustments to reflect the different costs of specific operational arrangements (e.g. different fleet types).

3.51 In addition, we note that the calibration element of our methodology results in an adjustment of the costs given by the regression to ensure alignment with 2019/20 actual rolling stock costs. As explained in Chapter 2, the purpose of the regression is to allocate TOC-level costs to individual service codes (i.e. to estimate *relative* costs for different types of service). The total costs used for the net revenue analysis therefore reflect actual TOC costs for 2019/20.

3.52 However, we have tested the validity of our results by comparing our rolling stock cost estimates from the regression to separate information that TOCs have provided to ORR on the costs of modern intercity bi-mode fleets. This comparison showed that the rolling stock cost estimates for the relevant TOCs was within the range for these costs given by the actual cost information received. We consider this to give us some confidence that our rolling stock cost estimates are reasonable.

Economies of Scale

3.53 Another query raised by industry stakeholders related to how the costs estimated using our regression approach would be affected by the economies of scale exhibited by franchised TOCs, compared to smaller open access operators.

3.54 We have compared the estimated costs from the regression for one open access operator against actual 2019/20 costs and also the costs for the Other Expenditure category, within which we would expect to observe any impact due to economies of scale. This showed that total estimated costs (for all four key cost categories) were similar to actual costs. However, estimated costs from the regression for the "Other Cost" category was significantly less than the actual costs.

3.55 This indicates that the use of franchised TOC data in the analysis may reflect some economies of scale cost savings that are not applicable to open access operators. All other things being equal, this would be a source of overstatement of the outputs of our net revenue analysis. However, as explained in paragraph 3.4 the use of franchised TOC data is required to meet the objectives of the study. The use of a linear regression with an intercept would have resulted in economies of scale being considered in our study, however, this was not used in our study for the reasons outlined in paragraph 3.42.

Deriving forecast 2024/25 costs from base year (2019/20)

3.56 As we are seeking to estimate net revenue for 2024/25 (i.e. year 1 of CP7), we need to forecast changes in costs between the base year (2019/20) and 2024/25.

3.57 To do this, we have assumed in our central case estimates that TOC costs increase at the rate of CPI between 2019/20 and 2024/25. The growth assumption of CPI has been chosen to reflect the expected level of TOC cost growth between 2019/20 and 2024/25. For simplicity we assumed that the net revenue analysis was undertaken in CPI-indexed prices and therefore, in this case, real growth was only applied to fare revenue.

3.58 However, we have undertaken some sensitivity analysis to understand the impact of this cost growth assumption on the results of the net analysis. These, together with the central case results, are described in more detail in the following section.

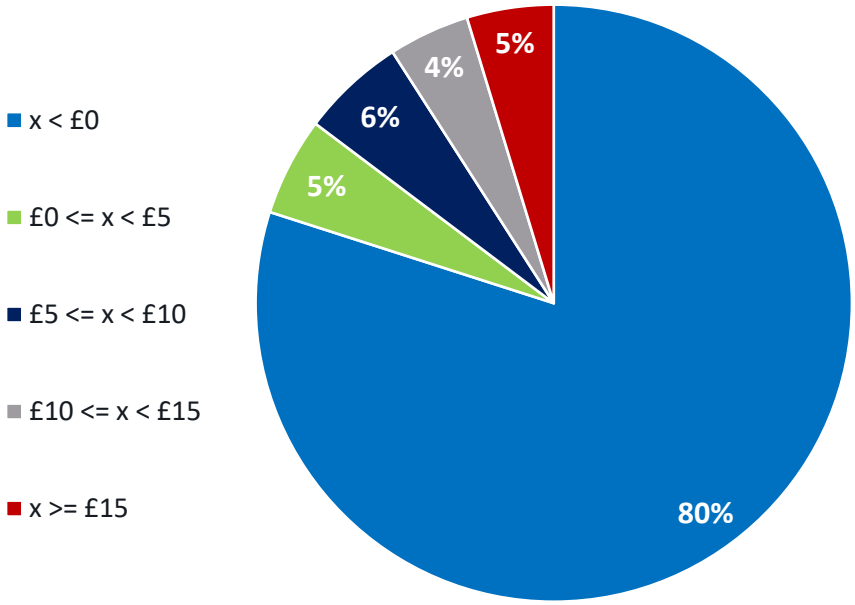
Results

3.59 The estimates of cost and fare revenue by service code described above are then used to estimate the **net revenue** by service code, according to the formula below:

Net revenue by service code (2024/25) =
Passenger fare revenue by service code (2024/25) - Costs by service code (2024/25)

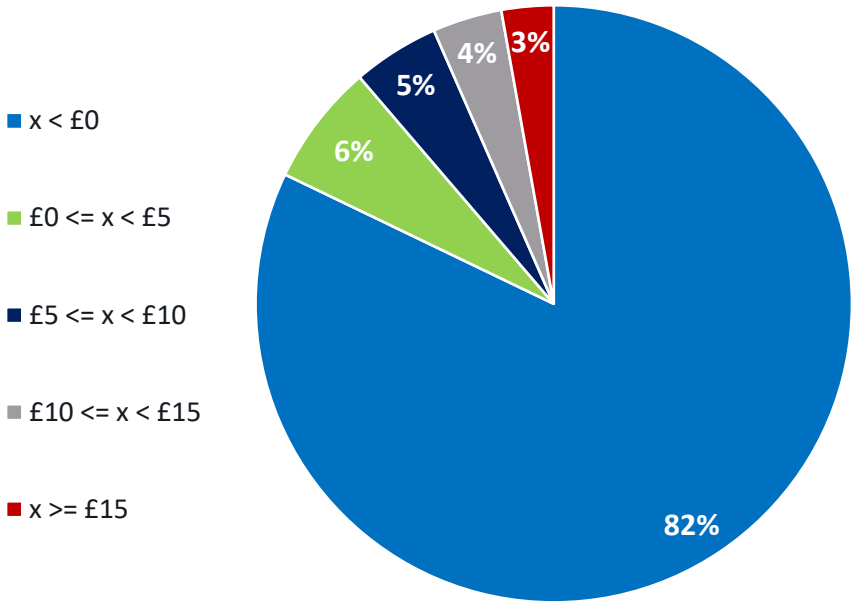
3.60 The pie chart shown as Figure 3.1 is the equivalent of that shown for PR18 (see Figure 2.1). This shows the distribution of service codes by net revenue per train mile for 2019/20. It indicates that 4% fewer service codes were estimated to be profitable (20%, or 64 out of 319, compared to 24% or 68 out of 283 for PR18). This is likely to be partly due to the slight shortfall of fare revenue in periods 12 and 13 of 2019/20 due to the impact of Covid-19. It is also worth noting that the more involved matching process in PR23 has retained more service codes than the PR18 analysis, and it is likely that the vast majority of the additional codes will not be profitable.

Figure 3.1: Estimated net revenue per train mile pie chart (2019/20 levels, 2019/20 prices)



3.61 Figure 3.2 shows the equivalent results for 2024/25, having applied the forecast cost and fare revenue growth assumptions. This gives a further reduction of 2% in profitable service codes (18%, or 57 out of 319).

Figure 3.2: Estimated net revenue per train mile pie chart (2024/25 levels, 2019/20 prices)



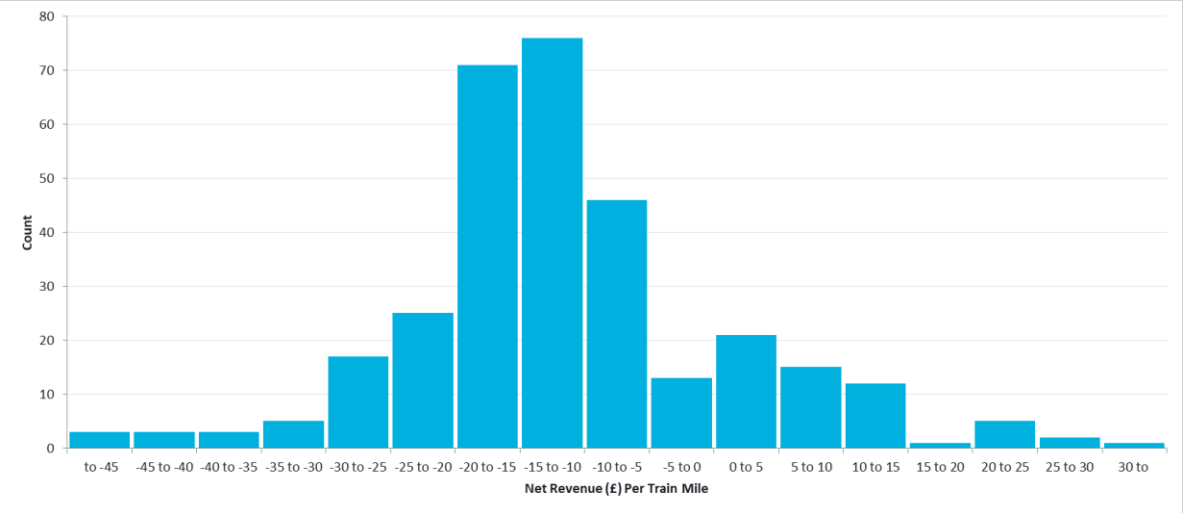
3.62 Overall, these results indicate that overall profitability across GB passenger services is expected to be lower at the start of CP7 than when we previously assessed the market in PR18. However, a significant proportion of service codes still generate a positive net revenue at an estimated average rate of £9.30 per train mile, with 12% of service codes exhibiting a net

revenue of more than £5[18]. It is also worth noting that although only 18% of service codes are forecast to be profitable overall, these account for 64% of total *fare revenue*.

3.63 We have also examined the *types of services* that comprise those with positive net revenues. In general, and consistent with our expectations, we find these are similar to the services that were identified in PR18 as exhibiting the highest net revenues i.e. those operating on major intercity routes and highly utilised, long-distance commuter routes. In particular, the results indicate that a significant proportion of services with the highest net revenues either start or end in London. This is discussed further in the next chapter on market segmentation.

3.64 Figure 3.3 is the histogram equivalent of Figure 3.2 and shows the number of service codes at different levels of net revenue.

Figure 3.3: Estimated net revenue per train mile histogram (2024/25 levels, 2019/20 prices)



Sensitivity Tests

3.65 The robustness of the net revenue analysis has been tested using cost and revenue sensitivity tests. The revenue sensitivity tests correspond to the three demand factors used to capture the long-term impact of Covid-19 on passenger demand, as described earlier in this chapter. For the cost sensitivity tests, we have assumed that costs increased by +/- 2% either side of the Central CPI cost growth assumption. Table 3.7 summarises the results in terms of the proportion of profitable service codes.

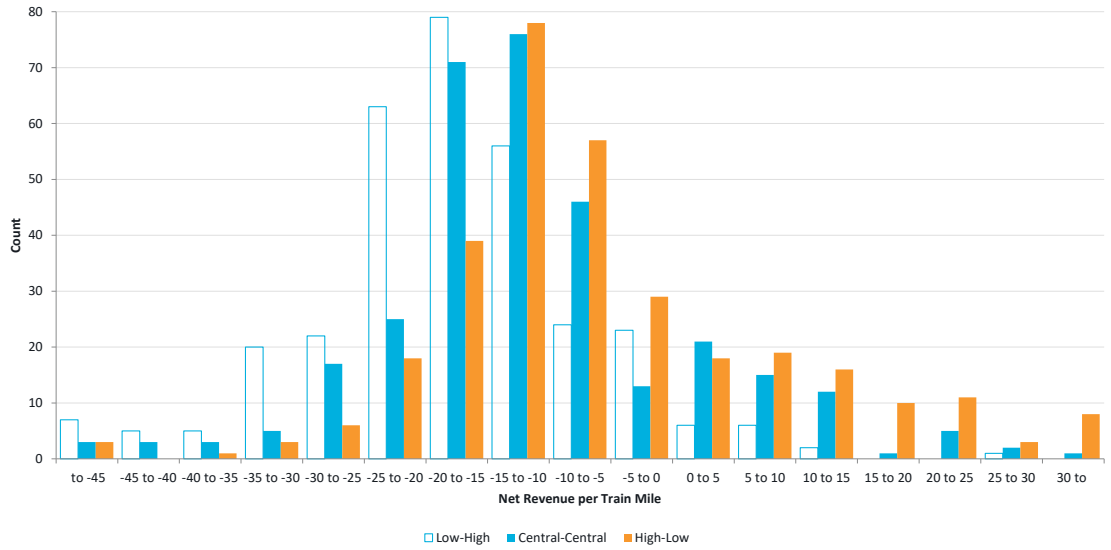
Table 3.7: Proportion of profitable service codes

Cost / Revenue	Low	Central	High
Low	14%	9%	5%
Central	20%	18%	14%
High	27%	22%	19%

[18] This compares with an average net revenue across profitable service codes of £11.90 in the PR18 analysis, where 17% of service codes exhibited an estimated net revenue per train mile in excess of £5.

3.66 Figure 3.4 shows the equivalent histograms of net revenue under the central case assumptions, compared with the two scenarios combining high and low cost / revenue growth.

Figure 3.4: Comparison of net revenue histograms by scenario



3.67 Although the cost sensitivities have an impact on the number of profitable service codes (seen in Table 3.7 above) they only result in a small change to the *overall distribution* of net revenue by service code. As a result, they do not materially affect our consideration of market segmentation and are therefore not included in our sensitivity tests in Chapter 4.

Assurance

3.68 Recognising the high level nature of this analysis and the need to treat all services on a consistent basis, we have applied a number of assurance checks at each stage of the net revenue analysis. The assurance checks (some of which are described earlier in this chapter) include the following:

- Accounting for the total LENNON revenue;
- A cross check against total LENNON revenue by TOC, as published by ORR[19];
- Checking for consistency between the distribution from two sources of passenger fare revenue (LENNON and MOIRA1);
- Ensuring that metrics are consistent between MOIRA1 and Network Rail data sources, where both are available;
- Checking that vehicle and train miles are internally consistent;
- Checking the size of the calibration factors when estimated costs are calibrated back to TOC totals (see paragraph 3.46 above);
- Comparing estimated costs with actual open access operator costs (as outlined in the Additional sense checks section above); and
- Comparing the list of profitable service codes in the PR18 and PR23 analyses, and explaining any major changes.

[19] https://dataportal.orr.gov.uk/media/1889/rail-industry-finance-uk-statistical-release-2019-20.pdf

4 Implications for Market Segmentation

Introduction

4.1 As set out in Chapter 1, an objective of this study is to consider the implications of the updated net revenue analysis for the scope of an open access ICC in CP7.

4.2 We have approached this task by reviewing the existing market segmentation that determines the scope of this charge (i.e. the definition of the interurban market segment for which the existing open access ICC is applicable), in light of the updated analysis presented in Chapter 3, to understand how well it distinguishes passenger services in terms of the key characteristics of these services. Specifically, we have developed and applied a number of criteria with which to assess possible alternative market segmentations that would distinguish passenger services differently.

4.3 The rest of this chapter describes those criteria, the alternative definitions considered, and the resulting implications for segmenting open access services.

Detailed market segment examination

4.4 As set out in Chapter 3, the net revenue analysis shows that expected net revenue will have fallen in CP7 relative to the analysis conducted in PR18. Despite this, the revised analysis indicates that the services which exhibit the highest net revenue tend to be those which were identified in PR18, these are:

- *Major intercity routes*, for example, services between London and other large UK cities like Birmingham, Manchester, Leeds and Liverpool; and
- *Highly utilised, long-distance commuter routes*, for example, services between London and Colchester, Southampton and Cambridge.

4.5 This indicates that a market segmentation that captures interurban services in some way is likely to remain appropriate for CP7.

4.6 In PR18, ORR specifically defined a single market segment for new interurban services based on the following assessment measures:

(a) At least one station served has average annual entries/exits above 15 million passengers per year, or the station served is within two miles (straight-line distance) of a station meeting that criterion;

(b) at least one other station served has average annual entries/exits above 10 million passengers per year, or it is within two miles (straight-line distance) of a station meeting that criterion; and

(c) two of the stations served meeting the demand thresholds, or within two miles of those meeting the demand thresholds (above), are at least 40 miles apart.

4.7 In practice, this definition primarily captures major intercity routes, though ORR noted that it also includes certain long-distance commuter flows that were considered part of the interurban market segment, such as London to Brighton and London to Cambridge.

4.8 We have considered whether the updated evidence on net revenue provides a clear basis on which to amend the definition described above, to better distinguish those interurban-type services which are likely to be able to bear an ICC. In doing so, we have also taken account of industry views on which services are likely to bear an ICC, provided as part of stakeholder consultation for PR23 (and also in the context of ORR's PR18 review).

4.9 In keeping with ORR's overall approach to the PR23 review, we have focused on the same assessment measures currently used to define interurban services (i.e. distance and station usage thresholds). These assessment measures allow for a practicable implementation of the charge, and avoid perverse incentives and changes in the definitions of in-scope service codes, such as specific frequencies or stopping patterns, or definitions of times of day. However, we have also considered the inclusion of an additional assessment measure to identify London-based services, distinct from other services. This reflects the importance of London as a key distinguishing characteristic of passenger services (as indicated in the net revenue analysis).

Market segments to be tested

4.10 The above assessment measures have been tested in various combinations to try to isolate those combinations that are most appropriate. We have considered station usage thresholds of 5, 10 and 15 million entries/exits per year, and distance thresholds of 20, 30 and 40 miles[20]. In the case of station usage, we have defined these segments based on 2018/19 passenger entry and exit figures (i.e. the last full year before Covid-19), to allow for ease of comparison with PR18.

4.11 Based on these combinations, we have considered a range of market segment definitions, setting aside those that performed poorly and narrowing down the exercise to cover three candidate segmentation definitions, as follows:

- *Option 1*: The status quo, i.e. an interurban market segment and an "other" segment (capturing all other services), based on the existing definition of an interurban service.

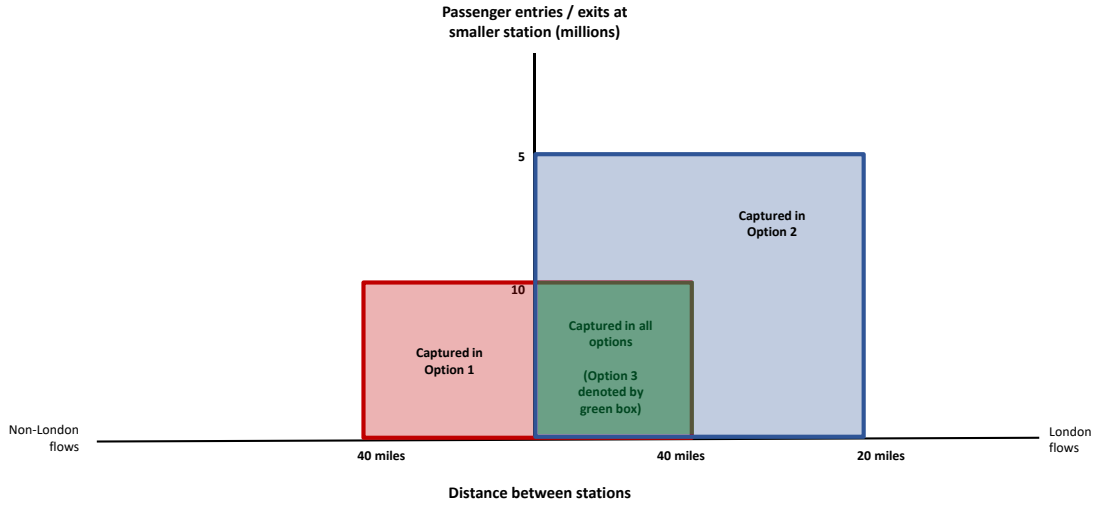
- *Option 2*: Amend the definition of the existing interurban segment such that it only captures London-based flows; but widen the existing interurban definition to capture more London-based flows than Option 1, by lowering the existing distance and passenger usage thresholds. We consider that a minimum distance threshold of 20 miles (instead of 40 miles) and a minimum passenger usage threshold of 5 million entries/exits (instead of 10 million) could be suitable thresholds for this segment. In practice, this would have the effect of grouping London intercity and long-distance commuter services in a single market segment, distinct from all other services.

[20] ORR considered these station usage thresholds in coming to its existing market segmentation for CP6. For the distance assessment measure, ORR considered thresholds of 40, 50 and 60 miles, but said there was no clear definition of the minimum distance for a long-distance rail journey and noted this would exclude services between some distinct urban areas e.g. Manchester and Leeds / Liverpool. See ORR's PR18 consultation on the open access ICC implementation, available **here**.

- *Option 3*: Amend the definition of the existing interurban segment such that it only captures London-based flows, but maintain the existing distance and passenger usage thresholds. This would largely capture London intercity services, along with some of the very long-distance commuter services.

4.12 These options are illustrated in Figure 4.1 below.

Figure 4.1: Illustration of options for open access market segmentation



4.13 We have then tested these candidate definitions using a number of different assessment criteria which we consider are relevant to the suitability of a passenger market segmentation. These focus on:

- How well the definition identifies the (most) profitable service codes;
- Whether the definition captures predominantly profitable service codes; and
- Identifying how many service codes within this definition are forecast to generate net revenues in excess of the current ICC level of £4 per train mile.

4.14 The specific criteria we have applied use £5 per train mile as a definition of 'highly' profitable and are as follows:

- The % of 'highly' profitable services that are captured by this definition;
- The % of services captured by this definition that are 'highly' profitable;
- The % of services captured by this definition that are 'marginally profitable', at below £5 per train mile, which is close to the current level of the ICC; and
- The % of services captured by this definition that are unprofitable.

Shortlisted market segmentation definitions

4.15 Table 4.1 below summarises how the candidate market segmentations perform against our chosen criteria, under our central case assumptions for fare revenue and cost growth between 2019/20 and 2024/25.

Table 4.1: Market segmentation assessment criteria (Central case)

	Market segmentation option		
	1	2	3
The % of 'highly' profitable services that are captured by this definition	39%	64%	25%
The % of services captured by this definition that are 'highly' profitable	44%	52%	53%
The % of services captured by this definition that are marginally profitable	25%	18%	24%
The % of services captured by this definition that are unprofitable	31%	30%	24%

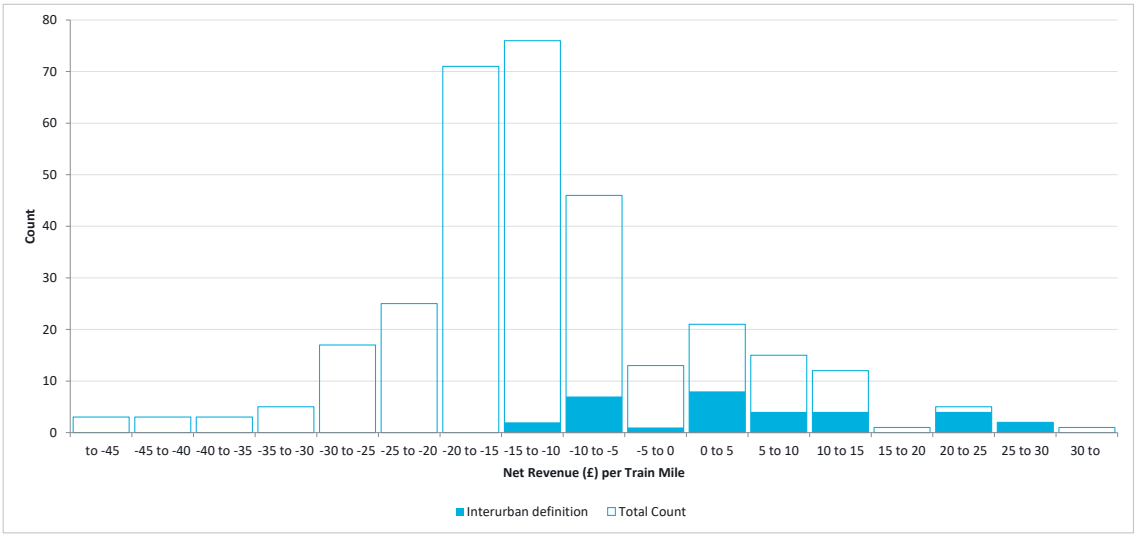
4.16 We provide a brief commentary on, and also set out the distribution of net revenue for, each option below.

Option 1

4.17 As shown in Table 4.1 and Figure 4.2 below, Option 1 (the existing interurban definition) appears to characterise the largely profitable interurban service codes relatively well – a significant proportion of profitable service codes (39%) and the majority of the very highly profitable codes (e.g. £20 per train mile or above) are included within this definition.

4.18 However, it does include a number of services codes which the updated net revenue analysis indicates would be unprofitable in the first year of CP7 (31% of services captured by this definition). Furthermore, it also includes a number of service codes that are 'marginally profitable' i.e. have a net revenue at or below the current level of the ICC (25%).

Figure 4.2: Histogram of market segmentation for Option 1



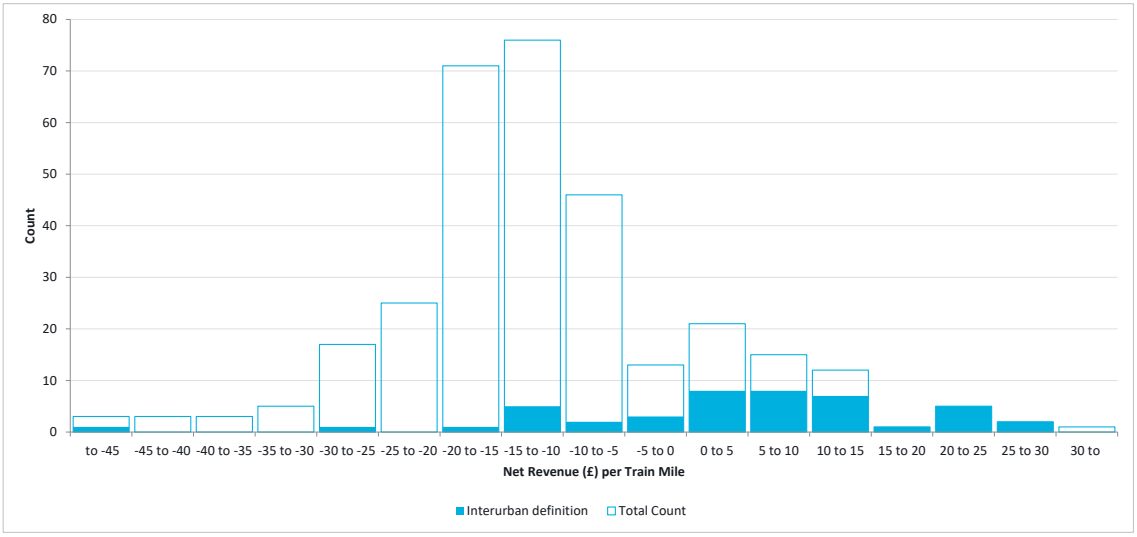
Option 2

4.19 This candidate market segmentation includes more long-distance London commuter services than Option 1, but would exclude all interurban services between other UK cities (some of which are captured by Option 1). Table 4.1 and Figure 4.3 show that, under our central case assumptions about passenger demand and revenue recovery, this segment captures 64% of the service codes that we estimate as being most profitable, compared with 39% of the

existing definition (Option 1). This is due to the inclusion of some more long-distance commuter services which exhibit high net revenues.

4.20 This indicates that a market segmentation which distinguishes these London-based services from all other services may better capture those services which tend to exhibit the highest operating surpluses. However, like Option 1, this definition also captures a relatively broad distribution of services, including some services that are marginally profitable (18%) or unprofitable (30%).

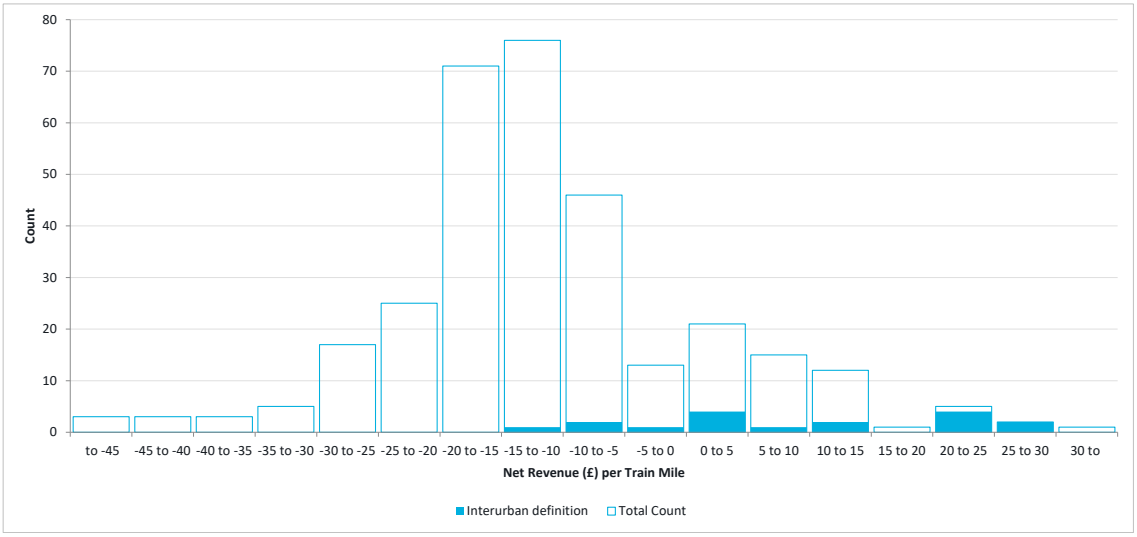
Figure 4.3: Histogram of market segmentation for Option 2



Option 3

4.21 Option 3 would capture the smallest set of interurban services – primarily intercity services to and from London. The proportion of highly profitable services is higher for Option 3 (53%) than Option 1 (44%) and 2 (52%). However, by excluding all non-London services, as well as a significant proportion of long-distance London commuter services, it also captures the smallest proportion of services which exhibit a high operating surplus and therefore excludes some interurban services which are likely to have similar characteristics to London intercity services.

Figure 4.4: Histogram of market segmentation for Option 3



Sensitivity testing

4.22 As described at the end of Chapter 3, we have undertaken a series of sensitivity tests on estimated fare revenue, to test the robustness of these definitions. Table 4.2 repeats the results from Table 4.1, based on the high and low revenue assumptions explained in Chapter 3. These tests help to demonstrate the robustness of these measures, particularly the relative stability of the proportion of services that are highly or marginally profitable under each candidate definition.

4.23 The large increase in the overall proportion of highly profitable services captured by all definitions under the "low" revenue growth scenario indicates that the service codes captured by these definitions generally identify the most profitable of all service codes. We also note that, under this scenario, the highly profitable services comprise a greater proportion of the candidate definition under Option 1 (25%) than Option 2 (18%). This is likely because the impact of the Covid-19 pandemic disproportionately affects commuter routes, which are a more prominent feature of the candidate definition under Option 2 (due to the lower distance threshold and the focus on London), so the distribution of services under Option 2 is more strongly affected by a more pessimistic assumption about how passenger demand (and fare revenue) will recover by 2024/25.

4.24 Under a "high growth" scenario, the picture is broadly similar to the central case scenario, though the distribution of services under all options includes more highly profitable services and fewer marginally profitable services (just 9% of services under Options 1 and 2, and 12% under Option 3).

Table 4.2: Market segmentation assessment criteria for High and Low revenue scenarios

	Market segmentation option		
	1	2	3
High			
The % of highly profitable services that are captured by this definition	37%	54%	23%
The % of services captured by this definition that are highly profitable	66%	70%	76%
The % of services captured by this definition that are marginally profitable	9%	9%	12%
The % of services captured by this definition that are unprofitable	25%	20%	12%
Central			
The % of highly profitable services that are captured by this definition	39%	64%	25%
The % of services captured by this definition that are highly profitable	44%	52%	53%
The % of services captured by this definition that are marginally profitable	25%	18%	24%
The % of services captured by this definition that are unprofitable	31%	30%	24%
Low			
The % of highly profitable services that are captured by this definition	73%	73%	55%
The % of services captured by this definition that are highly profitable	25%	18%	35%
The % of services captured by this definition that are marginally profitable	19%	20%	12%
The % of services captured by this definition that are unprofitable	56%	61%	53%

Key Findings

4.25 Overall, the above analysis has shown that, despite forecast net revenues declining somewhat for the first year of CP7, relative to the analysis conducted in PR18, the existing interurban definition does hold up reasonably well in identifying those interurban-type services which are likely to be able to bear an ICC. For the more profitable London-based flows, a definition based on that used for PR18 can be adopted, namely Option 3. This could reasonably be extended to include other interurban destinations and some of the longer distance commuter services (Option 2).

4.26 A key consideration for all these definitions, and particularly Options 1 and 2, is the number of service codes identified as 'marginally profitable'. This is because a potential open access operator may choose not to provide services on such flows if the additional ICC was levied at the current level of £4 per train mile. This is discussed further in the following chapter, which focuses on the high-level implications of this analysis for ability to bear.

5 High-Level Implications for Ability to Bear

Implications for ability to bear

5.1 The net revenue analysis and the market segmentation exercise described in the previous chapters provide the structure for our understanding of the ability to bear an ICC, and hence the potential level of the charge to be determined by ORR. However, given that the level of other track access charges is yet to be determined, it is not possible to determine exactly what level of ICC can be borne by open access operators in CP7. We also note that, for the reasons discussed below, even when these charges are available, the net revenue analysis will inform rather than directly determine the appropriate level for an ICC.

5.2 However, from the analysis presented in this report, we can draw the following high-level conclusions:

- The ability of the overall GB rail market to bear an ICC has likely declined since the PR18 analysis was completed, and it is not expected to fully recover by the beginning of CP7 (as shown in Figure 3.1 and Figure 3.2 in Chapter 3)
- However, the updated net revenue analysis has demonstrated that the same categories of services are generally the most profitable: long-distance interurban and long-distance commuting to London.
- Our analysis also indicates rail services to/from London generally exhibit higher net revenues than those to/from other cities.
- We have been able to identify candidate market segment definitions which broadly capture these types of services.

Other considerations for the determination of the level of an ICC

5.3 As stated above, the net revenue analysis will inform rather than directly determine the appropriate level for an ICC. We identify below three relevant considerations when using the net revenue analysis to inform the appropriate level of an ICC for a given market segment.

Time of day/week variation

5.4 The time-of-day and day of week of a given service is likely to influence the profitability of the service, and consequently the ability to bear a charge. As explained in Chapter 3, market segmentation cannot in practice be based on time of day as we understand that Network Rail are not able to charge an ICC on just peak services (at least not without changing billing capability). This means that market segmentation has to remain at service code level for practical reasons.

5.5 However, in considering ability to bear, it is necessary to consider how net revenue may vary within service codes (i.e. according to time-of-day or day-of-week). This is particularly the case

if services are operated at particular times of the day or week, rather than being spread evenly across different times of the day/week.

5.6 We note that both fare revenue and costs may be affected by this consideration. For example, a given open access service could in theory be concentrated at the most revenue generating times of the week, such as Sunday afternoons on interurban flows, where rolling stock is available and there is higher demand post Covid. All other things equal, this service may have a higher ability to bear an ICC than an equivalent service operating across different time slots. However, to the extent that this would be feasible, it seems likely that some costs (e.g. staff costs) will also be higher at these times. This could mean that the net revenue associated with such services may not differ significantly from that of services operated at other times.

Dynamic market considerations

5.7 Notwithstanding the time-of-day dimension, calculating ability to bear from net revenue may also depend on the scenario under consideration e.g. whether the open access service is an existing operator or a new entrant, and whether one or more existing TOCs operate on the same route. While it may not be possible to fully reflect individual circumstances while also setting an ICC in a practicable way for a given market segment, these factors would need to be considered further as part of determining the level of any charge.

Economies of Scale

5.8 In addition to the above considerations, the net revenue analysis outputs potentially indicate the presence of some economies of scale cost savings that may not be applicable to open access operators, as explained in paragraph 3.55 above. The impact of this would need to be considered as part of determining the level of any charge.

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