

REVENUE ANALYSIS REPORT



Department
for Transport

SYSTRA

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EXECUTIVE SUMMARY

Introduction

In January 2020, a Single Leg Pricing (SLP) Trial was introduced on three London North Eastern Railway (LNER) flows to/from London to Leeds, Newcastle and Edinburgh to provide a fairer and simpler fares structure. It is noted that LNER implemented Single Leg Pricing (i.e. selling Walk-Up Singles for ~50% of the Walk-Up Return price) before the January 2020 trial. The trial mainly involved removing the Walk-Up Returns and customers would need to buy two Walk-Up Singles (adding up to approximately the same price) or mix-and-match Walk-Up and Advance tickets for the different legs of their journey. It also meant that the Off-Peak Return was removed leaving passengers with a choice between advance tickets, super off-peak tickets or anytime tickets.

It is noted that a significant change that is likely to have an impact is the removal of the Off-Peak Return and its replacement with either advance tickets or the Anytime Singles as the only available Walk-Up option, and the resultant change in passenger ticket choices. Also, even though the Super Off-Peak Single sold online was also priced at 50% of the Return, Super Off-Peak Singles from other retail channels were still being sold at significantly higher prices; this is still the case on the other LNER flows. Given that previous work demonstrated that digital sales account for 85%+ of ticket sales, it is unlikely that a significant number of Leeds, Newcastle and Edinburgh customers were buying these more expensive Super Off-Peak Single tickets before January 2020.

In January 2020, SYSTRA Ltd were commissioned to undertake an evaluation of the SLP Trial, and have been working closely with the Rail Delivery Group, Department for Transport (DfT) and LNER to successfully achieve the aim of the project.

Evaluation Objectives

The aim of the trial evaluation was to assess the impact on the trial flow's *revenues* and *customer satisfaction*. A successful outcome for the trial would be for the impact to be revenue neutral. Improving the passenger experience and reducing complexity were also objectives, but these are not the subject of this specific report.

Methodology

The evaluation methodology has two main elements:

- a customer survey aimed to understand customers' satisfaction as well as changes ticket choice behaviours due to the Trial, and
- analysis of ticket sales data aimed at understanding the revenue impact of the Trial.

COVID-19

The COVID-19 pandemic hit soon after the start of this evaluation study, which meant that the project was paused. The project restarted in November 2021, by focussing on the analysis of ticket sales data. This analysis involved:

- high-level comparisons of revenues, journeys and market shares of the different ticket types on the Trial flows with control flows, and

LNER SLP trial revenue analysis

Intermediate report



- regression analyses of revenues from 2019/20 designed to estimate any statistically significant revenue impact of the Trial.

Control flows were chosen across LNER and other Train Operating Companies that are similar with the Trial flows, except for the introduction of the SLP Trial in January 2020.

Findings

The regressions were not able to detect any revenue impact on the trial flows, suggesting there is no significant effect of the SLP trial on revenue neither positively nor negatively. This is mainly because the impacts from the COVID-19 pandemic were felt soon after the start of the trial, which dominated the variance in revenue growth across the trial and control flows. It is possible that similar analyses that uses a more stable “new normal” as a baseline may detect a revenue impact from the Trial. Based on the regression analysis undertaken to date, it is not clear whether there would be a significant revenue impact, either positive or negative, if the SLP trial were to be introduced across other LNER flows.



1. INTRODUCTION

- 1.1.1 The Single Leg Pricing (SLP) trial was implemented on specific LNER flows; London to/from Edinburgh, London to/from Newcastle and London to/from Leeds, with the aim of providing customers with a fairer and simpler fare structure. The price per leg potentially becomes cheaper and allows passengers to mix different types of tickets for the different legs of their journeys, e.g. an Advance ticket for the outbound journey, and a Single Walk-Up for the return journey for which they may be unsure about when they will travel. Such a simpler fare structure is also a potential enabler for Pay-As-You-Go and dynamic pricing that ensures fares are more aligned with demand.
- 1.1.2 Single Leg Pricing was not a completely new change in the fare structure to LNER. Tickets were sometimes available at around half of the return price before the January 2020 trial. A significant change of the SLP trial that is likely to have an impact is the removal of the Off-Peak Return. This ticket has been removed from sale on the trial flows and its Walk-Up replacement is the more expensive Anytime Single available at the same time. Another factor to consider is that before the SLP trial, there were Super Off-Peak Singles sold online at half the price of the Return. As well as this, Super Off-Peak Singles sold offline were still being sold at significantly higher prices; this is still the case on the other LNER flows. SYSTRA Ltd were tasked with evaluating the impact of the SLP trial, understanding the impact on both revenue and customer satisfaction. The study also considers the impact of COVID-19 on both the trials and the operating context for the trial.
- 1.1.3 The scope of the analysis however has changed over time. SYSTRA Ltd were commissioned in 2019 to identify the impacts of the (then) upcoming SLP trial, whilst working closely with the Client, the Rail Delivery Group, alongside the Department for Transport and LNER. The COVID-19 pandemic hit Great Britain in March 2020, two months after the beginning of the SLP trial on the Edinburgh, Leeds and Newcastle flows. This greatly restricted the amount of useable data for this analysis, as most of the post-SLP trial phase has been heavily affected by COVID-19, disrupting any ongoing trends. Due to COVID-19 and the impact of SLP over 2020, 2021 and 2022, to isolate just the SLP trial, it was agreed with the Client that there would be more of a focus placed on understanding the impact of the trial in the latter years and when the impact of COVID-19 was less prevalent on travel demand i.e. periods when government restrictions were lifted.
- 1.1.4 The whole evaluation aims to provide a summative assessment of the impact of the current SLP trials on both revenue and customer satisfaction. It includes consideration of the counterfactual and whether the trials have had more or less impact on particular demographic/user groups. The study will also consider the impact of COVID-19 on both the trials and the operating context for SLP. The aim of this report is to set out the methodology and provide results on the evaluation of the revenue impact of the trial. The evaluation of the customer satisfaction element will follow, along with a summative assessment of the two elements. The customer satisfaction element will be achieved with the use of a survey, where



passengers' views on SLP will be compared with views of passengers on other flows on which it is not implemented, covering factors such as simplicity of the fare structure, flexibility that it may have allowed them to have in terms of mixing tickets for their outward and return legs, analysis of benefits and disbenefits, overall satisfaction levels, etc. For the revenue element of the evaluation, the focus is to provide an assessment of the **revenue** impact of the current SLP trials, considering the counterfactual based on comparable flows on LNER and other Train Operating Companies (TOCs).

1.1.5 This revenue report therefore covers the following topics:

- Context;
- Methodology, including inputs and assumptions;
- Caveats and assumptions of the analysis;
- High-level and regression findings; and
- Assurance.

2. CONTEXT

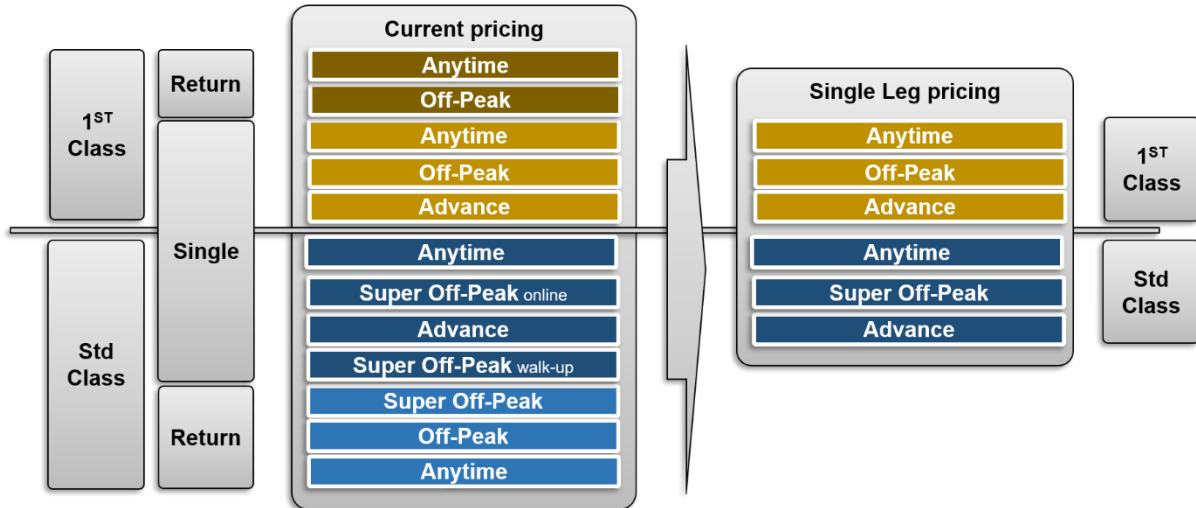
2.1.1 The purpose of this analysis is to estimate the revenue impact of the Single Leg Pricing Trial for LNER on the following flows (journeys in both directions):

- London <-> Edinburgh
- London <-> Newcastle
- London <-> Leeds

2.1.2 This analysis is to also estimate what the potential revenue impacts would be if LNER introduced the SLP trial onto the rest of their network.

2.1.3 Figure 1 shows the changes to the fare structure due to the Single Leg Pricing trial. This demonstrates how all Return tickets have been removed, simplifying the options available to the Anytime Single, Super Off-Peak Single and Advance Single for Standard Class. For the trial flows, as well as all Return tickets being removed, their corresponding Single ticket is available at approximately half the price of their Return. It is noted that the Anytime Single and the Super Off-Peak (online) were already priced at 50% of the Return across all LNER flows before the January 2020 trial. The Super Off-Peak Single (Walk-Up) is still being sold at significantly higher prices compared to the Super Off-Peak Single (online) on the non-trial flows.

Figure 1. Single Leg Pricing Trial Fares Simplification

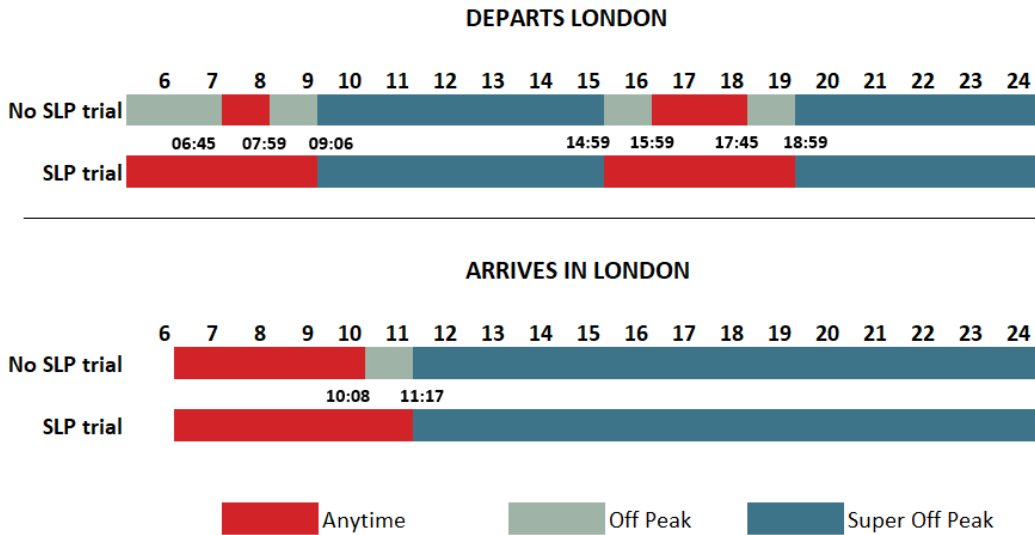


2.1.4 This change also meant that the Off-Peak Return was no longer available for flexible travel in the shoulder peak and was replaced with the Anytime Single. This is due to the Anytime being the only Walk-Up fare available for travel departing London before 09:06 (Mon – Fri), 14:59 – 18:59 (Mon – Thurs) and arriving into London before 11:17 (Mon – Fri). The removal of these Off-Peak Return tickets, as part of the SLP trial, therefore reduced the availability of cheaper flexible tickets at those times and has limited their Walk-Up ticket to an Anytime, as shown in Figure 2.

Advance tickets are typically available during peak and off-peak times as another ticket option to the passenger, however they do not provide the same flexibility of Walk-Up tickets (including the Anytime and Off-Peak).

2.1.5 SLP trials on LNER were implemented with effect from 2nd January 2020.

Figure 2. Cheapest Walk-Up Ticket Availability Before and After SLP Trial



- 2.1.6 The SLP trial is expected to have an impact on Train Operating Company (TOC) revenues, due to changes in yield on some journeys, some passengers switching ticket types, the response to cheaper fares (available through mixing-and-matching Walk-Up and Advance fares) and more expensive fares (for those still wishing to travel flexibly in both directions at times when the Off-Peak Return was previously available, rather than mixing and matching with flexible and advance tickets).
- 2.1.7 To understand the revenue impact of the SLP trial, it is necessary to analyse the revenue against the counterfactual. Similar flows to the trial flows have been selected amongst LNER and other TOCs to serve as a comparison.
- 2.1.8 The comparisons however were impacted by COVID-19 which has fundamentally changed passenger behaviour and revenues. As COVID-19 started very shortly after the commencement of the SLP trial, the revenue impact of SLP should be evaluated in comparison to what would have happened without the SLP trial in the same circumstances, as opposed to revenue prior to the COVID-19 pandemic. Section 3 sets out the methodology of the analysis completed to estimate the revenue impact of the SLP trial.

3. METHODOLOGY

This section discusses the methodology undertaken and what was considered to complete the analyses on the impact of revenues for the SLP trial evaluation.

3.1 Overview

- 3.1.1 To understand the revenue impact of the SLP trial, it was proposed that control flow analysis was completed on LENNON earnings and sales data over a specific period of time. The control flow analysis takes the three trial flows on which the SLP trial has been implemented. These are then compared with 'control' flows that are otherwise assumed to be similar, particularly in terms of revenue growth. This means that once any specific events or differences are considered, the main difference in theory should be the isolation of revenue impacts from the SLP trial.
- 3.1.2 The main assumption behind this analysis is that the difference in revenue growth between the trial and the control flows is due to SLP, unless otherwise considered. The more control flows used to compare the trial flows with, the more robust the estimate of the revenue impact of SLP will be. Ideally, the control flows would also have similar historical growth levels and journey purpose and ticket type mixes which would then allow the results to isolate the impacts of SLP on the trial flows.

3.2 Trial and Control Flows

- 3.2.1 The trial flows, along with their respective control flows are listed in Table 1, as agreed between the project team, RDG, LNER and DfT.
- 3.2.2 The LNER flows are shown in **red**, and all flows have London as their origin/destination.

Table 1. List of Control Flows

Trial Flow: Leeds	Trial Flow: Edinburgh	Trial Flow: Newcastle
Bradford	Dundee	Darlington
Garforth	Falkirk	Durham
Harrogate	Fife South	Haltwhistle
Ilkley	North Berwick	Morpeth
Keighley	Glasgow	Sunderland
Wakefield		Cardiff
York		Exeter
Birmingham		Liverpool
Bristol		Plymouth
Manchester		Swansea
Sheffield		Tyneside Valley

3.2.3 These were selected due to their similarities with the Leeds, Newcastle and Edinburgh flows on the basis of historical growth levels, journey purpose and ticket type mixes. An assessment matrix was developed, based on a mixture of analysis and professional judgement, whilst considering a set of important factors, including: distance, volume, journey purpose/ticket type mix, average fare and whether SLP is currently implemented.

3.3 Key Events

3.3.1 Prior to the analysis of the trial and control flows, it was important to set out the key events on these flows (for both LNER and other TOCS) that may have had an impact on revenue.

3.3.2 Over the last several years, a range of changes were made to the fare structure on LNER services in the trial areas. Some of these changes moved the fare structure closer to Single Leg Pricing and thus may reduce the extent of the revenue impact of the January 2020 trial. However, soon after the commencement of the SLP trial, COVID-19 began to have an impact on rail travel across the UK. The combination of national lockdowns, regional restrictions, guidance to work from home, and fear of infection all contributed to significant, and fluctuating impacts on rail demand and significant reductions in train capacities.

3.3.3 It is important to understand any significant events which overlap with the timelines of this analysis. If such events are not identified and included in the analysis, their impacts could be wrongly attributed to the SLP Trial.

3.3.4 Events are therefore taken into consideration so that they do not impact what is perceived to be a change in demand levels in the analyses. In addition, the following key changes may affect travel behaviour and have therefore impacted both the choice of data and subsequent analysis.

3.3.5 The following events in Table 2 list the changes with respect to fare structure on LNER over the last decade, up until the introduction of the SLP trial. This provides details of the events

which may impact the results, as well as the SLP trial, in terms of the fares seen by the passenger. These were provided by DfT and completed by LNER as part of the data request.

Table 2. Key Dates of changes with respect to fares structure on LNER

Events	Important dates	Commencement Date	The end date, if applicable	Flows which have been affected (trial/control)	Indication of overall expected or estimated, level of revenue impact
Super Off-Peak Singles offered at 50% discount (i.e. slightly cheaper than 50% of the Return) provided customers purchased the ticket one day or more before travel		June 2011	Present	All	Medium
Super Off-Peak Half available through Trainline and Evolvi with marginal price difference to existing discounted Super Off-Peak Single.		January 2016	Present	All	Medium
Super Off-Peak Half sold through own website alongside discounted Super Off-Peak Single. Former could be offered on the day of travel, unlike the latter.		March 2016	Present	All	Low
New LNER website launched, with technical issue meaning Super Off Peak Half could not be sold so 50% discounted Super Off-Peak Single was reinstated		3 September 2017	Present	All	Low
Super Off-Peak Half functionality added to LNER website		30 November 2019	Present	All	Low
SLP trial tickets on sale		30 November 2019	Present	Trial	Low
SLP trial commences removing all Return tickets between London and Leeds, Newcastle, Edinburgh offering passengers choice between Advance, Anytime or Super-Off-Peak tickets only.		2 January 2020	Present	Trial	Low

3.3.6 The above was considered when scoping the analysis. When specifying the regressions, the above events pre-2019 were simultaneously occurring across all of the flows and therefore the impact of individual events could not be distinguished. SYSTRA Ltd worked with DfT colleagues to understand the discounts that were offered on the flows analysed, and what proportion of the total sales were affected considering the price differentials on different channels. Although this was considered in the analysis, these were not defined variables in the regression modelling. It is therefore worth noting that the above impacts before the SLP trial affect all the considered trial and LNER control flows in the same way and do not contribute to the revenue impact quantification.

3.3.7 Specifically COVID-19 related, there are the following key events; however it is worth noting that as well as changes to travel advice, other considerations have come into play such as fear of infections and changes in the onboard service, which will have impacted behaviour and continue to do so today. These have therefore been used to inform the high-level analysis when profiling the demand and revenues, and have been taken into account in the

regressions through dummy variables that aimed to isolate their impact on revenue from that of the SLP trial.

Table 3. Key Dates of COVID-19 Restrictions in the UK

Events	Commencement Date
COVID-19 begins to impact passenger numbers with slight decrease compared to 2019	March 2020
Government recommendation to stay at home where possible leads to drop in demand.	16 March 2020
National lockdown leads to demand dropping to minimal levels	23 March 2020
National passenger numbers return to 30% of 2019 levels for the first time since March.	August 2020
National demand returns to highest level since March, before dropping as advice changes back to work from home where possible.	September 2020
Second national lockdown and three-tier system introduced depressed passenger numbers.	November 2020
Slight increase in demand as economy re-opens, before drop as restrictions tightened again by Christmas.	December 2020
Tier 4 restrictions came into force in London and South East England.	21 December 2020
England enters a third national lockdown	6 January 2021
Step 1 of roadmap begins. 'Stay at home' order ends but people are encouraged to stay local.	29 March 2021
Step 2 of roadmap begins. Reopening of non-essential amenities, outdoor avenues, holiday accommodation, etc.	12 April 2021
Step 3 – indoor venues reopened and can now attend large events.	17 May 2021
Plan 'B' measures announced due to spread of Omicron variant and mandatory COVID-19 passes, causing a large drop in demand.	December 2021

- 3.3.8 There are more specific events relating to the COVID-19 pandemic restrictions, including the local lockdowns of certain areas in England and the differing restrictions in both Wales and Scotland. It was noted that if there were substantial impacts due to differing restrictions, these would be identified in the high-level analysis and therefore accounted for.
- 3.3.9 More specific events in terms of operational impacts on LNER services have been provided by DfT and completed by LNER as part of the data request:

Table 4. Other LNER Operational Impacts

Events	Commencement Date	The end date, if applicable	Flows which have been affected (trial/control)	Indication of overall expected or estimated, level of revenue impact
New LNER Azuma rolling stock	15 th May 2019	Present	All	High
SplitSave initiative started via the Trainline (TTL) website	Trialed in October 2019 and slowly ramped in to be 100% of TTL app by January 2020	Present	All	Medium
Introduction of ROSE, LNER's new Revenue Management System (RMS).	18 October 2019 (ROSE went live, with old RMS running in parallel)	Present	All	High
Seat assurance introduced on LNER, meaning passengers could not travel on services without a reservation. Advance tickets and reservations available up to five minutes prior to departure of a service, compared to 40 minutes previously.	18 th May 2020	Present	All	Low
Friday ticket easement introduced on all services to and from London Kings Cross (and Stevenage), allowing Off-Peak and Super Off-Peak tickets to be available all day on Fridays.	21 st August 2020	Present	All	Low
Lumo services introduced from London to Edinburgh and Newcastle	25 th October 2021	Present	All	High
Significant engineering works	Various dates – provided separately	Present	All	High

3.3.10 Another factor that is expected to possibly affect the revenue estimates is passengers taking advantage of the system. In particular, this could include using the new SLP products for travel on alternative LNER flows, where the intended journey is to a location just before or after a trial flow destination; for example buying a London – Leeds ticket for a London – Wakefield/Doncaster/Retford journey. Where these types of locations form comparator flows, checks were in place to look out for comparative declines in volumes of journeys on ticket types that would have been purchased rather than a SLP fare. This behaviour may exaggerate the negative revenue impacts of SLP, as people would cherry-pick SLP trial flows if they were offered the best deal and then use workarounds that wouldn't be available in a wholly SLP system if those proved cheaper. There is the possibility that since the removal of the Off-Peak Return, passengers may realise that a station after or before the trial flow still sells an Off-Peak Return rather than an Anytime Single and make use of this.

3.3.11 The initial launch of the system did not impose any routing restrictions on the SLP trial offering opportunities for their use for journeys across other operators. This was subsequently changed to restrict route choice to East Coast services, thus removing this loophole with effect from 2nd March 2020. The volumes of passengers likely to have taken advantage of it are very



small, due to the level of understanding of the ticketing system required and limited window during which it was permissible, thus it is not expected to have an impact on the analysis.

- 3.3.12 The analyses undertaken as part of this evaluation looks at the revenue impact in aggregate, considering the impact of all such behaviour as well as the expected behavioural changes from the SLP trial.

3.4 Primary and Secondary Analysis

- 3.4.1 Two types of analysis were undertaken to understand the revenue impact of the SLP trial. The primary analysis compares **all control** flows (LNER and non-LNER services) against the trial flows to understand the impact the SLP trial has had on revenues. The secondary analysis was to look specifically into the **LNER control** flows to estimate the impact of the SLP trial if it were to be introduced across other LNER flows.
- 3.4.2 The two types of analysis were specified in the regression analysis and high-level comparisons were also completed.

3.5 Inputs

- 3.5.1 Prior to the analysis, SYSTRA Ltd requested LENNON data from DfT/RDG to apply the data in the analysis to understand the revenue impacts. The request was for earnings and sales data by TOC between Rail Periods 2015/P01 and 2022/P12, with Rail Years 2015-2022 being equivalent to Financial Years 2014/15-2021/22. This included all journeys to/from London (and the London Travelcard Area) to the Ticket Zone of the trial flow cities, as well as all the control flows listed in Table 1. Before COVID-19, the aim of this evaluation was to analyse long-term trends starting in 2015. Instead, there was a focus on the primary and secondary analyses of the SLP trial as defined above. This is instead of the focus on the impacts of SLP as a whole which has developed over time before the SLP trial began in January 2019. This was to feed into policy decisions relating to the roll out of the SLP across the rest of LNER and focused on the data from 2019 and onwards. Any data pre-2019 however was used to assess initial impacts, validate the trends and quality assure the work realised.
- 3.5.2 The request included a breakdown by ticket type, with the exclusion of Season tickets. This is due to the chosen flows being long-distance which are assumed to not be heavily impacted by commuter journeys.
- 3.5.3 For each flow in the periodic time series, calculations in the high-level analysis were done to understand the overall year-on-year growth for both revenue and journeys, as well as comparing each period (and an average of periods) with the same for previous years to identify trends. This review of the growths, along with the averaging of two periods in both analyses (high-level and regressions) ensured that seasonality did not affect the analysis.



3.6 Data Processing

- 3.6.1 Due to the large LENNON datasets received in .csv files, these were uploaded into a database, then cleaned and processed with SQL Server. This allowed for the merging of files and setup of categorisation for each line entry. This included the origin-destination journeys being matched to the non-London stations, each sector being identified with flags (e.g. trial flows with their respective control flows), inclusion of TOC flags for the primary and secondary analyses and values also being converted into useable formats. Revenue and journey numbers were summed by flow, period, TOC and ticket type, and exported into a single manageable .csv file.

3.7 High-Level Analysis

- 3.7.1 High-level analysis of the revenue data allowed for identification of any nuances in the data and an initial review of the results. Initially, there were various checks on the data received by profiling the entire dataset, broken down in various ways including by TOC, ticket type and flow. This helped to identify any issues and resolve these before commencing in-depth analysis.
- 3.7.2 For the analysis, the changes in market share by ticket type and changes of average yield were compared with the control flows (both LNER-specific and all TOC control flows separately). These demonstrated what the results are expected to look like and how passengers have responded to the availability of ticket types as well as other potentially known, or unknown, factors.
- 3.7.3 This element focused on both LNER control flows and all control flows, as part of the primary and secondary analyses respectively. There was also a focus on the average of the two Rail Periods of P11/12 for Rail Year 2020 and 2019. These are two periods which do not include the effects of COVID-19 and also allow for a comparison of pre and post-SLP revenue.
- 3.7.4 For comparison purposes, all high-level results are shown in Real 2018/19 prices.

3.8 Regression Analysis

- 3.8.1 At a more detailed level, the regression analysis aimed to estimate the revenue impact of the SLP trial on the trial flows as well as identifying the drivers behind the changes in revenue, after taking account of a range of other factors that may have led to a difference in the revenue relative to the control flows.
- 3.8.2 The regression model compared the average revenue across Rail Periods 11 & 12, for Rail Years 2019 to 2022. P11 and P12 are the only periods which account for the SLP trial, so averaging the two of these creates a more representative dataset accounting for impacts such as seasonality. There was also an initial focus on the P11 data 2019-2022 as P12 was not provided until later on in the analysis. It is worth noting that looking at revenues before 2019

would have created a stronger and more reliable dataset for the revenue impact prior to the SLP trial. However, due to the results discussed below, it is unlikely that looking at these revenues would have had an impact on the results and would have only provided further insight into the long-term impacts of SLP, rather than the focus on the trial itself.

- 3.8.3 It was decided to only consider P11 and P12 for the regressions, as they are the only post-trial and pre-COVID-19 periods available (in Rail Year 2020). Separately, the regression analysis tries to identify any differences in revenue in 2021 and 2022 as well. The analysis therefore takes into account the average revenue for Periods 11 and 12, for individual Rail Years 2019 through to 2022. This allows for the consideration of a range of impacts since the implementation of the SLP trial, including the impact of the COVID-19 pandemic and indicators on potential recovery (see Table 5).

Table 5. Interactions between COVID-19 and SLP for Trial vs Control Flows

	Trial Flows SLP	Trial Flows COVID 19	Control Flows SLP	Control Flows COVID 19
P11/12 2019	X	X	X	X
P11/12 2020	✓	X	X	X
P11/12 2021	✓	✓	X	✓
P11/12 2022	✓	✓	X	✓

- 3.8.4 A Difference-in-Difference (DID) analysis methodology has been used to analyse the revenue impacts. This approach compares the changes in outcomes over time between the trial flows and the control flows.
- 3.8.5 Whilst the same process was applied to both, the pre and during COVID-19 results were treated differently with respect to the change in total revenues, given the volumes of revenue were expected to be fundamentally different. The key question the analysis has tried to understand is the extent to which revenue would have been different without SLP, hence the use of comparator flows. This is opposed to the comparison to previous revenues, since comparison of revenues before and after the SLP trial will be rendered meaningless by the impact of COVID-19. For both regressions (taking into account only LNER or all control flows), two excel regression tools were used to validate the results and a second validation was undertaken using only P11.
- 3.8.6 Events are taken into consideration so that they do not impact what is perceived to be a change in revenue and demand levels in the analysis. COVID-19 and its impacts were taken into account through year-specific dummy variables (in effect differentiating 2019, 2020, 2021 and 2022). This dummy variable isolated the average impact of COVID-19 in these years across all trial and control flows. A second set of dummies accounted for the differences in the impact of COVID-19 in these specific years between the selected trial and control flows.
- 3.8.7 LNER-specific key events have been discounted in the secondary analysis, which only looked at LNER trial and control flows. This is because the impacts of any LNER-specific event are



assumed to be equal across all LNER flows. In the primary analysis, which analysed the impact of the SLP trial for the trial flows compared to all control flows across all TOCs, LNER trial flows were singled out and high-end TOC specification added that would segregate LNER-only impacts.

3.8.8 The below highlights what the DID analysis considered:

- SLP trial flows and Periods from P11/2020 are identified using a dummy variable that takes the value of 1; the control flows take the value of 0. Specification of the trial/control flows and the timelines of before/after the trial period of each of the trial/control flows is required for this.
- This controls for the unobserved heterogeneity of the flows (via fixed effects) i.e. for each of the three trial flows and their corresponding control flows, a dummy variable would pick up the impact of the unobserved factors on revenue growth. This is an extension of the base DID model.
- Controls for the COVID-19 pandemic effects (different restrictions and phases: pre-COVID-19, during COVID-19 and post-COVID-19)

3.8.9 For this analysis, the dummy variables on the relevant flows and Rail Periods account for a range of other factors that would have affected revenue as described above, on both the trial and LNER control flows. These include impacts such as:

- The introduction of new revenue management systems (e.g. on LNER from January 2020) affecting all LNER flows;
- New rolling stock (e.g. Azuma on LNER ongoing from May 2019);
- Significant engineering works;
- Split ticketing being available via the Trainline website from early 2020; and
- The switch to compulsory reservations for travel.

3.8.10 The DID revenue model was specified as follows:

- Dependent variable D: revenue($Y=Revenue$)
- Independent variables Fs: yield/fare ($X=Yield$)
- Control variables: Dummy variables (0,1) for specific flows within treatment group and control group. Similarly, dummies for time effects to account for events (e.g. lockdowns) will be estimated. Best model would only keep significant estimates.
- Design variables: Period P (before/after SLP change), Treatment T (trial/control), and their interaction to measure the SLP trial impact ($P \times T$)
- Then the simplest model equation would be: $Revenue = \beta_0 + \beta_1 \times Yield + \beta_2 \times period + \beta_3 \times treatment + \gamma \times SLP \text{ trial impact} + \dots + \text{error term}$

- The models will be estimated using MS Excel and the linear least squares method.
- The statistical significance of the estimate gamma will inform about the SQL impact:
 1. If $\gamma=0$, it would mean a neutral SLP impact
 2. If $\gamma<0$, it would mean a negative SLP impact
 3. If $\gamma>0$, it would mean a positive SLP impact

3.8.11 In effect, the dummy variables were defined as follows:

- 3 dummy variables (Design Variables) represented the timeline of the study: one for the trial phase (2020-2022), one for 2021 (during COVID-19), and one for 2022 (COVID-19 recovery). The base of the study was selected to be the pre-trial time, i.e. 2019.
- A dummy variable (Design Variable) represented the trial flows, as opposed to the control flows, used as base.
- 3 dummy variables were used as interactions (Design Variables): the trial flows dummy was multiplied with each of the 3 timeline dummies.
- Additional dummy variables (Control Variables) were tested to increase the robustness of the model: 2 dummy variables for the Edinburgh and Leeds sectors (with Newcastle used as the base). Tests were also run with additional TOC-specific dummies, which would also take into account LNER-specific key events.

3.8.12 The DID revenue model is directly used as there is a focus on understanding the revenue impact.

3.9 Caveats/Assumptions

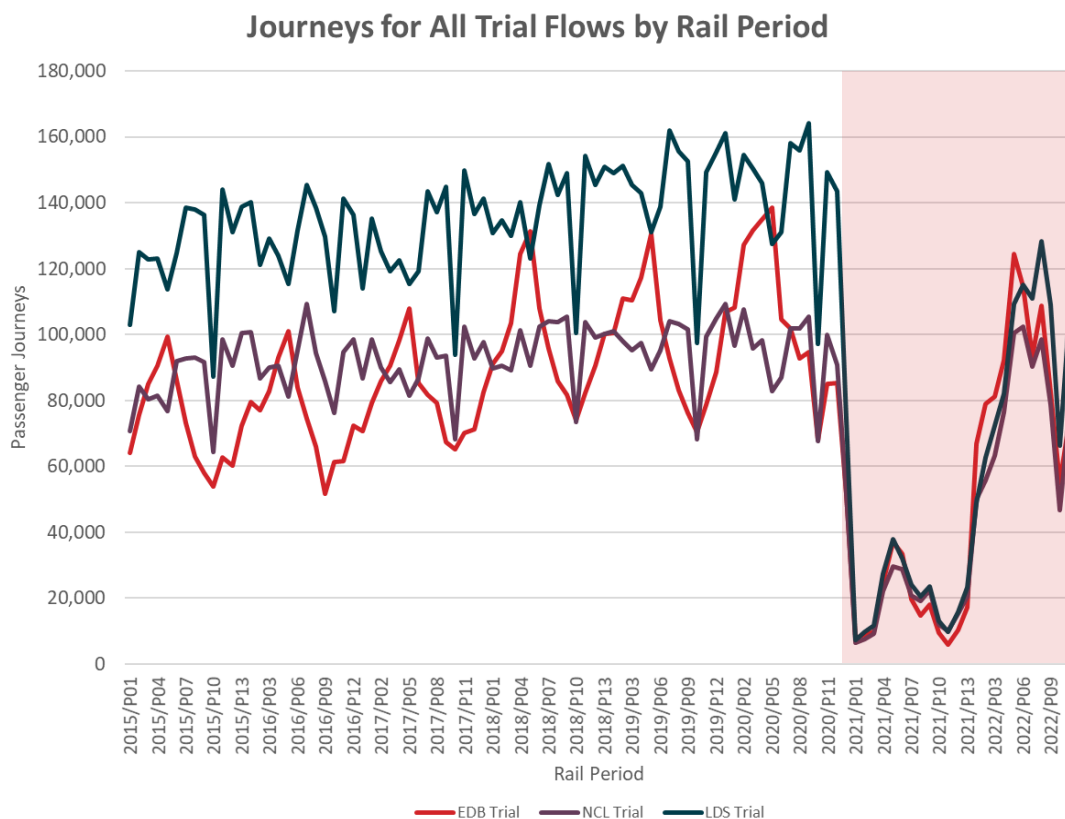
The following should be considered when reviewing the results for this analysis.

COVID-19 and the large drop in passengers observed

- 3.9.1 For the high-level analysis, there was a focus on the analysis of market share by ticket type and average yield for the periods which include minimal impacts due to the pandemic, P11/P12/2020 as shown in Figure 3. P11/P12 2020 are the only periods where the SLP trial was introduced and COVID-19 did not substantially impact revenues and journeys.
- 3.9.2 Due to the heavy disruption caused by COVID-19 in 2021, and even more so in P11/P12 2021 during full lockdown, data is more sporadic and the trends are less reliable. Results are provided regarding the revenue loss during COVID-19, but a focus has also been placed on 2022 data, as it has been assimilated to post-COVID-19 recovery and will inform on the impact of SLP in a more reliable and timely manner.

3.9.3 The regression analysis assumes that the impact of the COVID-19 pandemic and lockdowns is the same across the trial and their respective control flows. This is due to the methodology of the DID revenue model of using dummy variables, however, if there were significant differences between the trial and control, these would be identified in the high-level analysis. Through the approach of identifying discrepancies in the data from the high-level analysis and/or levels of significance in the regression modelling, this would then allow for a flag to separate the difference in the impact of COVID-19 for the particular flow. It is worth noting that the analysis did not identify any significant differences in COVID-19 impacts between the trial and control flows and therefore all flows were assumed to share the same impact on their revenues and journeys.

Figure 3. COVID-19 impact – journeys profiled by trial flow and by Rail Period



3.9.4 It is evident that COVID-19 caused a significant drop in demand and therefore revenues across the whole network from P13/2020, but also has resulted in impacts on the analysis provided in this report. As an example, in January 2021, the LNER trial flows had an overall drop of 92% in journeys in January, compared to 2020. The impacts of COVID-19 have been disruptive with various lockdowns and restrictions, which means that demand has fluctuated significantly

throughout the Periods since P13/2020. This has made it very challenging to identify the impact of the SLP trial and has therefore restricted the analysis of understanding how people ‘today’ may perceive or purchase SLP tickets, compared to considering the counterfactual of before these were available. A comparison of pre SLP and post SLP trial would thus be dominated by the impact of COVID-19, and it would be difficult to estimate impact of SLP.

- 3.9.5 Only P11/P12 for Rail Year 2020 included the Single Leg Pricing trial before the COVID-19 pandemic.
- 3.9.6 In the high-level analysis, the post-SLP data was compared to those from periods 2019/P11-2019/P12 (i.e. before the SLP trial). The comparison uses the average of the two periods pre and post-SLP, creating more reliable analysis and have been the focus of these initial findings.
- 3.9.7 In the regressions, several sets of data were analysed to estimate the revenue impact of the SLP trial:
- Primary Analysis – using the totals of all control flows
 - Model 1: 2019 to 2020 revenues combining data from P11 and P12
 - Model 2: 2019 to 2021 revenues combining data from P11 and P12
 - Model 3: 2019 to 2022 revenues combining data from P11 and P12
 - Secondary Analysis – using LNER-specific control flows
 - Model 1: 2019 to 2020 revenues combining data from P11 and P12
 - Model 2: 2019 to 2021 revenues combining data from P11 and P12
 - Model 3: 2019 to 2022 revenues combining data from P11 and P12

Data Assumptions

- 3.9.8 Revenues are compared in Real 2018/19 Prices, removing Retail Price Index (RPI) growth. This is so that the revenues are compared in a consistent price base year, accounting for inflation. This applies to the high-level analysis only as the regression modelling considers the growth across all of the flows to be equal.
- 3.9.9 It is noted however, that in September 2020 there was an increase to the price of SLP trial flow tickets in order to increase the likelihood of net revenue neutrality, increasing from 50% of a Return ticket, to 52%. As this event overlaps with the events of COVID-19, it is not possible to isolate the impacts of this fare change against the impacts due to COVID-19. However, there is a dummy variable assigned such that the regression modelling has flagged a change in revenues due to an event occurring (in this case, there are two known events).
- 3.9.10 Refunds are excluded, due to no breakdown available of refunds by ticket type. The refunds for the revenues account for approximately 4% on average across all flows pre-COVID. Season



tickets are also excluded from this analysis due to the low likelihood of the flows being commuter flows due to the relevant flows being a longer distance market.

4. FINDINGS

This section discusses the findings from the analyses, firstly covering the high-level outputs and subsequently the regression analysis.

In this section, the findings refer to the LENNON ticket type naming convention in the graphs. See Table 6 of how these are defined.

Table 6. Definition of Ticket Type Names in LENNON

LENNON Ticket Type	Ticket Type
Full (First and Standard)	Walk-Up Anytime Single/Return (First and Standard)
Reduced (First and Standard)	Walk-Up Off-Peak Single/Return (First and Standard) Walk-Up Super Off-Peak Single/Return (First and Standard)
Advance (First and Standard)	Advance Single (First and Standard)

4.1 High-Level Analysis

- 4.1.1 The results highlighted in this section analyse the change in average yield and market share by ticket type on the trial flows compared with their respective control flows.

Comparison of Changes in Earnings, Journeys and Yield

- 4.1.2 The Year-on-Year (YoY) change (2020 versus 2019) for Rail Periods 11 & 12 has been compared for all three trial flows, for earnings, passenger journeys and average yield.
- 4.1.3 Looking at the earnings and journeys in Figures 4 and 5 respectively, it is evident that these have increased in Edinburgh (EDB) for the trial flows, but the journeys for the EDB control flows have increased more. This suggests that the Edinburgh trial flow has made higher earnings than its control flows, but less journeys have happened. This has resulted in a higher yield, around 11% higher than expected where there is an assumption that the EDB trial flow would typically grow at the same rate as its control flows. The difference in yield can be seen in Figure 6.
- 4.1.4 Contrary to this, Newcastle and Leeds trial flows both have a decrease in earnings and journeys (and hence yield) compared to their control flows. This suggests that there has been a drop in demand and revenues compared to what was expected, with the shortest distance flow having the largest drop.
- 4.1.5 At an initial glance, it appeared that the longer distance the flow, the higher the revenues. This was also observed in the market share by ticket type analysis. More detailed analysis including the average yield by ticket type will also be discussed.

Figure 4. Summary of Earnings YoY Change Comparison

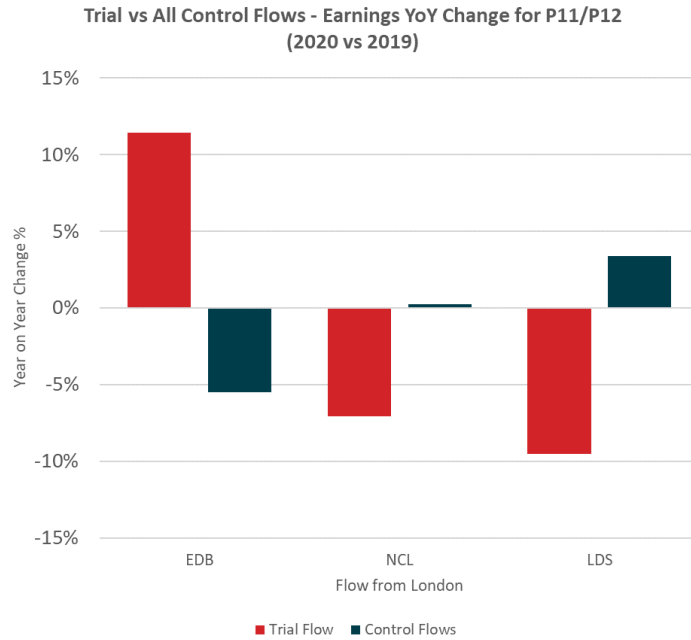


Figure 5. Summary of Journeys YoY Change Comparison

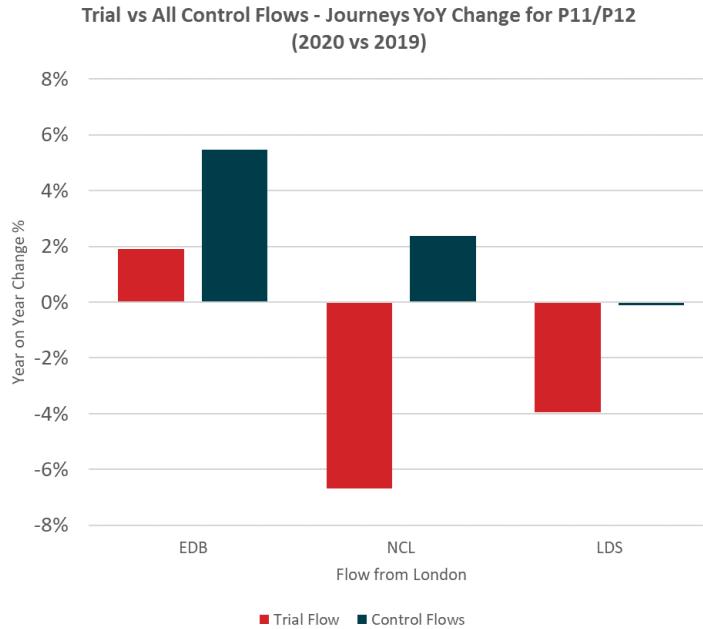
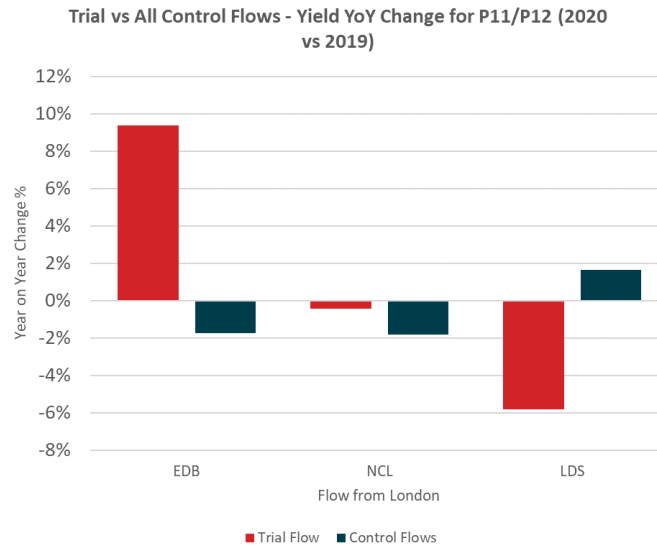


Figure 6. Summary of Average Yield YoY Change Comparison



Average Yield by Ticket Type Comparison

4.1.6 The average yield by flow and year (average of P11/P12) has been broken down by ticket type in Table 7.

4.1.7 For Edinburgh:

- There is an increase in average yield for the Trial flow across the two periods when comparing to 2019 for all ticket types except First Advance.
- For its control flows, on average there is a decrease in yield, but some ticket types are showing an increase in yield, including Standard Full.
- The Reduced (Standard & First Class) ticket types on the trial flow show that there is an increase of more than 10% change in average yield, in real terms.
- The average yield is also lower for Edinburgh than it is for Newcastle in most cases. It is worth noting that in terms of ticket fares, there is a very small difference comparing prices from London to Edinburgh with Newcastle. We understand from LNER that this difference in yield may be a function of the different mixes of leisure/business in the two markets, coupled with the fact that there are more Standard Anytime Newcastle trains southbound.

4.1.8 For the Newcastle trial flow, even though Table 7 below shows an average of a small change in yield, the change in yield varies by the ticket type, more so than the control flows.

4.1.9 For the Leeds trial flow, there is a decrease in yield for all of the Standard ticket types and the First Advance, but there is an increase in both First Full and First Reduced. This on average is showing a decrease in yield comparing 2020 with 2019. For the control flows, there is an increase in yield for all ticket types, except for the Standard Reduced and Standard Advance.

Table 7. Average Yield by Ticket Type

Rail Year	First Full	First Full	First Reduced	First Reduced	First Advance	First Advance	Standard Full	Standard Full	Standard Reduced	Standard Reduced	Standard Advance	Standard Advance
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Edinburgh Trial	£212	£220	£92	£102	£75	£73	£51	£53	£45	£50	£41	£43
Edinburgh Control	£143	£155	£63	£84	£83	£83	£54	£57	£54	£53	£40	£39
Newcastle Trial	£227	£224	£93	£106	£84	£78	£76	£81	£50	£46	£47	£57
Newcastle Control	£146	£146	£85	£95	£64	£64	£70	£77	£40	£39	£32	£31
Leeds Trial	£191	£194	£90	£95	£61	£57	£83	£80	£36	£33	£46	£46
Leeds Control	£136	£138	£72	£75	£55	£56	£70	£72	£30	£28	£29	£28

4.1.10 Note that Table 7 rounds the values of average yield to the nearest pound.

Market Share by Ticket Type

4.1.11 The market share by ticket type for journeys was analysed. This provided insights as to how demand may have shifted across the various ticket types.

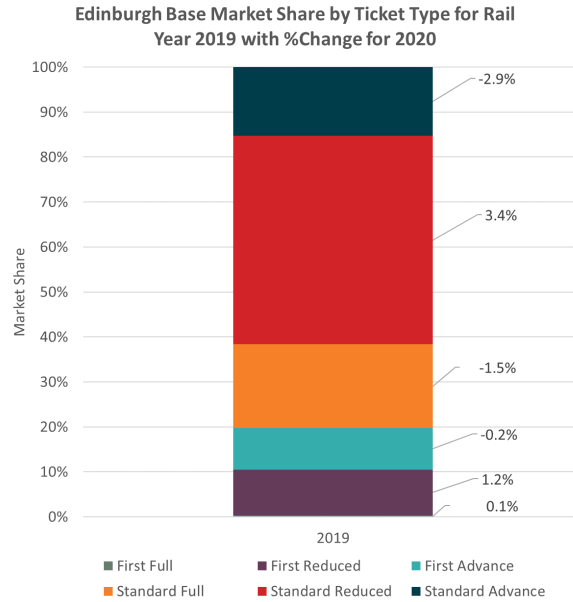
4.1.12 There was an expectation of behaviour change from the introduction of SLP, as it allows passengers to mix and match Single walk-up and Advance tickets for the different legs of the journey. Passengers which previously travelled on Off-Peak Return tickets would need to switch to either an Anytime, Super-Off Peak or an Advance ticket.

4.1.13 Observations showed that, relative to 2019, the market share of Standard Full tickets dropped in 2020 across all trial flows. Moreover, compared to other LNER control flows, the market share for Standard Reduced had decreased mainly due to the removal of the Off-Peak Return.

Edinburgh Trial Flow

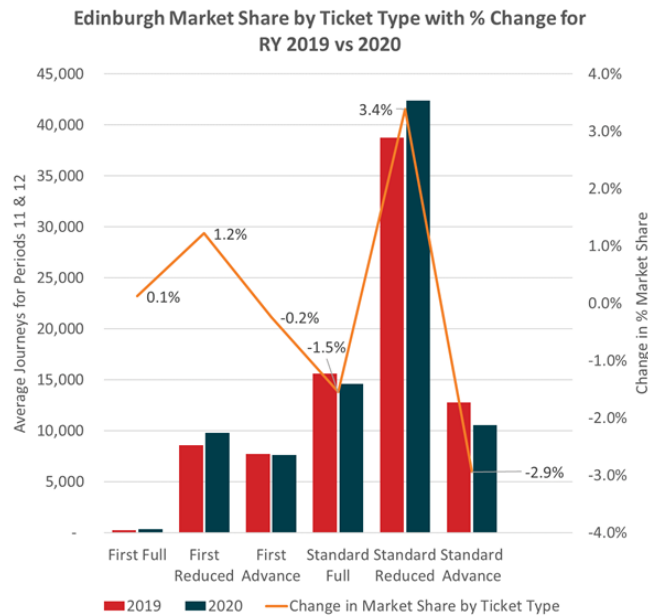
4.1.14 Figure 7 below shows the market share by ticket type (journeys) for the Edinburgh trial flow. The data label represents the percentage change in ticket type for 2020.

Figure 7. Edinburgh Market Share by Ticket Type – Bar chart



4.1.15 Figure 8 shows the number of average journeys for P11/P12 for both 2019 and 2020, as well as the change in market share. This shows an increase in Reduced ticket market share and a decrease in Advance tickets for both Standard and First Class, which had an overall net impact of an increase in average yield across all ticket types.

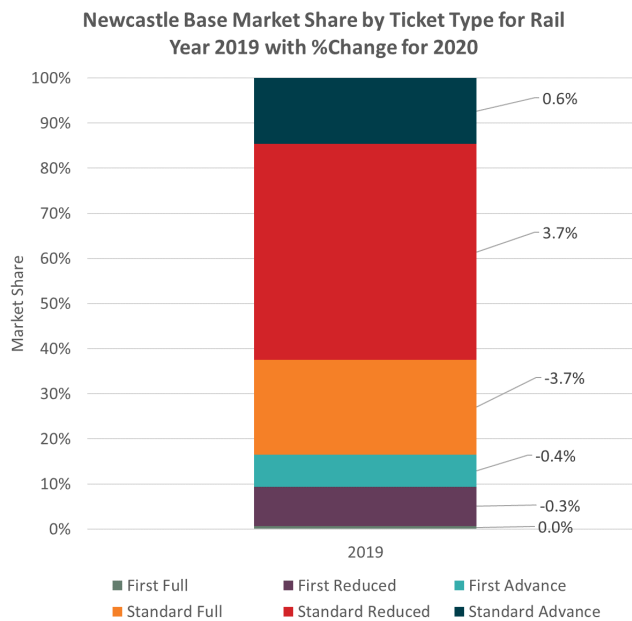
Figure 8. Edinburgh Market Share by Ticket Type and Year – Combo chart



Newcastle Trial Flow

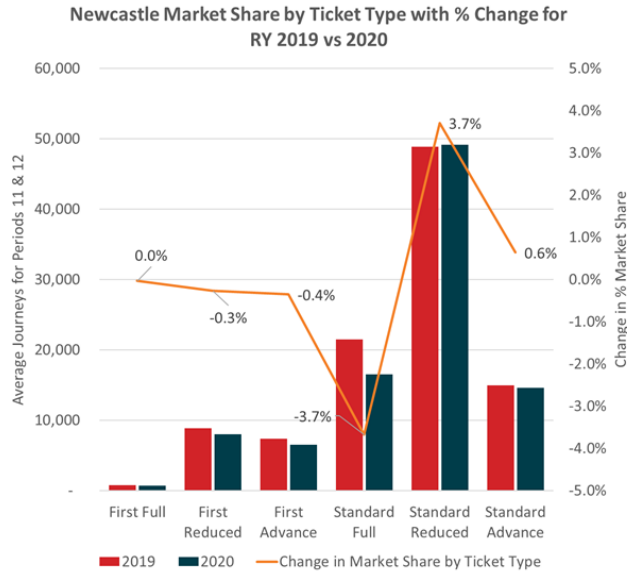
4.1.16 Figure 9 below shows that there is a drop in the Standard Full ticket type market share, with an increase in Standard Reduced market share. This is overall having a net impact on the average yield which is broadly neutral.

Figure 9. Newcastle Market Share by Ticket Type – Bar chart



4.1.17 It is worth noting that there is a slight decrease in overall journeys for 2020 for the Newcastle trial flow, hence the chart showing a drop in Standard Advance ticket journeys but an increase in percentage market share.

Figure 10. Newcastle Market Share by Ticket Type and Year – Combo chart



Leeds Trial Flow

4.1.18 For Leeds, there has been an increase in Advance ticket type market share for both Standard and First class, and a decrease in Full and Reduced tickets. This overall is resulting in a decrease in average yield across all ticket types.

Figure 11. Leeds Market Share by Ticket Type – Bar Chart

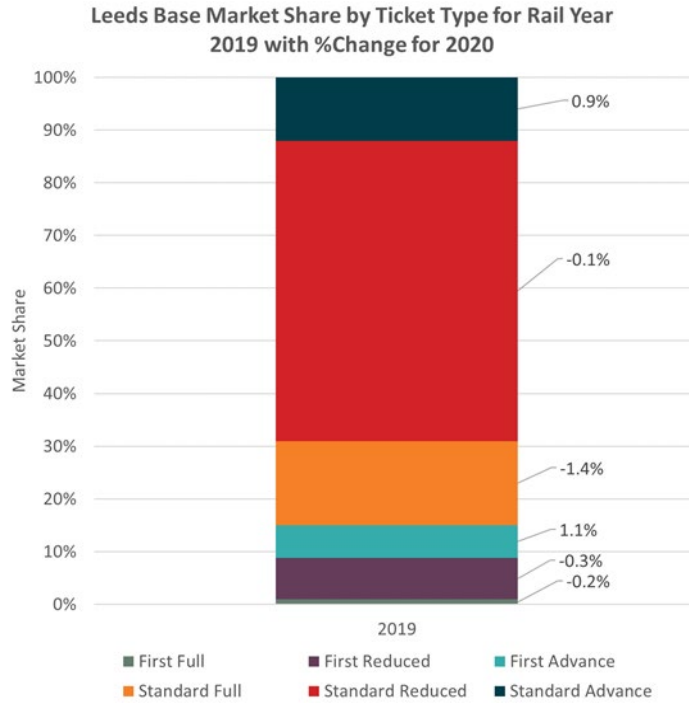
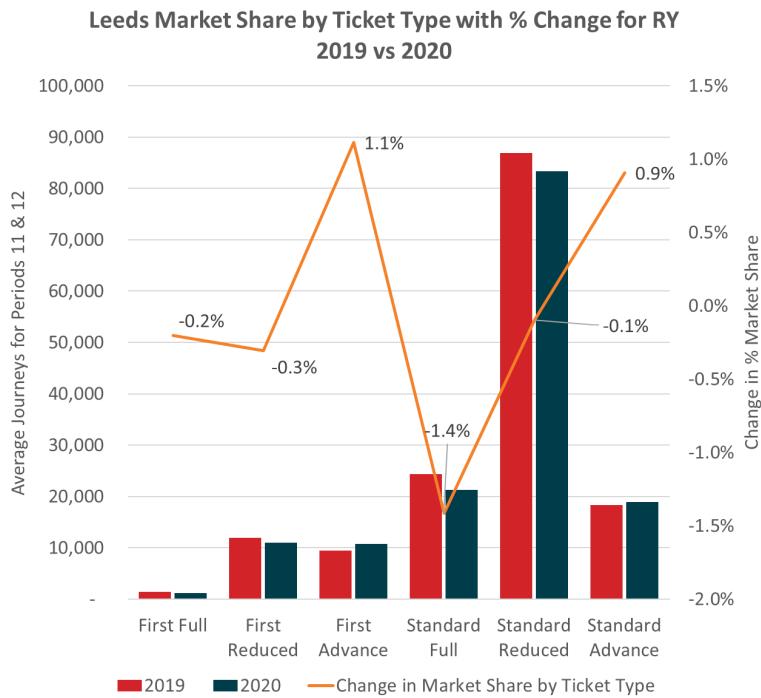


Figure 12. Leeds Market Share by Ticket Type and Year – Combo chart



Comparison of Market Share on Trial vs All Control Flows

- 4.1.19 The primary analysis aims to compare the trial flows against All Control flows, including both LNER and non-LNER specific flows, including Avanti West Coast and Great Western Railway services.
- 4.1.20 Table 8 compares the journey market share for the trial flows for each ticket type against their respective control flows. Therefore, if the value for Standard Full for Edinburgh is 0%, this would demonstrate that the Edinburgh trial flow has the same change in market share as its control flows. This would indicate that the flow is reacting in the same way, even though there is a change, which in this case is the Single Leg Pricing trial. If the value is positive, this would indicate that the Trial flow has an increase in that ticket type, above what is expected when comparing to its Control flows.
- 4.1.21 This table also shows that the Standard Reduced has increased its market share and Standard Advance has decreased its market share on the Edinburgh trial flow relative to the control flows. This comparison is affected by the Glasgow flow which has a higher market share in Advance ticket types overall, which increases even more so by 2020.
- 4.1.22 For Leeds and Newcastle, the market share of the Standard Reduced has reduced. This is most likely due to the removal of the Off-Peak Return. There is also an increase in market share for the First and Standard Advance ticket types, suggesting that passengers may be mixing-and-matching Walk-Up and Advance tickets. These effects were notably larger on the Leeds trial flow.

Table 8. Comparison of Change in Market share by Ticket Type against All Control Flows (P11/12 2020 vs 2019)

	First Full	First Reduced	First Advance	Standard Full	Standard Reduced	Standard Advance
Edinburgh	-0.1%	1.8%	0.7%	-1.1%	4.3%	-5.7%
Newcastle	0.1%	0.1%	0.5%	-1.1%	-0.2%	0.7%
Leeds	0.0%	-0.1%	1.8%	-0.4%	-3.9%	2.6%

Comparison of Market Share on Trial vs LNER Control Flows

- 4.1.23 The secondary analysis compares the trial flows against the LNER-specific flows.
- 4.1.24 Table 9 below shows that the Standard Reduced ticket type has a decrease in market share by journeys across all trial flows compared to the control flows. This is assumed to be due to the removal of the Off-Peak return, which has not been applied to the LNER control flows. Most of the results observed in the high-level analysis therefore seem to have been impacted by to the removal of the Off-Peak Return ticket.

4.1.25 The market share for Advance tickets has increased across all trial flows. On the longer distance LNER trial flows, passengers are also moving to the more expensive ticket types (e.g. Standard Full). Further tests on this suggested relationship are recommended to analyse the number of ticket types sold against distance as the regression modelling was done at an aggregated level by flow and TOC.

Table 9. Comparison of Change in Market share by Ticket Type against LNER Control Flows (P11/12 2020 vs 2019)

	First Full	First Reduced	First Advance	Standard Full	Standard Reduced	Standard Advance
Edinburgh	-0.3%	2.6%	-0.2%	2.7%	-7.7%	2.8%
Newcastle	-0.2%	0.1%	2.3%	0.2%	-3.8%	1.3%
Leeds	-0.1%	0.6%	0.6%	-0.4%	-4.0%	3.3%

4.2 Regression Analysis

4.2.1 A Difference-in-Difference approach was used to test the impact of the SLP trial. The regression models compare the trial flows (Edinburgh, Newcastle and Leeds) against all the respective control flows aggregated to estimate the revenue impact of the SLP trial. It is worth noting that comparisons at an individual flow level may be affected by flow-specific factors, which are not related to the SLP trial. Therefore it is important that all of the relevant control flows are used, with appropriate specification, as this gives more representative data.

4.2.2 Two sets of regression analyses were undertaken. The primary analysis compares the impact of the SLP trial relative to selected control flows across LNER and non-LNER services. The secondary analysis researched the impact of SLP relative to the LNER-only control flows.

4.2.3 For both analyses, the regressions were not able to detect a significant revenue impact for the SLP trial. This was mainly because COVID-related fluctuations in revenue that were dominant in the data which made the task of identifying differential changes in revenue on the trial flows due to the trial challenging.

4.2.4 Several model specifications were tested to add explanatory factors and/or isolate the impact of different factors, including:

- The average yield as independent variable
- Year on Year revenue growth was tested as dependent variable, instead of pure revenue (adjusted earnings)
- Dummy variables were added to identify the main non-LNER TOCs, to take into account TOC-specific fixed effects (differences in fares and ticketing policies, for example)
- P11 only was used for 2019-2022 instead of the average of P11/12, initially due to 2022/P12 data being unavailable, and was later used to validate the results.
- The models were specified to allow the revenue difference between the trial and control flows to be different in each of the years analysed (2020, 2021 and 2022).



- 4.2.5 The impacts of the key events, which included LNER-specific events and COVID-related events, and had been included within the dummy variables, were not noticeable either in the analysis; they were, like the effects of the SLP trial, overshadowed by COVID-19. While it is likely that the introduction of the Azuma rolling stock in 2019, or the actions of Open Access Operators have had an impact on revenue, it has not been observed in the analysis.
- 4.2.6 The results of the primary and secondary regressions, separated by year, are presented in Tables 10 and 11 respectively. The tables show the estimated effect of the SLP trial on revenue for the trial flows, compared to the control flows and the base year 2019, for the three analysed years.
- 4.2.7 The coefficients presented in the tables represent the interaction between the trial flows, and the SLP trial. The SLP trial dummy was split into the three considered years, leading to three interaction dummies, and three coefficients. The coefficients represent the revenue gain or loss for the trial flows, compared to the control flows, during the corresponding year of the SLP trial, for one rail period.

Table 10. Comparisons against LNER and non LNER control flows – Regression Results comparing with 2019 P11/12

Primary analysis: All Control Flows	Coefficients	Standard Error	t Stat	P value
2020 P11/12 trial flows	-£90,228	£1,982,186	0.0	0.96
2021 P11/12 trial flows	-£3,575,734	£1,982,186	-1.8	0.077
2022 P11/12 trial flows	-£995,476	£1,982,186	-0.5	0.62

- 4.2.8 The primary analysis, which aimed to determine the impact of SLP trial relative to all the selected control flows across all TOCs, did not indicate any significant effect of SLP on revenue for the three trial flows, as shown in Table 10 (see P-values). This is due to the impact of COVID-19, and the differences in fares, ticketing and revenue of the TOCs operating the selected control flows. The results are still in the same order of magnitude as the results of the secondary analysis, detailed below, which indicates a similar impact.

Table 11. Comparisons against LNER control flows – Regression Results comparing with 2019 P11/12

Secondary analysis: LNER Control Flows	Coefficients	Standard Error	t Stat	P value
2020 P11/12 trial flows	-£81,829	£721,559	-0.1	0.91
2021 P11/12 trial flows	-£5,033,447	£721,559	-7.0	0.000
2022 P11/12 trial flows	-£1,563,710	£721,559	-2.2	0.034

- 4.2.9 The secondary analysis, presented in Table 11, showed that, similarly, pre-Covid, the revenue impact of the SLP trial was not significant. Post-COVID, the difference between the trial and control flows has been dominated by the post-COVID recovery of the Edinburgh, Leeds and Newcastle flows relative to the control flows. It is unlikely that such analyses would recover a revenue impact of the SLP trial until a post-COVID equilibrium is reached. This also suggests that a similar conclusion would be reached if the SLP trial were to be introduced to the rest of the LNER network.

5. CONCLUSION

- 5.1.1 LNER was running Single Leg Pricing as a fare strategy, and selling most of their flexible Singles at half the price of the Returns. Customers were already able to mix-and-match tickets if they wanted to provided they purchased these in advance as the Super Off-Peak Single sold online priced at 50% of the Return was only sold in advance and not as a separate walk-up ticket. The SLP trial simplified the fare structure by removing the Return tickets from the fare structure on the trial flows. At the times where the Off-Peak Return was previously available, the more expensive Anytime Single was the only available Walk-Up ticket on the trial flows.
- 5.1.2 Regarding ticket types and potential switching:
- The removal of the Off-Peak Return is a significant driver of ticket choice behaviour and revenue impacts.
 - The market share of the cheaper Standard Advance tickets has generally increased which has had a net impact of a decrease in yield across all ticket types. Please note that the Edinburgh comparison differs to this, which is mainly driven by the comparison of Glasgow.
 - There appears to be a switch to more expensive Anytime tickets for the longer distance LNER flows, which can be combined flexibly with other single tickets and is giving an increase in average yield across the ticket types.
- 5.1.3 Regressions were not able to detect any revenue impact on the trial flows, suggesting there is no significant revenue effect of Single Leg Pricing, which was a core objective of the project. This is mainly because the impacts from the Covid pandemic were felt soon after the start of the trial, which dominated the variance in revenue growth across the trial and control flows. It is possible that when revenue stabilises around a new normal, similar analyses could detect a revenue impact.
- 5.1.4 Based on the analysis undertaken in this study, it is not clear whether there would be a significant revenue impact if the SLP trial were to be introduced across other LNER flows.

6. ASSURANCE

6.1.1 Assurance has been carried out to provide a level of confidence in the models used and hence the results provided by SYSTRA Ltd. The level of assurance is proportionate to the work carried out and therefore included the following:

- LENNON data provided by the Client has undergone checks prior to completing analysis. This includes undertaking checks against an independent data source for the different years for which the data was provided on the journey and revenue totals as well as market shares.
- All calculations undertaken as part of the high-level analyses were reviewed independently and sense-checked against the raw data.
- The regressions were undertaken by our Analyst. The specification of the models and the results were independently checked by the Lead Modeller.
- All analyses results are independently checked by our Project Director. The report has been prepared by the Project Manager and Quality Assured by the Project Director.

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