



Retail Zonal Pricing Review

Analysis of Zonal Costs

4 July 2007

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Glossary

The following abbreviations are used in this report:

ABC	Activity Based Costing System
Activities	Pipeline cost activities
BD	Business density
BW	Business Warehouse
DO	Delivery office
DO/IMC cost	Bottom-up Delivery Office / Inward Mail Centre costs
DO Volumes	Bottom-up unweighted DO volumes
DPD	Delivery point density
IMC	Inward mail centre
LD	Local distribution
MC	Mail centre
MCS	Mail Characteristics Survey
OPI	Operational Planning Information
PAF	Postal Address File
PCR	Price Control Review
Postcomm/PSC	The Postal Services Commission
RCS	Resource Control System
R&CM	Revenue & Cost Model
RM2000	Types of sorting frames included in delivery offices
SPDO	Scale Payment Delivery Offices
ZCM	Zonal Costing Model
ZCM file	"ZonalCostingTemplate05_06.xls"

1 Executive summary

Introduction

- 1.1 Royal Mail's licence provides for the possibility of it applying to charge mail senders different prices according to the geographic location of mail recipients (zonal pricing). This provision, set out in Condition 21 ("Prices for Postal Services"), paragraphs 17 to 19 ("Geographic Price Uniformity") of Royal Mail's licence, explicitly excludes those products that are subject of the Universal Service Obligation from zonal pricing.
- 1.2 On 5 July 2006, Royal Mail submitted an application to Postcomm to be allowed to introduce zonal pricing for certain bulk products, which are used by the largest mailers (e.g. banks, utilities, government, charities and advertisers)¹. Under Condition 21 of Royal Mail's licence, Postcomm is required to assess whether the proposed changes will, among other things, lead to prices being more reflective of costs than they would be if the existing geographically uniform prices were retained.
- 1.3 On 20 February 2007, Royal Mail submitted a revised application for zonal pricing, accompanied by a supporting model and documentation. Postcomm has now received the necessary data from Royal Mail, and has started to carry out an assessment of Royal Mail's zonal pricing application. As a part of this assessment, Postcomm asked LECG to assess the economic justification for zonal postal prices, and to consider how delivery costs differ by postal zone.

Scope

- 1.4 LECG's terms of reference are set out in Postcomm's Invitation to Tender (OPS/CON/CTR/145). LECG was asked to assess whether Royal Mail's zonal pricing application is more cost reflective than the current geographically uniform pricing structure. LECG was asked to perform a series of checks on Royal Mail's zonal costing model ("ZCM"). In particular, LECG was asked to test the robustness of Royal Mail's methodology and its supporting data, to consider the validity of the allocation of activity costs across postal zones and to consider if there were any alternative methods of deriving the relationship between delivery

¹ The products covered by Royal Mail's application are Mailsort 120 (first and second class, OCR and CBC); Mailsort 700 (first, second and third class); Mailsort 1400 (third class); Presstream (first and second class); and Walksort (first and second class).

costs and geography, based on economic or econometric techniques. In performing our work, we considered whether there were any alternative zonal classifications that were more cost reflective than the zones proposed by Royal Mail. A summary of our terms of reference is provided in paragraphs 2.5 and 2.6.

Approach

- 1.5 To assess whether the zonal pricing application was more cost reflective than the current geographically uniform pricing structure, we performed an extensive range of tests on the ZCM and on its data. We have assessed the appropriateness and robustness of Royal Mail's zonal cost allocations by considering the findings of the October 2006 operational review performed by Postcomm and its consultants². We have documented the mechanics and functionality of the ZCM and its original results. We have performed extensive sensitivity analyses to assess whether the zonal cost estimates produced by the ZCM are robust to changes in the data and to changes in underlying modelling assumptions.
- 1.6 We performed a range of statistical tests to assess Royal Mail's zonal classification, and considered a range of alternative zonal combinations. In particular, we tested whether the unit costs proposed by Royal Mail varied across postal zones. As a part of this process, we identified where cost differences were statistically significant. Finally, we estimated an econometric model, and tested the significance of the relationship between costs, volumes, factor prices and zonal characteristics, for a number of zonal definitions. This final step helped us to confirm the extent of geographical differences across zones.

Limitations

- 1.7 We have checked the internal consistency of data supplied to us by Royal Mail. However, nothing in this report should be taken to imply that we have conducted any procedures or investigations in an attempt to verify or confirm, by means of reviewing source documentation or processes, the accuracy of the data provided. Our work does not constitute an audit.
- 1.8 The scope of our work has been limited due to the nature of our terms of reference with Postcomm, which were informed by Postcomm's statutory powers and duties. Subsequent to our appointment Royal Mail submitted a revised

² "Zonal Pricing Application - Information Adequacy", Adam Mantzos, October 2006; and "Royal Mail's Zonal Pricing Application – Review of Information Provided; Frontier Economics, October 2006.

application for zonal pricing, and after an initial review of information provided by Royal Mail, it was agreed that certain changes should be made to the scope of our work. These limitations are summarised in paragraphs 2.17 to 2.19 below.

- 1.9 Postcomm asked us to accept the thresholds that Royal Mail have used to define the postal zones, in part because testing and redefining the thresholds would be a lengthy process and could not be achieved within the deadlines set for this project, and in part because of Postcomm's obligations under the licence. Postcomm informed us that its role and power under the licence is simply to determine - among other things - whether this specific zonal pricing proposal by Royal Mail is more cost reflective than the existing uniform pricing and not to propose alternative models. Therefore, whilst we have focused on different zonal combinations, we have not attempted to change the definition of a zone in terms of delivery point density ("DPD") and business density ("BD"). This work could be performed as a next step if required.

Conclusions

- 1.10 We summarise our conclusions below.

Review of Royal Mail's cost model and allocation methodologies

- 1.11 The ZCM was provided by Royal Mail as part of their application for zonal pricing³. The ZCM is a multi-page spreadsheet that calculates the unit costs of delivering mail by postal zone and pipeline activity, by allocating top-down input costs from Royal Mail's costing system, and revenue based traffic measures, to delivery offices ("DOs") and postal zones within inward mail centres ("IMCs").
- 1.12 Top-down costs are sourced from Royal Mail's Revenue and Cost Model ("R&CM"). These costs represent 2005/06 (the latest audited financial year) actual data and form an element of *total* operating costs as included in Royal Mail's Regulatory Financial Statements 2005/06⁴. We have not reviewed the cost allocation methodology that is used to derive top-down costs, because it has been reviewed a number of times by Postcomm and its consultants.

³ In Section 3, we provide an overview of Royal Mail's ZCM and its inputs.

⁴ Since performing our analysis, Royal Mail has informed Postcomm that they have made slight changes to the costing model. These changes mean there is a 0.01% difference in volumes compared with the ZCM inputs. Royal Mail has confirmed (email from Royal Mail dated 4 July 2007) that these volume changes result in very little, if any, differences in average unit costs. Additionally, Royal Mail states that this change in volume has no impact on the relative distribution of volumes by DO.

1.13 Five postal zones and six pipeline cost activities (“activities”) are identified in the ZCM. The five activities are local distribution (“LD”) to DO, DO indoor delivery staff, DO outdoor delivery staff, DO outdoor vehicles, DO other delivery, and IMC sorting. The five zones are presented in the table below, which shows Royal Mail’s zonal classification and the definition of each of the five zones, in terms of DPD and BD thresholds.

Table 1: Zonal definitions

Zones	BD	DPD
L - London	N.A.	N.A.
A – Business District	> 10%	> 500 per km ²
B – High Density	N.A.	> 1,000 per km ²
C – Average Density	N.A.	> 100 per km ² and ≤ 1,000 per km ²
DE – Low Density	N.A.	≤ 100 per km ²

Source: Royal Mail, Zonal Pricing Modified Application, 20 February 2007.

1.14 The unit costs computed by the ZCM are weighted averages⁵ and are based on top-down costs and volumes, which are allocated to each zone. The table below shows the unit costs calculated by the ZCM.

Table 2: Original ZCM results – Unit costs by activity

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
London	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: ZCM file.

⁵ For each postal zone, unit costs by activity are given by the ratio between the top-down allocated activity costs and the top-down allocated volumes. The sum of all activity unit costs, in each postal zone, provides total unit zonal costs.

- 1.15 We have reviewed the allocation methodology followed by Royal Mail to allocate top-down costs and volumes to DO and IMC zones. Overall, we believe that Royal Mail has adopted a broadly acceptable approach given that it does not have reliable cost data at a zonal level for DOs and IMCs that are derived on an audited bottom-up basis. Given this constraint, the only option is to allocate top-down costs to DOs and IMCs using bottom-up inputs.
- 1.16 The allocation methodology appears to be broadly sensible (though perhaps not ideal). For the highest costs (e.g. indoor and outdoor staff delivery), the bottom-up inputs are sourced directly from Royal Mail Business Warehouse - Resource Control System ("BW-RCS"). The cost allocation methodology is then relatively straightforward, using simple proportions. For other costs (e.g. LD), the allocation methodology is more complex. It is here that other alternative allocation methodologies might be justified. However, these costs are relatively small, and we believe that different methodologies would not change zonal costs materially.
- 1.17 We believe that Royal Mail's overall approach is appropriate, given that robust bottom-up cost data is not availability. Nevertheless, it remains that using an audited, more disaggregated dataset (i.e. such as cost and volume data derived at a DO, IMC or postcode sector level) rather than allocating top-down costs might yield different zonal results. We have been unable to evaluate the degree to which these results might differ.

Assessment of the ZCM robustness and sensitivity analysis

- 1.18 We reviewed the bottom-up (i.e. DO and IMC) data used in the ZCM. Our review is summarised in Sections 4 and 5 below. We have not performed an audit of the data, but we have considered whether it contains outlying observations. To identify such observations, we have checked the data for internal consistency, and have compared the data to the datasets that were submitted by Royal Mail for the PCR.
- 1.19 During the process of reviewing the data, we have also reviewed the formulas embedded in the ZCM. Whilst this process did not constitute a systematic auditing of the ZCM, we note that our review found no errors.
- 1.20 We have performed a number of checks on the ZCM. First, we performed a data review to assess the robustness of the underlying data. The IMC data appeared to contain no outliers. However, we found 97 outlying DO observations. We

excluded these DOs from the sample and re-estimated zonal costs. We found that zonal costs never changed by more than 5% when these observations were removed. This might suggest that the data is robust. We reached a similar conclusion during the PCR.

1.21 During the PCR, Royal Mail told Postcomm that the activity data it collected at individual DOs and IMCs suffered from certain misallocation problems. We understand that this is still the case. The use of more robust bottom-up data in the allocation process might generate different zonal results. However, given that there are more than 1,000 DOs, and provided misallocation errors are not systematic throughout the DO network, any misallocations might average out.

1.22 We also conducted sensitivity analyses to test how changes in modelling assumptions changed the estimated unit zonal costs. The following tests were performed:

- dropping 240 DOs that were deemed by Royal Mail to have overstated volumes in the PCR;
- reallocating DOs to postal zones based on postcode sector values for DPDs and BDs;
- using unweighted IMC volumes to allocate top-down volumes to IMCs *before* allocating volumes to postal zones within the IMC;
- using weighted (as opposed to unweighted) DO and IMC volumes to allocate top-down volumes to DOs and IMCs;
- adjusting lorry loading times in the LD cost calculations (which are set at 15 minutes) to 10, 20 and 25 minutes respectively;
- reducing IMC costs by 10%, 20% and 30%, to test whether the ZCM is sensitive to the allocation of time spent on tasks in mail centres (“MCs”); and
- including Central London only in the London postal zone.

1.23 We found that the ZCM is robust to the exclusion of observations from the dataset, as well as to changes in a range of model assumptions. This robustness may be explained by the fact that the model does not rely on many assumptions, with the primary model assumptions relating to the assessment of LD and IMC costs (and these costs represent a small share of total costs and are therefore not

material to the overall results). Most of the other data is cost data that is provided directly from Royal Mail's accounting systems (i.e. it is not estimated data).

Statistical testing and alternative zonal combination

- 1.24 We have tested whether the zonal costs produced by the ZCM are statistically different between all zonal pairs. To perform this test, we have computed unit costs by activity for each DO, to obtain a distribution of unit costs. We then tested whether the average of these unit costs varies by zone.
- 1.25 We have found evidence that average unit costs differ across all zones except between zones A and B. We also investigated whether the London zone could be subdivided into further zones and we found that it could. Our analysis is provided in Section 6 below.
- 1.26 Our analysis indicates that the following changes could be made to Royal Mail's ZCM to improve cost reflectivity:
- zones A and B could be pooled together;
 - the London zone could be divided into two zones: London A (L-A) and the rest of London (L-Rest);
 - zone DE could be split into two zones, D and E; and then
 - London A could be combined with zone D.
- 1.27 The table below presents the results of pooling zones A and B together, and splitting the London zone into L-A and L-Rest.

Table 3: ZCM with zones AB, C, and DE plus the London zone split into L-A and L-Rest

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L- A	■	■	■	■	■	■	■
L- Rest	■	■	■	■	■	■	■
AB	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

1.28 The table below presents the results from applying all the changes in paragraph 1.26 above.

Table 4: ZCM with zones L-A plus D, L-Rest, AB, C, and E

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L-A plus D	■	■	■	■	■	■	■
L-Rest	■	■	■	■	■	■	■
AB	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
E	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

1.29 With respect to the results provided in Table 4 above, statistical tests for the equality of unit cost distributions (refer to Section 6 for a full discussion on the nature of these tests), find that unit costs in all zones are statistically different.

1.30 It is important to note the following. First, and generally speaking, when performing statistical tests the size of the samples used is important. The smaller

the sample, the higher the differences between two means must be in order for the test to find that they are different. Also, the higher the variability (the variance) in the data, the easier it is to find no statistical difference. The tests we performed were geared to assess whether the underlying distributions of unit costs differ. We found that in most cases they do (e.g. even in almost all cases involving small sample sizes, such as zones A and L-A, which points to strong results). In only two instances, we found no statistical difference: between zones A and B, and between zones L-A and D.

- 1.31 Second, statistical significance is different from actual significance. The unit costs in zones L-A and DE, for example, appear to be quite different when looking at Table 3 above, and yet they are not found to be different once the distribution of costs across the two zones is taken into account, and statistical testing performed (this result is explained in Section 6 in more detail) . Whether one wants to rely on statistical results or factual figures in defining the optimal zonal classification is a matter of policy.
- 1.32 The results of the statistical testing show there are zonal structures that would be more cost reflective than the current uniform pricing, as unit costs do vary with geography. The zonal structure presented by Royal Mail, is one of many possibilities. Nevertheless, statistical testing shows that a number of amendments could be made to the proposed structure in order to improve cost reflectivity.
- 1.33 We have not been asked to comment on the appropriateness of, or to identify all, alternative classifications. Our presentation of alternative zonal classifications is not a proposal but an illustration of alternative ZCMs with a similar structure to that proposed by Royal Mail. We have found some alternatives that appear to be more cost reflective, indicating that the ZCM classification proposed by Royal Mail is not optimal. We do not propose that these alternatives should be implemented, and indeed there might be practical problems with doing so. For example, it might be difficult to separate zone DE into two zones. In this case, the costs in zone E would become higher than the price of a 2nd class stamp. It might also be confusing to customers to have zones L-A and D combined or impractical to split the London zone.

Econometric Modelling

- 1.34 We have performed an econometric analysis to test whether there is evidence that the zonal differences in unit costs across postal zones originate from a differential impact of geography on total costs. The econometric analysis allowed us to consider whether *total* costs still varied across zones, after having allowed for the impact of mail volumes and factor prices. Our analysis is set out in Section 7.
- 1.35 The results of our modelling of total DO costs are that:
- there is no evidence that zone A has an impact on total costs. What makes zone A different from either zone B or C is the proportion of BD. The econometric results suggest that this definition is not correct, because increasing the proportion of postcode sectors in A does not have a significant impact on DO costs, however increasing the proportion of postcode sectors in B or C does. This suggests that there is a need to adjust the DPD threshold for zone A, or the BD threshold, or both. Another possibility would be that, when considering costs at DO, rather than the postcode sector level, BD is not a relevant cost driver, which might be why the zonal cost variable A is not significant;
 - there is evidence that the costs of zones D and E should be considered separately; and
 - there is evidence that the London zone should be split into more than one zone.
- 1.36 We have found evidence that the zones in the original ZCM can be further refined to reflect better the impact of geographic variability in costs. In line with the results summarised in Section 6, we have found consistent evidence that both *unit* and *total* costs are affected by geography in London, which is treated as a single zone in the ZCM, while they are not in zone A, which is a separate zone. There is *no* evidence that the unit costs of delivering mail differ between the average DOs in zones A and B.
- 1.37 Our analysis suggests that the costs of delivering mail are not uniform. However, we cannot say with confidence whether the zonal classification proposed by Royal Mail is better than other possible definitions, based on alternative zonal thresholds. One might want to test whether adding the variables that are used to

define the zones (e.g. DPD and BD) would yield significant coefficients for those variables. If that were the case, it would mean that the thresholds for DPD and BD chosen to define the zones do not capture all the cost variation that is caused by geography. Postcomm or Royal Mail might want to investigate this further.

2 Introduction and scope of work

Introduction

- 2.1 Royal Mail's licence provides for the possibility of it applying to charge mail senders different prices according to the geographic location of mail recipients (zonal pricing). This provision, set out in Condition 21 ("Prices for Postal Services"), paragraphs 17-19 ("Geographic Price Uniformity") of Royal Mail's licence, explicitly excludes those products that are subject of the Universal Service Obligation from zonal pricing.
- 2.2 On 5 July 2006, Royal Mail submitted an application to Postcomm to be allowed to introduce zonal pricing for certain bulk products, which are used by the largest mailers (e.g. banks, utilities, government, charities and advertisers)⁶. Under Condition 21 of Royal Mail's licence, Postcomm is required to assess whether the proposed changes will, among other things, lead to prices being more reflective of costs than they would be if the existing geographically uniform prices were retained.
- 2.3 After receiving Royal Mail's July 2006 zonal pricing application, Postcomm commissioned two consultant reports, which identified a number of deficiencies in the information and data supplied by Royal Mail in support of its application. Such deficiencies, the consultants concluded, would make it impossible for Postcomm to carry out a full review of the analysis presented by Royal Mail. The consultants, however, advised that given the information and data that either had already been made available, or could be easily supplied by Royal Mail, Postcomm would be able to conduct a number of crosschecks to assess the consistency of Royal Mail's zonal pricing application.
- 2.4 On 20 February 2007, Royal Mail submitted a revised application for zonal pricing, accompanied by a supporting model and documentation. Postcomm received the necessary data from Royal Mail on 2 April 2007. Postcomm asked LECG to assess the economic justification for zonal postal prices, with reference to the extent to which delivery costs differ by postal zone. In this section, we summarise

⁶ The products covered by Royal Mail's application are Mailsort 120 (first and second class, OCR and CBC); Mailsort 700 (first, second and third class); Mailsort 1400 (third class); Presstream (first and second class); and Walksort (first and second class).

our terms of reference, our approach and the information we have relied upon. We also summarise certain limitations to the work we have undertaken.

Terms of reference

2.5 LECG's terms of reference are set out in Postcomm's Invitation to Tender (OPS/CON/CTR/145). Postcomm summarises the terms of reference as follows:

"The consultant will help determine whether Royal Mail's zonal pricing application is supported by the underlying zonal cost curve (as implied by the data Royal Mail has provided) and whether it is therefore more cost reflective than the existing geographically uniform price structure. This piece of work is likely to focus on identifying the nature of the underlying cost curve by:

- *advising on the appropriateness and robustness of how Royal Mail has allocated activity costs across zones;*
- *by reference to an operational review of Royal Mail's existing cost model including a sensitivity analysis on the robustness of the key parameters within the model; and*
- *documenting the implicitly assumed functional form (of the delivery cost function) being used by Royal Mail in their cost model.*
- *a cross-check on the allocation of activity costs across delivery zones and amendments for additional cost drivers (the selection of which was based on previous advice from Postcomm consultants). This will include the allocation of Inward Mail Centre costs, which are not included in Royal Mail's existing cost model. These cross-checks should fall into two categories:*
 - *a cost function approach, drawing on a reasonably expected a priori cost function based on industry knowledge, which is then estimated on a zonal basis using DO or IMC level data and compared to Royal Mail's original zonal allocation of costs; and*

- *a unit cost approach where empirical data on unit costs at the DO or IMC level is used to determine zonal costs and compare this to Royal Mail's zonal allocation of costs.*

The appropriate cross-check will depend on the original approach used by Royal Mail to allocate costs, the individual activities' cost functions and the available data.

- *identifying any alternative, equally or more robust, methods of deriving the relationship between delivery cost and geography, cost and price, based on economic and operational expertise including econometric techniques where appropriate.*
- *modelling the effects of any changes on the cost function highlighted by the work on the zonal distribution of costs, that may seem appropriate and where the impact is likely to be material. The zonal distribution of costs should be modelled, where possible, as a continuous function of the proxy measures (Delivery Point Density and Business Density) to facilitate a review of both the cost reflectivity of the proposed zones and the delineation of the zones."*

2.6 Postcomm requires a report that addresses the objective of the ITT, which is to assess whether Royal Mail's proposed zonal pricing results in a higher level of cost reflectivity than the current uniform pricing system. We discuss the approach we have been asked to adopt and scope limitations later in this section.

LECG overview

2.7 LECG is a global consulting firm, which provides independent and objective advice and analysis on matters of economics, finance, and strategy, to law firms, businesses, regulators, and governments. Founded in 1988, LECG has 1291 professional staff, including 376 experts, operating in 36 offices throughout the Americas, Europe, and Asia-Pacific.

2.8 LECG has extensive regulatory experience, working with regulators and regulated companies. Our experts have advised a wide range of regulators and regulated companies in the UK and throughout Europe on how to allocate revenues and costs between businesses for regulatory pricing purposes. In addition to working

extensively with Postcomm, we have assisted UK regulators, including the CAA, Ofgem and Ofcom on regulatory and price control issues.

- 2.9 The skills required to complete the scope of work of this project are embodied in the members of the project team. Members of the team have extensive postal regulatory experience. The team has worked closely with Postcomm by assisting the regulator to determine its final proposals for the 2006 PCR. The team assigned to work on this project contains a combination of accountants and economists with cross industry and postal specific experience.

Summary of approach

- 2.10 Postcomm asked LECG to assess whether Royal Mail's proposed zonal pricing results in a higher level of cost reflectivity than the current uniform pricing system, and whether there is an alternative model that is more suitable to achieve the cost reflectivity requirement.
- 2.11 We have assessed the appropriateness and robustness of Royal Mail's zonal cost allocations by considering the findings of the operational review performed by Postcomm and its consultants. We have reviewed and substantiated the key inputs into Royal Mail's ZCM back to supporting models and other relevant analysis. We have then documented the costing model adopted by Royal Mail and its original results and zonal definition. This work is discussed in Section 3 below.
- 2.12 We have reviewed the data submitted by Royal Mail and conducted an outlier analysis. We have then tested the sensitivity of Royal Mail's zonal cost estimate to the exclusion of the outlying figures. The results of this work are discussed in Section 4 below.
- 2.13 Based on discussions with Postcomm and Royal Mail, we have performed a sensitivity analysis to test the robustness of Royal Mail's zonal cost estimates to changes in the assumptions that are contained within the ZCM. The results of this work are discussed in Section 5 below.
- 2.14 We have performed statistical tests on Royal Mail's zonal costs, and for a number of alternative zonal combinations. In particular, we have tested whether all unit activity costs included in Royal Mail's model vary across postal zones. In

performing this task, we have considered where cost differences are statistically significant. The results of this work are discussed in Section 6 below.

- 2.15 We have provided an alternative method of estimating the relationship between costs and geography by developing an econometric model, and tested the significance of the relationship between costs, volumes, factor prices and zonal characteristics, for a number of zonal definitions. The results of this work are discussed in Section 7 below.
- 2.16 Our full approach was documented in our response to Postcomm's ITT. Each section below provides further details on our approach.

Limitations of scope

- 2.17 We have checked the internal consistency of data supplied to us by Royal Mail. However, nothing in this report should be taken to imply that we have conducted any procedures or investigations in an attempt to verify or confirm, by means of reviewing source documentation or processes, the accuracy of the data provided. Our work does not constitute an audit. This report has been written solely for the use of Postcomm. We are aware that Postcomm may rely in part on our findings, as set out in this report.
- 2.18 The scope of our work has been limited due to the nature of our terms of reference with Postcomm, which were informed by Postcomm's statutory powers and duties. Subsequent to our appointment Royal Mail submitted a revised application for zonal pricing, and after an initial review of information provided by Royal Mail, it was agreed that certain changes should be made to the scope of work. Specifically, it was agreed that we should:
- not test the mechanics and functionality of Royal Mail's cost allocation model (i.e. the Activity Based Costing ("ABC") model), which underlies the inputs into the zonal cost model, because Postcomm and its consultants have reviewed this model on a number of prior occasions;
 - assume that the top-down cost and volume data derived from Royal Mail's costing model are appropriate inputs into the zonal model. That said, where possible, we have tried to substantiate the input data in the ZCM wherever was appropriate to do so. We understand top-down costs represent 2005/06 (the latest audited financial year) actual data and form

an element of total operating costs as included in Royal Mail's Regulatory Financial Statements 2005/06⁷. Royal Mail's costing model has been reviewed by Royal Mail's consultants Oxera, and used by Postcomm and its consultants in various regulatory reviews. Consequently, it was agreed with Postcomm and Royal Mail that this is the most appropriate set of costs on which to base our zonal costing analysis;

- not use bottom-up data in the allocation process. During the PCR, Royal Mail told Postcomm that the activity data it collected at individual DOs and IMCs suffered from certain misallocation problems. We understand that this is still the case. The use of more robust bottom-up data in *the allocation process* might generate different zonal results. However, given that there are more than 1,000 DOs, and provided misallocation errors are not systematic throughout the DO network, any misallocations might average out.
- work within the modelling framework designed by Royal Mail, which is based on weighted average unit costs, and not to develop an alternative costing approach. We understand that Postcomm's role and powers under the licence is simply to determine – among other things - whether this specific zonal pricing proposal by Royal Mail is more cost reflective than the existing uniform pricing. Postcomm's role is not to propose an alternative – perhaps even better geared to costs - model; and
- accept the thresholds that Royal Mail has used to define the postal zones. We understand that Postcomm cannot reject Royal Mail's proposal simply because the zonal definition can be refined. As noted above, Postcomm should only consider whether Royal Mail's proposed structure is more cost reflective than the existing uniform pricing structure. Therefore, we have focused on different zonal combinations, but we have not attempted to change the definition of a zone in terms of DPDs and BDs. This work could be performed if required, but we note that testing and redefining the thresholds would be a lengthy process.

⁷ Since performing our analysis, Royal Mail has informed Postcomm that they have made slight changes to the costing model. These changes mean there is a 0.01% difference in volumes compared with the ZCM inputs. Royal Mail has confirmed (email from Royal Mail dated 4 July 2007) that these volume changes result in very little, if any, differences in average unit costs. Additionally, Royal Mail states that this change in volume has no impact on the relative distribution of volumes by DO.

2.19 Each of these limitations, and their validity, is discussed in further detail in the relevant sections of this report.

Information sources

2.20 The findings presented in this report are based on our review and consideration of the information obtained from the following Royal Mail and Postcomm submissions. We have reviewed, *inter alia*:

- Royal Mail, "Application under Licence Condition 21 for Approval to Offer Geographic Zonal Prices for Bulkmail Services [Modified]", 20 February 2007;

[Redacted text block containing multiple paragraphs of information]

- Royal Mail's licence;

[REDACTED]

3 Zonal Costing Model overview

Introduction

- 3.1 In this section, we provide an overview of Royal Mail's ZCM, we summarise Royal Mail's definition of postal zones and provide a high-level overview of key model inputs and outputs.

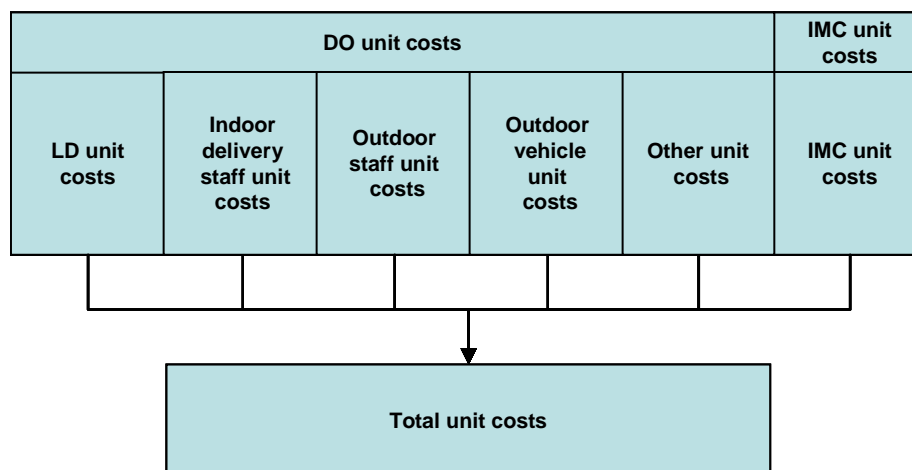
ZCM overview

- 3.2 The ZCM was provided by Royal Mail as part of their application for zonal pricing. The ZCM is a multi-page spreadsheet that calculates the unit costs of delivering mail by postal zone and pipeline activity. Five postal zones and six pipeline cost activities ("activities") are identified in the ZCM. The five postal zones are London ("L"); business districts ("A"); high density ("B"); average density ("C"); and low-density ("DE") zones. Some work on cost activities has already been performed by Postcomm and its consultants⁸. Postcomm concluded that the following activity costs should be considered in the zonal costing analysis: LD to DO; DO indoor delivery staff; DO outdoor delivery staff; DO outdoor vehicles; DO other delivery; and IMC sorting. The ZCM includes these activities.
- 3.3 The unit costs computed by the ZCM are weighted averages. For each postal zone, unit costs by activity (e.g. unit LD costs in zone A) are given by the ratio between the top-down⁹ activity costs (e.g. LD costs) and the top-down volumes allocated to that zone. The sum of all activity unit costs, in each postal zone, provides total zonal unit costs. The figure below shows the composition of these costs.

⁸ "Zonal Pricing Application - Information Adequacy", Adam Mantzos, October 2006; and "Royal Mail's Zonal Pricing Application – Review of Information Provided; Frontier Economics, October 2006.

⁹ Top-down costs and volumes are input figures that are allocated to DOs and IMCs in the ZCM. Top-down costs are defined in paragraph 3.14 Top-down volumes are defined in paragraph 3.20.

Figure 1: The composition of unit delivery costs



Source: LECG analysis.

- 3.4 The allocation of top-down activity costs and volumes to zones is discussed in further detail below.

Postal zones

- 3.5 The five postal zones identified in Royal Mail's application for zonal pricing are shown in Table 5 below. The criteria used to identify four of the five zones are based on DPD and BD. The London zone, approximately defined as the area within the M25 motorway, includes 11 IMCs and 207 DOs. Royal Mail have given Postcomm the following definition for the London zone:

“The London Zone has been defined to include those Mail Centres and Delivery Offices where either a) London pay rates apply or b) either of the two highest ‘defined’ area pay rates apply. The latter covers those places, which are not traditionally regarded as part of London, but which have justified higher wage rates to counter recruitment and retention issues. The following postcode areas are typically in the second category: AL, BR, HA, SM, TW, UB, WD.”¹⁰

- 3.6 Pay rates in the London zone range from ██████ per week to ██████ per week, while the highest and lowest pay rates in the rest of the UK are ██████ (in,inter

¹⁰ Source: Royal Mail.

alia, postcode areas OX and RG) and [REDACTED] (in, *inter alia*, postcode areas AB, TR, and YO)¹¹.

Table 5: Zonal definitions

Zones	BD	DPD
L - London	N.A.	N.A.
A – Business District	> 10%	> 500 per km ²
B – High Density	N.A.	> 1,000 per km ²
C – Average Density	N.A.	> 100 per km ² and ≤ 1,000 per km ²
DE – Low Density	N.A.	≤ 100 per km ²

Source: Royal Mail, Zonal Pricing Modified Application, 20 February 2007.

- 3.7 The ZCM allocates each postcode sector¹² and each DO to a postal zone. The table below shows the zonal distribution of the 1,375 DOs and 9,617 postcode sectors. The single postal zone to which each DO is allocated is based on the average DPD and BD value across all the postcode sectors in its territory.

¹¹ Source: Royal Mail.

¹² A postcode sector is the geographical area defined by the first part of the postcode plus the number at the start of the second part of the postcode i.e. in the code TW18 4JN the sector is TW18 4.

Table 6: DOs and postcode sectors by zone. ZCM allocation¹³

Zone	DOs	Postcode sectors by zone				Total postcode sectors
		A	B	C	DE	
London	207	332	724	204	22	1,282
A	17	153	49	11	0	213
B	151	117	959	174	23	1,273
C	572	410	1,307	2,048	928	4,693
DE	428	81	116	385	1,574	2,156
Total	1,375	1,093	3,155	2,822	2,547	9,617

Source: LECG calculations based on data from ZCM file.

- 3.8 The distribution of postcode sectors in Table 6 shows differences between London and the rest of the country. For example, while 26% of all postcode sectors in London are classified as zone A sectors, the percentage in the rest of Great Britain is only 9%. By contrast, only 2% of all postcode sectors fall into zone DE in London. In the rest of the country, the proportion is 30%. The majority of postcode sectors are in zones B and C, both in London and outside. However, in London 56% of all postcode sectors are in zone B and 16% are in zone C. Outside of London, only 29% of all postcode sectors are in zone B and 31% are in zone C.
- 3.9 The London zone is characterised by a high concentration of postcode sectors in zones A and B, which together account for 82% of total postcode sectors in London. The remaining 18% is accounted for by zones C and DE. The rest of the country has a different geographical distribution, with 61% of all sectors accounted for by zones B and C, a proportion that increases to 91% if zone DE is included.
- 3.10 Although the ZCM treats the London zone as a single zone, we show the zonal distribution of DOs (and postcode sectors) in London in the table below.

¹³ The above table refers only to the DOs and postcode sectors that are allocated to the DOs (using the mapping provided by Royal Mail), that are included in the "DO Cost Function" sheet of the ZCM. This is because the DOs included in the "DO Cost Function" sheet are the ones that are used to calculate the unit costs in the ZCM. We note there are some postcode sectors contained in the input sheets allocated to DOs that are not included in the "DO Cost Function" sheet. These DOs and postcode sectors are not included in the table above.

Table 7: London DO zonal distribution and postcode sector composition

DO zone	Number of DOs	Postcode sector distribution					Number of Postcode Sectors in DOs
		A	B	C	D	E	
A	6	239	21	5	0	0	265
B	148	70	611	41	5	0	727
C	53	23	92	158	17	0	290
Total	207	332	724	204	22	0	1,282

Source: LECG calculations based on data from ZCM file.

- 3.11 Table 7 shows that in London, the number of DOs in zone A is low, there are no DOs in either zone D or E, but there are a few zone D postcode sectors. Comparing Table 6 and Table 7, we see that the distribution of postcode sectors within DOs belonging to each postal zone is different between London and the rest of the UK. In London, the six DOs classified as zone A have 90% (i.e. 239 out of 265) of their postcode sectors in zone A. This proportion falls to 72% in the rest of the UK. Again for zone A, there are a total of 332 postcode sectors in London, and of these 239 (72%) are in the six DOs that are classified as zone A. The situation is quite different for the rest of the UK, where out of 761 zone A postcode sectors only 20% (153) are in DOs classified as zone A. The majority of zone A postcode sectors (54%, or 410) are in DOs classified as zone C, and 15% (117) are in DOs classified as zone B. A similar comment can be made for zone E postcode sectors, 44% of which are located in DOs classified as zone D, and 43% are in DOs classified as zone E.
- 3.12 As costs are not available for individual postcodes, DOs cannot be allocated to multiple postal zones for costing purposes. Rather, each DO is assigned to a single zone. The allocation of DOs to individual postal zones results in unit cost estimates that only approximate the actual distribution of unit costs across zones. Ideally one would want to have an estimate of what delivery costs are in each postcode sector, but we do not believe that Royal Mail are currently able to produce reliable cost estimates at such a level of disaggregation. This is due to time allocation problems (e.g. staff performing indoor activities would be required to allocate time spent among the postcode sectors served by the DO, with obvious room for allocation errors).

ZCM input data

- 3.13 Zonal unit costs are based on cost and volume data from a number of sources. The key inputs into the ZCM are top-down activity costs; top-down volumes; bottom-up DO and IMC activity costs; bottom-up DO volumes; postcode sector level volumes from the Mail Characteristics Survey (“MCS”); and bottom-up and postcode sector data on DPD and BD. We discuss each ZCM input below.

Top-down activity costs

- 3.14 Top-down cost inputs are allocated to zones using bottom-up inputs. Top-down costs are pipeline activity costs for 2005/06 sourced from Royal Mail’s cost accounting system (i.e. the Revenue and Cost Model – “R&CM”). In October 2006 Postcomm and its consultants¹⁴ performed a review of Royal Mail’s July 2006 zonal pricing application. This review assessed the adequacy of the information provided by Royal Mail for Postcomm to assess the cost reflectivity of the July 2006 zonal pricing application. Postcomm and its consultants made a number of recommendations in relation to the relevant pipeline activities and their associated cost functions that should be considered by Royal Mail for inclusion in any zonal pricing application.
- 3.15 Our approach has included a cross reference exercise to ensure that the pipeline activities and cost functions set out in the October 2006 review have been incorporated in Royal Mail’s current zonal pricing application. However, we have not been asked to consider whether these are the appropriate pipeline activities to determine zonal costs. Though broadly speaking, these activities appear to be appropriate.
- 3.16 Royal Mail operates an ABC system (i.e. R&CM) which follows standard ABC principles in defining activities, assigning costs to those activities and driving the activity costs to ‘cost objects’. The cost objects are generally defined as subdivisions of individual products. The estimated cost of a product is the sum of the costs of a number of cost objects and the cost of a service (e.g. First Class letters) is the sum of the costs of a number of products. The R&CM can present costs in a number of different ways, for instance by activity, product, and format. For the purposes of the ZCM, input data is derived from the R&CM at a pipeline activity cost by format level.

¹⁴ Refer to footnote 8.

- 3.17 We have substantiated the input data in the ZCM with reference to outputs from the R&CM¹⁵ and Postcomm's October 2006 review. The table below provides a summary of the top-down costs in the ZCM. All figures below have been reconciled to outputs from the R&CM.

Table 8: Top-down activity costs included in the ZCM

Activity	Letter	Flat	Packet	Total
LD	██████	██████	██████	██████
Indoor delivery	██████	██████	██████	██████
Outdoor delivery	██████	██████	██████	██████
Delivery vehicles	██████	██████	██████	██████
Other delivery	██████	██████	██████	██████
IMC staff	██████	██████	██████	██████
Total	██████	██████	██████	██████

Source: Royal Mail.

- 3.18 The costs in the table above represent 2005/06 (the latest audited financial year) actual data and form an element of total operating costs as included in Royal Mail's Regulatory Financial Statements 2005/06¹⁶. Royal Mail's costing model has been reviewed by Royal Mail's consultants Oxera, and used by Postcomm and its consultants in various regulatory reviews. We note, that in relation to the information provided by Royal Mail, its licence states that its financial and accounting records must be:

"...maintained using accounting systems operating on the basis of objectively justifiable cost accounting systems which allocate cost and revenue data to each of the separate services"¹⁷.

- 3.19 As these costs represent the latest audited set of financial data and because the R&CM data has been reviewed before, it was agreed with Postcomm and Royal

¹⁵ Source: Royal Mail.

¹⁶ Refer to footnote 8.

¹⁷ Royal Mail's licence. Condition 15.2(e).

Mail that this is the most appropriate set of costs on which to base our zonal costing analysis. Without bottom-up audited cost data, we agree that this is the most appropriate dataset to use. However, this caveat is important, as it remains that a more disaggregated dataset (i.e. such as cost and volume data derived at a postcode sector level) might yield different, and more robust, zonal results.

Top-down volumes

3.20 Top-down volumes are allocated to zones using bottom-up volume data. Top-down volumes represent revenue-equated volumes. Revenue-equated volumes are derived by Royal Mail regulatory economics team and are more reflective of total addressed delivered volumes than pure operational volumes, which are prone to measurement bias. Historically Postcomm has used revenue-equated volumes in its regulatory reviews of Royal Mail. The table below provides the volumes included in the ZCM.

Table 9: [Redacted]

Letters	Flats	Packets	Total
[Redacted]	[Redacted]	[Redacted]	[Redacted]

Source: Royal Mail.

3.21 The volumes are based on 2005/06 actual data. Postcomm and Royal Mail believe that this is the most appropriate set of volumes on which to base the zonal costing analysis.

Bottom-up DO and IMC activity costs

3.22 For individual IMCs and DOs, costs by activity are derived from a number of sources. Bottom-up costs are used in the ZCM to allocate top-down costs to individual DOs and IMCs (and hence to allocate costs to zones). The table below provides a summary of top-down and bottom-up cost components and data sources. We refer to bottom-up DO/IMC costs as “DO/IMC cost” throughout this report.

Table 10: Top-down and bottom-up costs

Activity	Top-down costs	Bottom-up costs	Source for bottom-up data
LD	Total staff costs	Not available directly. Modelled as a function of distance, loading time and driver rates. Loading times are fixed for all DOs at the same values. Driver rates are those at the parent MC	Operational planning information (“OPI”) data. Driver rates are from Business Warehouse (“BW”). Loading times are from OPI/Industrial Engineering
LD	Total vehicle costs	Not available directly. Modelled as dependent on distance and fixed and variable vehicle costs. Fixed and variable vehicle costs are set at the same value for all DOs	OPI data. Values for fixed and variable vehicle costs are from Rate card version U, and correspond to the shared cost per mile of a 7.5t lorry with tail lift
LD	Total other costs	Not available	
Indoor delivery	Total staff costs	Indoor staff costs plus meal relief and training costs	BW - Resource Control System (“RCS”)
Outdoor delivery	Total staff costs	Outdoor staff costs plus delivery support costs	BW/RCS
Delivery vehicles	Total outdoor vehicle costs	Vehicle costs	BW
Other delivery	Total property costs	Charges made by Post Office Property Holdings to Royal Mail Letters for use of the various buildings	Royal Mail Finance
Other delivery	“Other other” costs	Not available	
IMC staff	Total IMC staff costs	Inward processing staff costs plus allocated meal relief and training and processing support staff costs	BW

Source: Royal Mail file “Data description ZCM second submission.xls”. “Total other costs” in relation to LD include accommodation, computer and equipment charges. “Other other costs” in relation to other delivery include computer, equipment, depreciation charges.

3.23 There are differences between top-down and bottom-up costs for the following activity costs: LD, indoor and outdoor staff, and IMC staff costs. Royal Mail has

provided satisfactory explanations for these differences and reconciliation calculations¹⁸.

Bottom-up DO volumes

- 3.24 Bottom-up volumes in the ZCM are unweighted DO mail volumes sourced from the BW dataset. These mail volumes are measured at each DO, and are used to allocate top-down volumes to zones. Bottom-up volumes are also used in the final step of the ZCM unit cost calculations for IMCs, as explained later in this report. We refer to bottom-up unweighted DO volumes as “DO volumes”.

Postcode sector level volumes from the MCS

- 3.25 The MCS is a statistical survey of outward mail volumes carried out at outward mail centres. The delivery address on each sampled mail item is part of the information recorded, and it indicates “fall to earth” (i.e. the postcode the mail is delivered to). Information on MCS volumes is available for each postcode sector in the ZCM, and is used to allocate top-down IMC costs and top-down volumes to postal zones within IMCs.

- 3.26 MCS figures are subject to a margin of error due to their statistical nature. In addition, there are limitations as to how accurately MCS volumes measure DO and IMC volumes. This is because the MCS does not sample all the traffic streams that are ultimately delivered.¹⁹ As these volumes are more likely to be business volumes, using MCS volumes to allocate top-down volumes will produce a biased zonal distribution of mail volumes.

Bottom-up and postcode sector data on DPD and BD

- 3.27 Data on DPDs and BDs are available at the postcode sector level. They are also available for each DO, but not for IMCs. Data on DPD and BD are sourced from the Postal Address File (“PAF”) database, and they are used to define the postal zones.

Key ZCM outputs

- 3.28 In this section, we describe the process by which the ZCM computes unit costs by activity for the five postal zones described in Table 5 above. To compute zonal

¹⁸ Source: Royal Mail.

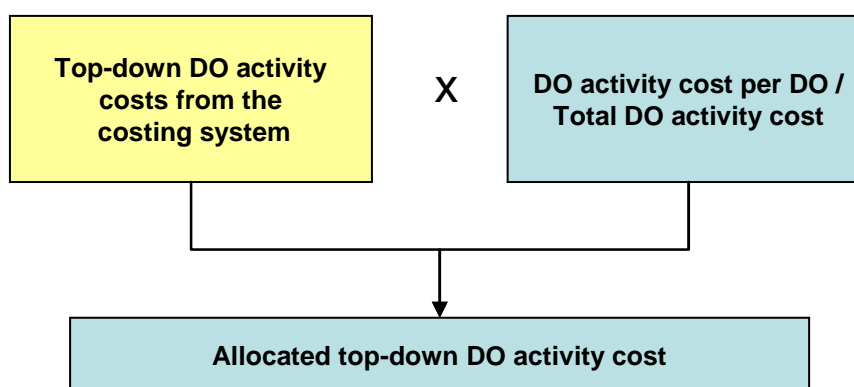
¹⁹ For example, we understand that a large proportion of the EC postcode “fall to earth” (i.e. mail to addresses in the City of London) is distributed directly to the appropriate DOs, and bypasses inward processing entirely. Source: Royal Mail.

costs and volumes, the ZCM allocates top-down activity costs and volumes to the five postal zones. The method of allocating top-down figures differs between DOs and IMCs. An overview of each method is given below.

Top-down cost allocation for DO activities

- 3.29 The first step of the ZCM is to allocate each DO to one of the five postal zones based on DPDs, BDs and on whether it is in London. In the second step, top-down costs for the five activities are allocated to DOs based on a weighting factor²⁰ as shown in the figure below.

Figure 2: Royal Mail methodology to allocate top-down costs to DOs



Source: LECG analysis. Yellow indicates a single top-down cost figure (e.g. total DO costs), while blue indicates figures available for each DO.

- 3.30 For each activity, the costs allocated to all DOs in a given postal zone are then added up to obtain allocated top-down activity cost by zone. For indoor and outdoor staff costs, and delivery vehicles, the procedure for allocating top-down activity costs is simple, as DO measures for these costs are available (refer to Table 10).
- 3.31 Top-down LD costs are given by the sum of three components: staff costs, vehicle costs and other costs. These costs are not recorded at the DOs and therefore bottom-up costs have to be estimated (see Table 10). The ZCM computes DO LD staff and LD vehicle costs as the product of the number of journeys made to the IMC per annum, times the driver or vehicle rate per journey. These costs are then used to allocate top-down LD staff and LD vehicle costs, following the method shown in Figure 2. Other LD costs are allocated in the same proportion as allocated top-down LD staff and vehicle costs.

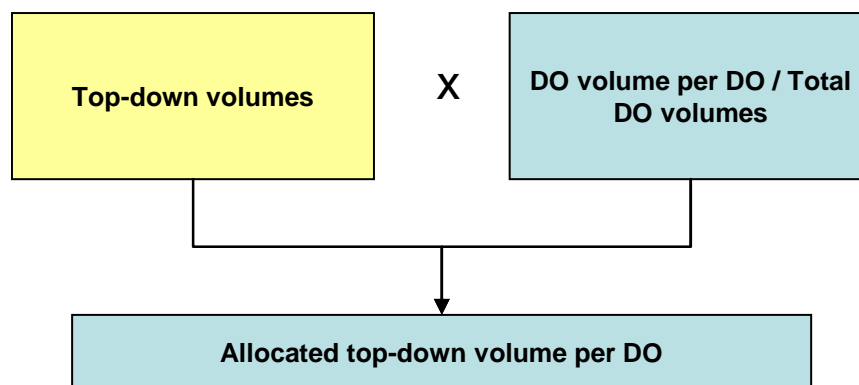
²⁰ The calculation of the weighting factor differs by activity.

- 3.32 Top-down other delivery costs include property costs and “other other” delivery costs not accounted for by the other activities. The procedure to allocate top-down property costs is summarised in Figure 2. “Other other” top-down delivery costs are allocated using DO volume weights, which are the same weights used to allocate top-down volumes described in the next paragraph. In principle, “Other other” costs might have been allocated differently, for example in proportion to how the other activity costs have been allocated. In practice however, “other other” costs represent only 1.6% of top-down delivery costs. Using a different allocation procedure would not produce material changes in the ZCM results.

Top-down volume allocation for DO activities

- 3.33 The computation of unit costs requires the allocation of top-down volumes to DOs. Top-down volumes are allocated in proportion to bottom-up DO volumes, as shown in the figure below:

Figure 3: Royal Mail methodology to allocate top-down volumes to DO



Source: LECG analysis. Yellow indicates a single top-down volume figure (e.g. total DO volumes), while blue indicates figures available for each DO.

Top-down cost and volume allocation for inward processing activities

- 3.34 To allocate top-down IMC costs to individual IMCs, the ZCM follows the same method described in Figure 2 (i.e. it uses bottom-up IMC costs to allocate top-down IMC costs to each IMC). IMCs, however, cover large geographical areas (i.e. as there are only 69 of them), and cannot be assigned to an individual postal zone.
- 3.35 Hence, as a second step these allocated costs need to be further allocated to the postal zones covered by the IMC. This is done using MCS volumes. For each IMC, the ZCM calculates the proportion of MCS volumes that are delivered to

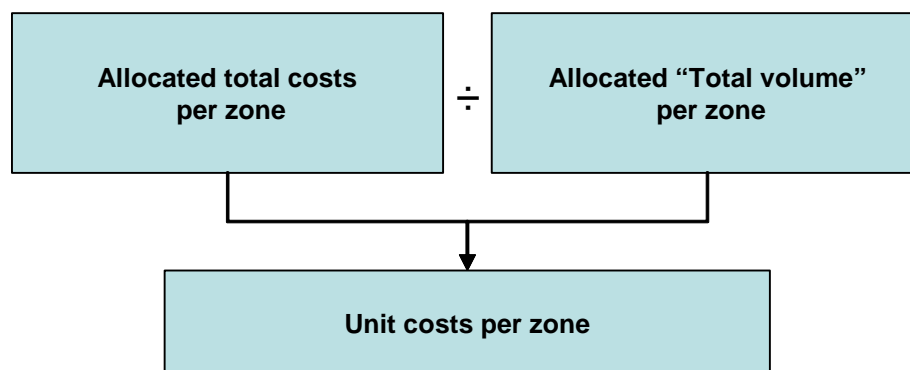
each postal zone (e.g. 25% of MCS volumes are delivered to postcode sectors that are in zone A). This proportion is then used as a weight to allocated top-down IMC costs to postal zones. So, if 25% of MCS volumes are addressed to zone A postcodes, 25% of its costs will be assigned to zone A.

- 3.36 Top-down volumes are allocated directly to zones in a single step, using MCS volumes as described in paragraph 3.35. Allocated IMC costs and volumes are then summed by postal zone. The ratio between these two measures gives an intermediary measure of IMC unit costs by zone. This intermediary unit cost is then multiplied by zonal top-down allocated DO volumes, to compute inward processing costs for each zone based on the same volume measure used to compute all unit costs for DO activities.

Calculation of unit costs by zone

- 3.37 For each of the six cost activities, and for the total, unit costs are calculated as shown in the figure below.

Figure 4: Calculating unit costs per zone



Source: LECG analysis.

- 3.38 The table below shows the resulting unit costs produced by the ZCM.

Table 11: Original Royal Mail results – Unit costs by activity

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
London	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: ZCM file.

3.39 It is clear that not all activity costs have the same impact on total unit costs. The table below shows the contribution of each pipeline activity to total unit costs by zone.

Table 12: Original Royal Mail results – Unit costs by activity

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
London	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations on data from ZCM file.

3.40 In aggregate, indoor and outdoor delivery staff costs account for ■ of the total unit cost of delivering mail. LD and vehicle costs represent a small proportion of total unit costs, but they have a higher impact in zone DE, where distances between DOs and IMCs are larger. Inward sorting costs at IMCs represent between ■ of total unit costs.

Conclusions

- 3.41 Top-down costs are sourced from Royal Mail's Revenue and Cost Model ("R&CM"). These costs represent 2005/06 (the latest audited financial year) actual data and form an element of *total* operating costs as included in Royal Mail's Regulatory Financial Statements 2005/06. We have not reviewed the cost allocation methodology that is used to derive top-down costs, because it has been reviewed a number of times by Postcomm and its consultants.
- 3.42 We have reviewed the allocation methodology followed by Royal Mail to allocate top-down costs and volumes to DO and IMC zones. Overall, we believe that Royal Mail has adopted a broadly acceptable approach given that it does not have reliable cost data at a zonal level for DOs and IMCs, which are derived on an audited bottom-up basis. Given this constraint, the only option is to allocate top-down costs to DOs and IMCs using bottom-up inputs.
- 3.43 The allocation methodology appears to be broadly sensible (though perhaps not ideal). For the highest costs (e.g. indoor and outdoor staff delivery), the bottom-up inputs are sourced directly from its BW-RCS. The cost allocation methodology is then relatively straightforward, using simple proportions. For other costs (e.g. LD), the allocation methodology is more complex. It is here that other alternative allocation methodologies might be justified. However, these costs are relatively small, and we believe that different methodologies would not change zonal costs materially.
- 3.44 Accepting the constraint that bottom-up data is not readily available, we conclude that Royal Mail's overall approach is appropriate. Nevertheless, it remains that using an audited, more disaggregated dataset (i.e. such as cost and volume data derived at a DO, IMC or postcode sector level) rather than allocating top-down costs, might yield different zonal results. The degree to which these results might differ cannot be evaluated.

4 Review of source data

Introduction

- 4.1 We performed a data review of the bottom-up inputs in the ZCM (e.g. DO and IMC costs by activity, volumes, and DO and postcode sector data on DPDs and BDs²¹). We sought to identify outlying or irregular data by considering summary statistics for each variable, producing pair wise scatter plots between pairs of variables and by computing data correlation matrices.
- 4.2 Outliers are sometimes caused by data errors. Ideally, the cause of any outlier should be investigated. We asked Royal Mail at a working meeting whether in general it would be feasible for them to comment on any outliers that we identified. They indicated that this would be a time consuming and difficult process.
- 4.3 Our approach, therefore, was to undertake a number of data review tests. We then considered how robust Royal Mail's conclusions were to the exclusion of outliers and irregular data. We agreed with Postcomm that if we found that the results were sensitive to excluding data, we would then investigate the data further. In performing our analysis we considered whether:
- the values of the variables (i.e. DPD and BD) used to allocate DOs to specific postal zones were consistent with those submitted by Royal Mail during the PCR;
 - the results of the ZCM were sensitive to using different information sources for the DPD and BD data;
 - the DO and IMC cost and volume data contained in the ZCM file were internally consistent; and
 - the DO and IMC cost and volume data in the ZCM file was consistent with the PCR data.
- 4.4 We found that there were no outliers in the IMC cost and volume variables. However, 97 DOs appeared to be outliers (representing 7% of the 1,375 DOs). We found that the removal of these data did not have a significant impact on the ZCM. As such, no further investigation of the data was performed. We

²¹ This data is contained in the ZCM file.

summarise the results of our analysis below. Further details are provided in Appendix 1. Appendix 2 contains the list of the 97 outlying DOs.

Changes in DPD and BD values with respect to the PCR data

- 4.5 We considered whether the variables used to allocate DOs to postal zones were consistent with those submitted by Royal Mail for the PCR²². Royal Mail explained that small changes in BD are common, and there are cases where changes could be up to 10%. We identified those cases where the change in BD between 2003 (i.e. the PCR file) and 2005 (i.e. the ZCM file) were greater than 10%²³. We found seven outlier DOs on this basis (i.e. Leicester Central; EC1-EC4; Birmingham Central; Manchester; WDO; Liverpool CDO 1-3; and Bristol 1).
- 4.6 DPDs can also change from year to year. The range of changes between the ZCM and PCR files is large, from 749 fewer delivery points per km² to 497 more. The average change is 3.7 delivery points per km², with a standard deviation of 41.7. We identified DOs where the change in DPD was larger than two standard deviations from the mean change²⁴. We found 12 outliers on this basis (i.e. Gorseinon; Low Fell; Market Deeping; Whitby; Llanidloes; Leicester North; Henfield; Dungannon; Ballymoney; Gateshead; Nottingham South and Mumbles).
- 4.7 As DPD and/or BD change, a DO's zonal classification can also change. We found that this happened on 13 occasions (i.e. Camp Hill; Coleshill; Birkenhead; Blackpool; Carnoustie; Salford; Gateshead; Lowfell; North Tyneside; Stone; Thatcham; Avonmouth and Glasgow G40). These DOs are clearly on the boundary between two postal zone classifications. This could influence the ZCM, depending on which zone they are allocated. As such, we excluded these DOs from our analysis.

Changes in the allocation of DOs to postal zones when using postcode sector data

- 4.8 The ZCM contains two worksheets with DPD and BD data, one at the postcode sector level, and the other at the DO level. The ZCM carries out the zonal classification using data at the DO level. An excel spreadsheet was provided by

²² IMCs are not allocated to specific zones.

²³ We chose the 10% threshold as Royal Mail adopted it during the PCR to identify DOs with bad volume data.

²⁴ This is the standard threshold used to identify outliers in statistical analysis.

Royal Mail to allow a mapping between postcode sector and DO data²⁵. We have used this mapping to check whether there were differences between the two datasets.

- 4.9 There were significant differences in DPDs²⁶ in eight DOs, which were considered as outliers. This might indicate data errors. These DOs are: Harping Road; Glasgow 20 – 23; Edinburgh NW; Leicester North; Norwich; Oldham; Belfast 10 and 11; and Edinburgh West. For six of these DOs (all but Norwich and Belfast 10 and 11) their zonal classification changes when using postal sector level data. There are 36 further DOs where the zonal classification changed between the two worksheets provided (i.e. the postcode sector and the DO level sheets). These 36 DOs were considered as outliers due to the internal inconsistency in the data files. The list of the 42 DOs where the zonal changes occurred and the relevant zonal changes are presented in the table below.

²⁵ Source: Royal Mail.

²⁶ Cases in which differences in DPDs were greater than 500.

Table 13: DOs with zonal classification inconsistencies

DO name	Zone based on postcode sector level data	Zone based on DO level data
Altens	D	C
Ashford (Kent)	D	C
Ashton under Lyne	C	B
Ayr	D	C
Banchory	E	D
Beverley	D	C
Cheltenham	D	C
Craigavon Lurgan	D	C
Daventry	D	C
Dore	D	C
Edinburgh NW	C	B
Edinburgh West	B	C
Galashiels	D	C
Glasgow G20 - G23	D	B
Harpings Road	C	B
Harrogate	D	C
Ilfracombe	D	C
Inverness	E	D
Keynsham	D	C
Kidlington	D	C
Kings Lynn	D	C
Leicester North	C	B
Lerwick	E	D
Leyburn	E	D
Lincoln	D	C
Llandrindod Wells	E	D
Londonderry	D	C
Maldon and SPDO	D	C
Nottingham North	C	B
Oldham	C	B
Penzance	D	C
Sandwich	D	C
Sandy and Rural	C	D
St Austell	D	C
Stafford	D	C
Taunton	D	C
Thame	D	C
Vale of Glamorgan	D	C
Warwick	D	C
Whitehaven	D	C
Worcester APC	D	C
York Central	D	C

Source: LECG calculations based on data from ZCM file.

ZCM internal consistency

- 4.10 In this section, we summarise our data review of DO costs and list the inconsistencies found.

LD costs

- 4.11 LD staff and vehicle costs are a product of the number of journeys made to the IMC per annum multiplied by driver or vehicle rate per journey. We found a positive relationship between DO volumes and the number of journeys made to the IMC to collect them (i.e. the higher the volume, the higher the number of journeys made). Some DOs, however, have high mail volumes but make few or no journeys to collect the mail from the IMC. This might happen when the DO is located in the same building as the IMC, and in that case, the journey distance to the IMC is stated as zero in the ZCM file. There are four cases where the distance between the DO and the IMC is zero, but the number of journeys is positive, and this appears to be an internal inconsistency. This happens for Derby and Rurals; EC1-EC4; CV North, East, South and West; and Peterborough PDO.
- 4.12 Some DOs also make a high number of journeys to the IMC to collect mail. On average, the number of journeys is six per day, with a standard deviation of 5.1. We found that 29 DOs have a number of journeys that is higher than twice the standard deviations from the mean (i.e. higher than 16). For these DOs, we have cross-referenced the number of journeys with mail volumes. These observations can only be considered as outliers where the volume per journey is also excessively low. There are nine DOs that fall into this category (i.e. Leith 5; Leith 6; Craigavon; Craigavon Lurgan; Hollywood; Edinburgh Central 1 and 2; Newport West; Stoke-Hanley; and Northampton and SPDO).
- 4.13 The distance and journey time to an IMC are also important factors in determining LD costs. We found a clear relationship between these variables except for in three instances: Westbury (which is located approximately 28 miles from the IMC but has a journey time of 0.211 hours²⁷), and Kirkwall and Stornoway – which are on islands.

²⁷ The average stated speed is 23.65 mph, implying that the journey should take over an hour.

Indoor delivery costs

- 4.14 The ZCM allocates top-down indoor delivery staff costs using a weight based on the sum of DO indoor delivery staff costs, meal and training relief costs. There should be, and there is, a good linear relationship between these variables with the exception of Watford WD, which has indoor labour costs that are nine times higher than indoor meal relief, versus a sample average of four times higher.

Outdoor versus delivery support costs

- 4.15 The ZCM allocates top-down outdoor delivery costs using a weight based on the sum of DO outdoor staff costs and delivery support costs. There should be, and there is, a positive correlation between these two variables, and on average outdoor delivery costs are 25 times higher than delivery support costs. There are three DOs where delivery costs are more than 40 times higher than delivery support costs (i.e. Derby and Rurals; Northampton and SPDOs; and Wolverhampton). There were a further eight DOs, where delivery support costs represented around 20% of outdoor delivery costs, against the sample average of 3.9% (i.e. Willesden SDO; Harrow; CV North, East, South and West; WC; Burnley; NW; W; and EC1-EC4). Again, we considered these DOs to be outliers.

ZCM and PCR consistency checks

- 4.16 The following DO activity cost variables, used to compute unit costs in the ZCM are also included in information provided by Royal Mail in PCR 2006: unweighted volume, indoor staff costs, outdoor staff costs, and total staff costs. To find possible inconsistencies, we plotted percentage changes in DO indoor and outdoor delivery staff costs, and in total staff costs²⁸, against changes in volumes between the PCR and the ZCM. We assume that a change in volume would be associated with a change in these costs. We found no clear outliers when comparing changes in total costs with volumes.
- 4.17 In comparing changes in indoor staff costs, four DOs (i.e. Kirkcudbright; Port Ellen and Rural; Maybole and Wolverhampton) were identified as potential outliers. For outdoor staff costs, Maybole was an outlier. The table below summarises our analysis for these DOs. It also reports a data quality index, which was provided by Royal Mail in the PCR data. A value of one identifies DOs that had unreliable

²⁸ Source: Royal Mail.

(i.e. overstated) volume figures. 240 DOs were excluded from the econometric analysis during the PCR due to poor data quality.

Table 14: DOs with outlying changes in volumes and costs since PCR

DO name	Unweighted volume	Indoor costs	Outdoor costs	Data quality index
Kirkcudbright	■	■	■	■
Port Ellen and Rural	■	■	■	■
Maybole	■	■	■	■
Wolverhampton	■	■	■	■

Source: LECG calculations based on data from ZCM and PCR data files.

- 4.18 We found no inconsistencies with respect to IMC costs between the data in the ZCM and those in the PCR MC files.

Sensitivity to the exclusion of outlying DOs from the analysis

- 4.19 In total, we identified 97 DOs that may contain outlier observations. To determine whether the results contained in the ZCM are based on robust data, we excluded the 97 outliers from the analysis. When dropping these observations, total costs and volumes changed, decreasing by 11% and 12% respectively. The weights used to allocate costs and volumes to DOs changed as well, resulting in a change in unit costs by zone. The table below reports the percentage changes in delivery costs at DOs²⁹.

²⁹ IMC costs are ultimately allocated using DO volumes, but they always sum up to IMC input costs. When we drop the 97 outlying DOs, total allocated DO costs *and* volumes change. Allocated DO volumes decrease by 12%. Allocated IMCs costs do not change because no IMC is dropped from the analysis. With unchanged allocated IMC costs but changed DO volumes, the calculations of unit IMC costs will be biased, because the unchanged costs will be divided by a figure that is 12% lower. We have made these calculations but they are not reported in Table 15. We report that total unit costs would decrease by 1% in London and zone DE. They would increase by 1% in zone B and by 3% in zone A and remain unchanged in zone C. These are very small changes, and they are identical (apart from zone C) to those shown in Table 15.

Table 15: Percentage changes in DO unit delivery costs after dropping 97 outliers

Zones	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	10%	-5%	2%	0%	0%	-1%
A	-14%	1%	14%	-36%	-12%	3%
B	1%	1%	1%	-3%	2%	1%
C	-6%	0%	0%	-1%	1%	0%
DE	-2%	0%	0%	-3%	-2%	-1%
Total	1%	-1%	1%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

- 4.20 Although individual activity costs (especially in zone A) show material changes, the overall changes in zonal costs are small. The highest change is a 3% increase in total costs in zone A. This might be expected given that zone A includes only 17 DOs. Overall, this check shows that the ZCM model is not sensitive to the impact of outliers. The data on which the ZCM is based appears to be robust, although a definite conclusion on its robustness can only be reached through a full audit process, which is beyond the scope of this analysis.

Conclusions

- 4.21 We reviewed the bottom-up (i.e. DO and IMC) data used in the ZCM. We have considered whether the data contains outlying observations. To identify such observations, we have checked the data for internal consistency, and have compared the data to the datasets that were submitted by Royal Mail for the PCR.
- 4.22 During the process of reviewing the data, we have also reviewed the formulas embedded in the ZCM. Whilst this process did not constitute a systematic auditing of the ZCM, we note that our review found no errors.
- 4.23 We have performed a number of checks on the ZCM. First, we performed a data review to assess the robustness of the underlying data. The IMC data appeared to contain no outliers. However, we found 97 outlying DO observations. We excluded these DOs from the sample and re-estimated zonal costs. We found

that zonal costs do not change by more than 5% when these observations were removed. This might suggest that the data is robust. We reached a similar conclusion during the PCR.

- 4.24 During the PCR, Royal Mail told Postcomm that the activity data it collected at individual DOs and IMCs suffered from certain misallocation problems. We understand that this is still the case. The use of more robust bottom-up data in *the allocation process* might generate different zonal results. However, given that there are more than 1,000 DOs, and provided misallocation errors are not systematic throughout the DO network, any misallocations might average out.

5 Sensitivity analysis

Introduction

5.1 In the previous section, we considered how stable the results of the ZCM were to the removal of outliers. In this section, we perform further sensitivity checks. The ZCM estimates unit activity costs by postal zone by allocating top-down costs and volumes to DOs, IMCs and to postal zones. Like *all* models, the ZCM is based on a number of assumptions. We have discussed these assumptions with Postcomm and Royal Mail to assess their validity. Based on these discussions, we have run a number of sensitivity tests to assess the robustness of the ZCM to changes in underlying assumptions. Specifically, we have considered the following sensitivities:

- dropping the 243 DOs deemed by Royal Mail to have overstated volumes in the PCR³⁰;
- re-allocating DOs to postal zones based on postcode sector values for DPDs and BDs;
- using unweighted IMC volumes to allocate top-down volumes to IMCs *before* allocating volumes to postal zones within the IMC;
- using weighted (as opposed to unweighted) DO and IMC volumes to allocate top-down volumes to DOs and IMCs;
- adjusting lorry loading times in the LD cost calculations (which are set at 15 minutes) to 10, 20 and 25 minutes respectively;
- reducing IMC costs by 10%, 20% and 30%, to test whether the ZCM is sensitive to the allocation of time spent on tasks in MCs; and
- including only Central London, as defined by Royal Mail, in the London postal zone..

5.2 We discuss the results of these tests below. Further details can be found in Appendix 3.

³⁰ Source: Royal Mail.

Excluding DOs based on prior PCR work

- 5.3 For the PCR, Royal Mail supplied information on the quality of some variables, including volumes. Royal Mail indicated that 243 DOs experienced high volume growth and that the volume figures for these DOs might be overstated. In line with our conclusions for the PCR, we have dropped these DOs from the sample. We have recalculated the ZCM based on this reduced dataset and the table below reports the percentage change in delivery costs by zone³¹.

Table 16: Percentage changes in DO unit delivery costs after dropping DOs with poor volume data quality

Zones	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	-5%	1%	0%	1%	1%	1%
A	-20%	0%	-6%	-25%	-1%	-3%
B	0%	1%	1%	2%	0%	1%
C	-2%	2%	1%	2%	2%	1%
DE	-16%	4%	-1%	-4%	-3%	-1%
Total	-11%	2%	0%	-4%	0%	0%

Source: LECG calculations based on data from ZCM file.

- 5.4 The results show that the changes in “total” unit costs are small. The largest change (-3%) is in zone A, which is to be expected given its small sample size.

Re-allocating DOs to postal zones based on postcode sector

- 5.5 We indicated in Section 4, that 42 DOs had different zonal allocations according to whether postcode sector or DO level DPDs and BDs were used to allocate DOs to zones. The names of these DOs and their zonal allocation are shown in Table 13. These DOs were also part of the 97 outliers that were dropped for the sensitivity analysis shown in Table 15. As a separate sensitivity analysis, we have also reassigned these DOs to zones based on postcode sector data. The

³¹ The same argument presented in footnote 29 applies here. Nonetheless, we have calculated the changes in unit costs if IMC costs were allowed to vary because of dropping the outliers. Total unit costs would remain unchanged in London and zone C; decrease by 1% in zone DE; and increase by 1% in zone B and by 3% in zone A.

results of this analysis, in terms of percentage changes, with respect to the original ZCM model, are shown below.

Table 17: Percentage changes in unit delivery costs after reallocating 42 DOs to alternative zones

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L	0%	0%	0%	0%	0%	0%	0%
A	0%	0%	0%	0%	0%	0%	0%
B	0%	3%	0%	0%	2%	2%	0%
C	0%	-6%	0%	0%	-3%	0%	-1%
DE	0%	-4%	2%	-1%	-5%	-3%	-1%
Total	0%	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

- 5.6 The results from this sensitivity check show that estimated unit costs do not change, apart from a 1% decrease in zones C and DE.

Using unweighted IMC volumes to allocate top-down volumes

- 5.7 The ZCM allocates top-down IMC costs to the individual IMCs using IMC cost shares. These allocated costs are then re-allocated to postal zones covered by each IMC using MCS volume shares as weights. Top-down volumes, however, are allocated directly to the postal zones covered by each IMC, using MCS volume shares as weights. We have run a sensitivity analysis to see how total unit costs would change if top-down volumes were first allocated to IMCs, and then to postal zones following the same procedure used for top-down costs (i.e. first to IMCs and then across zones). We have therefore allocated top-down volumes to *each* IMC using the method shown in Figure 3.³² We have then re-allocated these volumes to the postal zones covered by each IMC, as per Royal Mail's methodology. The results, in term of percentage changes with respect to Royal Mail's ZCM model, are presented in the table below. This sensitivity only affects IMCs so we only report results for IMCs and total unit costs.

³² The figure shows the allocation of top-down volumes to DOs. The methodology is identical for allocating top-down volumes at IMC, but with IMC rather than DO volume shares used as weights.

Table 18: Using unweighted IMC volumes to allocate top-down volumes across IMC: percentage change in unit costs

Zones	IMC	Total
L	9%	1%
A	-2%	0%
B	-4%	0%
C	-2%	0%
DE	-2%	0%
Total	0%	0%

Source: LECG calculations based on data from ZCM file.

- 5.8 The results show that IMC unit costs by zone change when unweighted volumes at the IMC are used to allocate top-down volumes. This is because the allocating factors change, so that different proportions of top-down IMC volumes are ultimately allocated to each zone. One reason for the change is that MCS volumes are a measure of “fall to earth”, rather than a measure of mail volumes processed at the IMC. There are some IMCs (e.g. RM has in the past mentioned London Central) where “fall to earth” volumes are larger than processed volumes, as a large portion of mail are delivered directly from the DOs (i.e. they are not processed at the IMC).³³ For these IMCs, using IMC volumes to allocate top-down volumes as a first step results in a lower proportion of top-down volumes being allocated to these IMCs. If the IMC is located in one particular zone (i.e. London), then the unit costs in that zone increase, while the unit costs in all other zones decreases. We observe this result in Table 18 above.
- 5.9 However, changes in IMC unit costs do not pass through to total costs by zone, due to the size of IMC costs relative to total unit costs. Therefore, total unit costs are not sensitive to the method of allocation that has been adopted.

³³ Source: Royal Mail.

Using weighted DO and IMC volumes to allocate top-down volumes

- 5.10 Royal Mail uses unweighted DO volumes to allocate top-down volumes of around 21bn pieces of mail to the DOs. We have considered whether weighted³⁴ or unweighted volumes should be used. Weighted volumes are measures of workload and as such, might be a more appropriate measure to use, especially when, as in this case, labour costs represent a large proportion of total costs. For this reason, we have run a sensitivity analysis to assess the change in the unit costs when weighted volumes are used in the model instead of unweighted volumes.
- 5.11 We re-calculated the ZCM using DO weighted volumes wherever DO volumes were used in the allocation process. For IMCs, we allocated top-down volumes to individual IMCs first, following the procedure described in paragraph 5.7 above, but used weighted IMC volumes in the first step. The results of this analysis, in terms of percentage changes with respect to the original ZCM model, are shown below.

Table 19: Using weighted volumes to allocate top-down volumes: percentage change in unit costs

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L	18%	0%	0%	0%	0%	0%	2%
A	-4%	3%	3%	3%	3%	2%	2%
B	-6%	1%	1%	1%	1%	0%	0%
C	-3%	0%	0%	0%	0%	0%	0%
DE	-5%	-1%	-1%	-1%	-1%	-1%	-1%
Total	0%	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

- 5.12 The results show that the impact of using weighted volumes is higher for IMCs than for DOs. IMC unit costs in London increase by 18%, while in all other zones they decrease. Overall, however, unit costs do not change in zones B and C,

³⁴ Royal Mail defines weighted volumes as follows: "DO managers record volumes on a daily basis against various operational traffic streams. These measurements are used to calculate an overall weighted volume, using weighting factors based on workload calculations." Royal Mail, "PCR3 6024 DO data for internal benchmarking.pb.051004.doc".

decrease by 1% in zone DE, and increase by 2% in zones L and A. Total unit costs in London increase from 17.35 to 17.61.

- 5.13 The results suggest that the ZCM results are robust to changes in volume specifications. The ZCM only uses DO and IMC volumes to allocate top-down volumes, which is an unweighted measure of addressed delivered mail traffic. For DOs, weighted and unweighted volumes are very similar. However, this is not the case for IMCs. Fortunately, top-down IMC costs are low (i.e. £325m) and play a minor role in the composition of total unit costs. Our analysis shows that even changes in excess of 15% for unit IMC costs have a weak effect on total unit costs (refer to Table 19, row 1).
- 5.14 Total unit costs are mainly driven by unit indoor and outdoor staff costs at the DOs. With 1,375 DOs, the sensitivity of the ZCM model to alternative allocation procedures is very low (apart for zone A, which is more sensitive because of its small sample size).

Adjusting lorry loading times in the calculation of LD cost

- 5.15 When estimating the staff cost element for LD, Royal Mail assumes that it takes 15 minutes to load and unload a lorry (i.e. a total of 30 minutes per return journey from the DO to the IMC). We considered the effect of allowing loading time to change to 10, 20 and 25 minutes. None of these changes had a material impact on total unit delivery costs. Unit LD costs represent a small proportion (i.e. 4% on average) of total unit costs and labour costs are only a proportion of LD costs (i.e. 72%).

Reducing IMC costs

- 5.16 Most MCs have both inward and outward sorting activities. MC activities include inward and outward sorting, meal relief and training, and processing support. Time spent on meal relief and training and processing support is split between inward and outward sorting activities. To account for possible misallocations we ran a sensitivity analysis to assess the impact of reducing IMC costs by 10%, 20% and 30% respectively. As costs at all MCs were changed by the same proportion, IMC costs increased in exactly the same way across the five zones. This, however, had a slightly different impact on total unit costs by zone, because costs in Zone A are more affected than in any other zones.

- 5.17 When IMC costs are decreased by 10% with respect to the original ZCM, total unit costs go down by 1% in each zone. When they are decreased by 20%, total unit costs decrease by 2% in all zones except for in zone A, which decreases by 3%. Finally, a large decrease of 30% decreases total unit costs by 3% in all zones except for zone A, which decreases by 4%. These are relatively small impacts to material changes in underlying assumptions.

Including Central London only in the L postal zone

- 5.18 Royal Mail defined London approximately as the area inside the M25 motorway (the exact definition is given in paragraphs 3.5 and 3.6 above). One important issue is whether this definition is correct, or whether the London area should include Central London only, or account for different postal zones within London. Royal Mail has supplied information on whether a postcode sector is in Central London. Central London is defined as the area that includes postcode sectors and DOs, that are served by the four MCs located in Central London (i.e. London East, London West, London Central and London South), plus the following DOs, all served by Greenford MC: Cricklewood; Willesden; St John's Wood; Kentish Town; Mill Hill; Hampstead; Hendon; Golders; The Hyde SDO; and NEDO. We have used this information to redefine the geographic zones.
- 5.19 In our scenario, we defined London as only including Central London postcode sectors. We have allocated the Outer London postcode sectors to zones A, B, C or DE. After redefining the postal zones, we run the ZCM again. The table below shows the percentage change in unit costs with respect to Royal Mail's model.

Table 20: Including Central London only in the L zone: Percentage changes in unit costs

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L	21%	-7%	3%	-4%	3%	13%	3%
A	0%	0%	0%	0%	0%	0%	0%
B	-6%	-6%	11%	4%	3%	7%	5%
C	-1%	0%	2%	1%	-1%	2%	1%
DE	0%	0%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file

5.20 Under this alternative scenario, costs increase by 3% in the newly defined L zone and by 5% in zone B. To interpret these changes, we calculated unit costs by postal zone for Central London, Outer London and the rest of the country. There are three postal zones in London, as defined by Royal Mail's zonal classification: A, B and C. Table 21 below shows these total unit costs. Unit costs by postal zone for the rest of the UK are those that are estimated by Royal Mail's ZCM presented in Table 10. It appears that in Central London, costs in zone A are higher than in zones B and C. In addition, for zones B and C, costs in Central and Outer London are similar. This suggests that the higher costs in Central London might be driven by the costs in the six DOs classified as zone A, which are all in Central London. This result suggests that further investigation of the London zone is required, which we do in the following sections.

5.21 The table below also shows that in zone B unit costs in Outer London are sensibly higher than in the rest of the UK, which explains the increase in unit costs for zone B displayed in Table 21.

Table 21: Total unit costs by postal area: Central London, Outer London, and Rest of the UK

Zones	Central London	Outer London	Rest of the UK
A	■	■	■
B	■	■	■
C	■	■	■
DE	■	■	■

Source: ZCM.

Conclusions

- 5.22 We have performed a range of checks on the ZCM. First, we have performed a data review to assess the robustness of the underlying data. This review was discussed in Section 4 and completed here. We have conducted a range of sensitivity analyses to test whether changes in ZCM's assumptions have material impacts on estimated unit costs. The tests performed are listed in paragraph 5.1:
- 5.23 The results of these tests showed that the ZCM is robust to the exclusion of observations from dataset, as well as to changes in a range of model assumptions. We believe that this robustness is because the ZCM does not rely on many assumptions, with the primary model assumptions relating to the assessment of LD and IMC costs (and these costs represent a small share of total costs and are therefore not material to the overall results). Most of the other data is cost data that is provided from Royal Mail's systems and is not estimated.
- 5.24 The results of the sensitivity test for the London zone also suggest that further investigation should be carried out to assess whether it should be split into more than one zone.

6 Statistical testing and alternative zonal combinations

Introduction

- 6.1 Royal Mail's proposed zonal classification differs from the one used for access tariffs (i.e. which has five zones A to E). Royal Mail changed the zonal definition by combining zones D and E³⁵ and introducing the Greater London zone. This section presents our analysis of whether the zonal classification proposed by Royal Mail (i.e. London plus zones A, B, C, and DE) is well supported and economically justified. In performing our analysis, we have considered whether other zonal classifications could be supported.
- 6.2 A large number of zonal combinations are theoretically possible. It has not been possible to test every single possible combination in the time available. However, in consultation with Postcomm, we have tested a number of alternative scenarios. Specifically, we have evaluated whether the unit costs in the ZCM, both by activity and in total, vary statistically by postal zone. If costs do not vary statistically by zone, this might suggest that the ZCM is not cost reflective and that some zones should be combined.
- 6.3 Analysis of this type allows us to test if different combinations of zones, where unit costs differ by geography, are possible. We have considered two scenarios. First, we have considered the zonal classification used for access tariffs. Second, we have considered the treatment of the London zone and the extent to which unit costs in London differ across zones.

Approach

- 6.4 We have performed statistical tests of equality on unit cost distributions across zones. Under this test, we first compute unit costs for each of the 1,375 DOs using the same scaling factors and formulas used by Royal Mail in the ZCM. We then compute zonal average unit costs based on these individual unit costs. Instead of having *single* unit costs per activity and postal zone, as the weighted average zonal costs produced by the ZCM, we now have a *distribution* of unit costs per activity and postal zone, which can be subject to statistical testing. The

³⁵ Royal Mail assigned all UK postcode sectors into five possible postal zones (i.e. A to E). The thresholds for zones A to C are defined in Table 1 above. Postcode sectors are assigned to zone D if their DPD is equal to or less than 100 per km², and to zone E if the DPD falls to 10 per km² or less.

statistical test for the null hypothesis is that average unit costs per activity are the same across *all* the zones, versus the alternative hypothesis that unit costs differ in *at least* one pair of zones.

- 6.5 We have carried out two standard statistical tests, a non-parametric test called the Kruskal-Wallis test and an ANOVA (analysis of variance) testing procedure. Under the null hypothesis, the Kruskal-Wallis test has a chi-square distribution and the ANOVA procedure requires an F-test. When interpreting the results of these tests, it is important to note that unit costs only need to differ between one pair of zones to reject the null hypothesis. Consequently, we need to consider which pair(s) of zones differ. This can be done using pair wise tests of equality for each unit cost category, using simple t-tests.
- 6.6 As an example, we tested that LD costs were equal between zone A and each other zone, zone B and each other zone, and so on. With five zones, there are 10 pair wise tests for each cost category. When many pair-wise tests are run at once (i.e. like 10 in this case) there is a risk of finding significant differences by chance³⁶ – what statisticians call “fishing expeditions”. To account for this, we must adjust the critical values of the tests. One common procedure for adjusting critical values is the Bonferroni testing procedure, which we have followed³⁷.
- 6.7 The tests were run for DO unit costs only as they cannot be run for IMC costs due to small sample sizes. Any resulting statistical test would have low power³⁸. This is not a significant issue, because IMC costs are immaterial in relation to their contribution to the overall difference in costs between zones.

Assessment of Royal Mail’s zonal classification

- 6.8 The table below summarises the results of the statistical tests for equality for DO unit costs across zones. The table shows that total unit costs differ across all

³⁶ Let’s say that we are running 1 pair wise test where the null hypothesis that the two means are the same is in fact true, and that we set the significance level for that test at $\alpha = 5\%$. This means that we have a 95% probability of getting it right. If we run k pair wise tests at once, where all k the null hypotheses are true, our probability of getting them all right is equal to $(1-\alpha)^k$. With $k = 10$, the probability of getting all the tests right goes down from 95% to 60%, meaning that we have a 40% chance that one of these 10 tests will be significant.

³⁷ There are two other standard procedures, the Sidak and Scheffe procedures. We have run these as well, although the Scheffe procedure has very low power (see footnote 38). These procedures confirm the Bonferroni results.

³⁸ In this context, the power of a test is defined as the probability, assuming that the differences in unit costs are statistically significant, of correctly rejecting the null hypothesis that they are the same. Put simply, low power means a low probability of getting it right.

zonal pairs except for zones A and B. The results for other cost categories are more complex. Detailed results for these tests, under all the scenarios considered in this section, can be found in Appendix 4.

Table 22: Tests for the equality with original ZCM

Unit cost	Result
Total	Differ across all zonal pairs except for the pair A and B
LD	Differ for the 4 pairs between zone DE and the other zones
Indoor staff	Differ for the 4 pairs between L and the other zones, plus between zones C and DE
Outdoor staff	Differ across all zonal pairs except for the pair L and C
Delivery vehicles	Differ for the 4 pairs between zone DE and the other zones, plus between zones B and C
Other delivery	Differ for the 4 pairs B with DE and L; and C with DE and London

Source: LECG calculations based on data from ZCM file.

- 6.9 The (Bonferroni-corrected) probability value for the t-test of total unit cost equality between zones A and B is 0.54, which is very high. It is convention to reject the null if the probability value (“p-value”) is less than 0.05 (or 5% significance level). Hence, in this case, the null hypothesis that unit costs in zone A and B are the same cannot be rejected. For total unit costs between all other zones, the p-values are all less than 0.01.
- 6.10 LD costs are only statistically different in zone DE. LD costs are directly related to distance, and as distances are much higher in these zones. Indoor delivery staff costs differ in London. As an indoor activity, these differences are likely to reflect wage differentials rather than purely geographic factors. Both of these results feel intuitively correct. Outdoor staff costs differ in 9 out of 10 zonal pairs.
- 6.11 To validate these results (i.e. that there is no difference between unit costs in zones A and B) we produced new estimates of unit costs under a revised zonal classification. We combined these two zones to give a revised zonal classification of L, AB, C, and DE. The table below shows the new unit costs. The row highlighted in yellow shows what changes in comparison to Royal Mail’s original ZCM.

Table 23: Unit cost by zone, with zones A and B combined

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
AB	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

6.12 We have rerun the test for equality to assess whether costs in zone AB are statistically different to the other zones. The test confirms that total unit costs differ across all these zonal pairs (of which there are now 6).

Table 24: Tests for the equality with zones A and B combined

Unit cost	Result
Total	Differ across all zonal pairs
LD	Differ for the pairs between zone DE and the other zones
Indoor staff	Differ for the 3 pairs between L and the other zones, plus between zones C and DE
Outdoor staff	Differ across all zonal pairs except for the pair L and C
Delivery vehicles	Differ for all pairs except for L and AB
Other delivery	Differ for the 4 pairs AB and DE; AB and L; C and DE; C and L

Source: LECG calculations based on data from ZCM file.

6.13 It is clear that total unit costs are different across the defined zones. However, it is important to test whether the costs are statistically different, because if they were not then an average DO in, say, zone A would have the same cost as an average DO in, say, zone B, and this would mean that there are no grounds to separate the two zones. We found that in the original ZCM, there are four zones where total unit costs are statistically different, not five. These zones are L, AB, C, and DE. Of course, a more refined classification might be possible. For

example, it might be possible to disaggregate zones D and E. We investigate this later in this section.

Assessment of the access tariff zonal classification

- 6.14 Royal Mail uses a different zonal classification for access pricing (i.e. A, B, C, D, and E). We have run statistical tests to assess whether this classification appropriately reflects differences in unit costs. Unit costs under this zonal classification are presented in the table below.

Table 25: Unit costs by zones A, B, C, D, E, with no London zone - Access classification

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
D	■	■	■	■	■	■	■
E	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

- 6.15 The table above shows that costs in zones A, B and C are similar, while costs in zones D and E are not. The table below shows the results of statistical tests for the equality. These results show that costs in zones A, B and C are statistically the same³⁹, while costs in zones D and E are statistically different.⁴⁰

³⁹ This result seems odd when one considers that the main cost drivers, indoor and outdoor staff costs, are statistically different between zones B and C. The issue here is that the differences between zones B and C in average unit indoor staff costs are *negative*, while the differences in average unit outdoor staff costs are *positive*, so that they cancel out when the two unit costs are summed. The average unit costs are those computed for testing (i.e. using the cost distributions).

⁴⁰ We have also tested whether average unit costs in the rest of the UK are different between zones D and E, zones which are aggregated into one in Royal Mail's ZCM. The results discussed in paragraphs A.4.11 and A.4.12 show that average unit costs are different.

Table 26: Tests for the equality for access tariff zones

Unit cost	Result
Total	Differ across all zonal pairs but no difference between A, B, and C
LD	Differ for all pairs but those formed by zones A, B, and C
Indoor staff	Differ for pairs A and C; A and D; B and C; B and D; C and D; and D and E
Outdoor staff	Differ across all zonal pairs
Delivery vehicles	Differ for all pairs but A and B; and A and C
Other delivery	Differ for pairs B and E; C and E; C and D; and D and E

Source: LECG calculations based on data from ZCM file.

- 6.16 Eliminating the London zone produces a flatter cost curve (i.e. lower differences across zones) and suggests no justification for differential pricing across zones A, B, and C. Using access zones, there are three zones where total unit costs are statistically different, not five. These zones are ABC, D, and E. This occurs because 207 DOs from London are allocated into zones A, B and C, resulting in a flatter cost curve. This could happen if London had consistently higher unit costs zone by zone with respect to the rest of the country. We investigate unit costs in London below.

Assessment of the London zone

- 6.17 We have also considered whether the London zone should be treated as a single zone, or whether London unit costs vary across London geographic zones. There are no DOs in zones D and E in London and there are six DOs in zone A. Unit costs are shown in the table below.

Table 27: Unit costs by zone - London

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
A	█	█	█	█	█	█	█
B	█	█	█	█	█	█	█
C	█	█	█	█	█	█	█
Total	█	█	█	█	█	█	█

Source: LECG calculations based on data from ZCM file.

- 6.18 Table 27 shows that high unit costs in zone A are driven mainly by high unit indoor staff costs, which amount to 49% of total unit costs for zone A. These costs are high in all the DOs⁴¹ belonging to zone A, which are all in Central London. We have investigated whether indoor costs are high in all DOs in Central London (i.e. also in DOs that are in zones B and C) or only in those DOs that belong to zone A. We found that for London DOs in zone B, indoor staff costs in Central London and Outer London are similar. The same is true for zone C⁴².
- 6.19 We have run statistical tests for the equality of zones in London. The results are shown in the table below.

⁴¹ The figure of █ is, as usual in the ZCM, a weighted average. Individual costs at the six DOs are █ (Southwark SDO), █ (W), █ (Victoria), █ (WC), █ (EC1-EC4) and █ (NW). (Source, ZCM file).

⁴² For zone B, unit indoor costs in Central and Outer London are █ and █. For zone C they are █ and █ respectively. (Source, ZCM file).

Table 28: Tests for the equality of unit costs by activity and zone - London

Unit cost	Result
Total	Differ between zones A and B; and zones A and C
LD	Differ between zones A and C; and zones B and C
Indoor staff	Differ between zones A and B; and zones A and C
Outdoor staff	Do not differ across any zonal pairs
Delivery vehicles	Do not differ across any zonal pairs
Other delivery	Differ between zones A and B; and zones A and C

Source: LECG calculations based on data from ZCM file.

- 6.20 The results show that the DOs in zone A in London have a statistically different total unit cost distribution from the remaining DOs in London. The cost difference is so high that even though there are only six DOs in zone A, the test rejects the null hypothesis of equality. These total unit cost differences are entirely driven by differences in unit indoor staff costs and other delivery unit (property) costs.
- 6.21 The table below reports the results of estimating unit costs with the London zone split into two further zones: London A and London Rest, plus non-London zones AB, C and DE. Zones A and B have been combined because of the findings in Table 22 and Table 24, while we have kept zones C and DE from the original ZCM.

Table 29: Unit costs by zones L-A, L-Rest, AB, C, and DE

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L- A	■	■	■	■	■	■	■
L- Rest	■	■	■	■	■	■	■
AB	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

6.22 To assess this zonal classification, we have run tests for unit cost equality between the five zones. The table below reports the results.

Table 30: Tests for the equality of unit costs with zones L-A, L-Rest, AB, C, and DE

Unit cost	Result
Total	Differ between all zones but L-A and DE
LD	Differ between zone DE and all other zones
Indoor staff	Differ between all zonal pairs but zone AB and C; and AB and DE
Outdoor staff	Differ across any zonal pairs but L-A and all other zones; and L-Rest and C
Delivery vehicles	Differ between zone DE and all other zones; and AB and C
Other delivery	Differ across any zonal pairs but L-Rest and DE; AB and C; and L-A and L-Rest

Source: LECG calculations based on data from ZCM file.

6.23 The results in Table 30 suggest that unit costs in zone L-A are statistically the same as unit costs in zone DE⁴³.

⁴³ The tests we are performing in this section are tests that the underlying distributions of unit costs between two zones have the same mean. There are 6 DOs in L-A, and 428 DOs in zone DE. These 428 DOs have a wide range of unit costs; so that the unit cost variance in zone DE is more than double that of L-A. The result that the two means are the same is driven by the large standard deviation in zone DE, coupled with the small sample size of zone A.

Conclusions

6.24 Our analysis indicates that the following changes could be made to Royal Mail’s ZCM:

- zones A and B could be pooled together;
- the London zone could be divided into two zones: London A and the rest of London;
- zone DE could be split into two zones, D and E; but then
- London A could be combined with zone D.

6.25 The table below presents the results of applying all these changes.

Table 31: ZCM with zones L-A plus D, L-Rest, AB, C, and E

Zones	IMC	LD	Indoor Staff	Outdoor Staff	Delivery Vehicles	Other Delivery	Total
L-A plus D	■	■	■	■	■	■	■
L-Rest	■	■	■	■	■	■	■
AB	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
E	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

6.26 The table below reports the results of the tests for the equality for the unit cost distributions, and shows that unit costs in all zones are now statistically different.

Table 32: Tests for the equality with zones L-A plus D, L-Rest, AB, C, and E

Unit cost	Result
Total	Differ between all zonal pairs
LD	Differ between all zonal pairs but L-Rest and AB; L-Rest and C; and AB and C
Indoor staff	Differ between all zonal pairs but L-A plus D and AB; and AB and C
Outdoor staff	Differ between all zonal pairs but L-Rest and C
Delivery vehicles	Differ between all zonal pairs but L-Rest and AB
Other delivery	Differ between all zonal pairs but L-A plus D and L-Rest; L-Rest and E; and AB and C

Source: LECG calculations based on data from ZCM file.

- 6.27 Two qualifications need to be made when drawing our conclusions together. First, and generally speaking, when performing statistical tests the size of the samples used is important. The smaller the sample, the higher the differences between two means must be in order for the test to find that they are different. Also, the higher the variability (the variance) in the data, the easier it is to find no statistical difference. The tests we performed here are geared to assess whether the underlying distributions of unit costs differ. We found that in most cases they are different (even in almost all cases involving small sample sizes, such as zones A and L-A). In only two instances, we found no statistical significance: between zones A and B, and between zones L-A and D (refer to paragraph A.4.16).
- 6.28 Second, statistical significance is different from actual significance. The unit costs in zones L-A and DE, for example, appear to be quite different when looking at Table 29, and yet they are not found to be different once the distribution of costs across the two zones is taken into account, and statistical testing is performed. Whether one wants to rely on statistical results or actual figures in defining the optimal zonal classification is a matter of policy.
- 6.29 The results of the statistical testing show there are zonal pricing structures that would be more cost reflective than the current uniform pricing, as unit costs do vary with geography. The zonal structure presented by Royal Mail is one of many possibilities, and one in which the underlying cost distributions in two of the five

zones (zones A and B) are statistically the same. Statistical testing shows that a number of amendments could be made to the proposed structure.

- 6.30 We have not been asked to comment on the appropriateness of, or to identify all, alternative classifications. Our presentation of alternative zonal classifications is not a proposal but an illustration of alternative ZCMs with a similar structure to that proposed by Royal Mail. We have found some alternatives that appear to be more cost reflective, indicating that the ZCM classification proposed by Royal Mail is not optimal. We do not propose that these alternatives should be implemented, and indeed there might be practical problems with doing so. For example, it might be difficult to separate zone DE into two zones. In this case, the costs in zone E would become higher than the price of a 2nd class stamp. It might also be confusing to customers to have zones L-A and D combined or impractical to split the London zone.

7 Econometric analysis

Introduction

- 7.1 In Section 6, we tested whether total DO *unit* costs are statistically different across the postal zones defined by Royal Mail in the ZCM. We found that within the London zone, unit costs are different between London zone A (L-A) and the rest of the zones in London (L-Rest). In the rest of the UK, unit costs are different in zones AB, C, D, and E. We also found that unit costs are statistically the same in L-Rest and in zone D. The postal zones where unit costs differ are therefore L-A, L-Rest with D, AB, C, and E.
- 7.2 The fact that *unit* costs are different between postal zones, however, does not mean that *total* costs are. Two postal zones might have different unit costs but identical total costs. The driver of different unit costs would be different volume levels. It is an important question whether total costs vary with geography, or whether differences in unit costs only reflect the effect of volume differences.
- 7.3 The purpose of this section is to test whether the differences in total DO *unit* costs across postal zones (as found in Section 6) are due to purely geographic factors, or whether they are due to other factors such as volume or factor prices, e.g. wages. If it is found that, after the effects of volume and factor price have been accounted for, *total* costs at DOs still change significantly when the zonal composition of DOs changes, then we can say that unit costs based on postal zones defined by geographical factors (i.e. DPD and BD) are more cost reflective than a uniform one.
- 7.4 This test can only be performed using econometric techniques, which enable us to estimate the parameters of a function (in the form a mathematical equation) relating total DO costs to their cost drivers (e.g. volumes, factor prices, and geographic variables). The parameters of each geographic variable measure the extent by which total costs respond significantly to changes in that variable, *after* the effect on total costs of volumes and factor prices have been accounted for.

Approach

- 7.5 We provide a summary of the econometric cost model in this section. The econometric cost model is based on the cost model we used for DOs during the

PCR⁴⁴. Using bottom-up data, the PCR efficiency model estimated the parameters of a function, relating total DO *labour* costs to cost drivers. Cost drivers are factors that influence the (labour) costs of delivering mail (i.e. the wage rate, mail volumes per delivery point, number of delivery points, distance between delivery points, BD, mail redirections, percentage of RM2000 sorting frames in the DO, and an index that measured the competitiveness of Royal Mail's wage). In the PCR model, geography was modelled using dummy variables⁴⁵ that identified five zones: major city centre, urban, suburban, rural and deep rural⁴⁶. The functional form chosen for the PCR cost model was the Cobb-Douglas function, in which all the variables but the dummies are in natural logarithms.

7.6 To assess zonal cost differences we have also estimated a Cobb-Douglas function. In this case, allocated⁴⁷ top-down costs (i.e. the sum of LD, indoor staff, outdoor staff, delivery vehicles and other delivery) are expressed as a function of a number of factors. These factors include the wage rate,⁴⁸ the LD driver wage rate⁴⁹, the LD vehicle rate⁵⁰, the outdoor vehicle rate⁵¹, allocated top-down mail volumes⁵², the percentage of mail that is walksorted at the IMC⁵³, and percentage of RM2000 sorting frames in the DO⁵⁴.

⁴⁴ LECG, Future Efficient Costs of Royal Mail's Regulated Mail Activities, Excised Version 4 August 2005.

⁴⁵ Dummy variables are variables that take the value of one if a characteristic is present and zero otherwise. For example, the urban dummy would be equal to one if the DO is in an urban area and zero otherwise.

⁴⁶ These zones were defined differently for access zones and ZCM zones.

⁴⁷ For each DO, total cost of delivery is the amount of top-down total costs allocated to that DO.

⁴⁸ This is the relevant labour price variable for indoor and outdoor staff costs. It was supplied by Royal Mail as a hard coded variable in the ZCM file.

⁴⁹ This is the relevant wage rate for the labour component of LD costs. It is the driver's rate for the IMC from where the volumes are distributed. The variable was supplied by Royal Mail in the ZCM file.

⁵⁰ This is the relevant factor price for the vehicle component of LD costs. It is expressed as vehicle costs per journey. It has been calculated using variables in the ZCM.

⁵¹ This is the relevant factor price for delivery vehicle costs. It is expressed per vehicle. It has been calculated by dividing outdoor vehicle costs by the number of vehicles at the DO. Outdoor vehicle costs are provided in the ZCM file. Royal Mail also provided vehicle numbers.

⁵² That is, mail volumes at each DO are the amount of top-down volumes allocated to that DO by the ZCM. These are *unweighted* mail volumes, and come from the ZCM file.

⁵³ This is a potentially relevant driver for indoor costs. The variable was supplied by Royal Mail.

⁵⁴ This variable was supplied by Royal Mail.

- 7.7 To measure the impact of geography, we added to the model five zonal variables⁵⁵, constructed using the information on postcode sectors available in the ZCM. For each DO, we have counted the number of A postcode sectors, B postcode sectors, etc., that exist in the DO territory. The definition of the postcode sector zones is that adopted by Royal Mail in the ZCM (i.e. L, A, B, C, and DE), which we needed to create five zonal variables. For example, zonal variable A contains one value for each DO, equal to the number of postcode sectors that the DO has in zone A⁵⁶. The zonal variables therefore have nothing to do with how the ZCM allocates each DO to zones. Rather, for each DO, the zonal variables tell us the number of postcode sectors in the territory.
- 7.8 The coefficient of each of the five zonal variables, say zonal variable A, can then be interpreted as follows. If we left everything unchanged (wages, volumes, and all other variables in the model), but increased the number of postcode sectors in Zone A by 1%, would total costs change significantly on average? If the answer to this question is yes, then we can say that zone A is correctly defined. If the answer is no, then there is no point in having a zone A, because it does not affect costs. The test is performed by looking at whether the coefficient of the zonal variable A is statistically significant (i.e. has a P-value of less than 0.05). Finding that the coefficient of a zonal variable is not significant does *not* mean that there are no differences in unit costs across those two zones: there might be large differences, due to volume or wage differences. Finding no significance simply means that the geographic factors that identify that zone are not relevant. Thus, a

⁵⁵ As postal zones are defined by DPD and BD, the latter do not need to be added to the econometric model. However, adding DPD and BD to the model can be used to test for the correctness of the thresholds chosen to identify the postal zones in the ZCM (the thresholds are, for example, a DPD of between 100 and 1000 per km² for zone C). If the thresholds of the zones are correct, DPD and BD should be insignificant when added to the cost model. This is because all the impact of geography on costs should be entirely accounted for by the zonal variables.

⁵⁶ Many DOs do not have postcode sectors in all of the zones. For example, zonal variable A is equal to zero for each DO that does not have any postcode sectors in zone A. Zonal variables can therefore have many zeroes. As we estimate a Cobb-Douglas model, we need to take the logarithm of each zonal variable, and doing so is problematic, as it is indefinite when the variable takes the value of zero. Had the number of zeroes been small, we could have substituted them with a small number (say 0.0001). However, this is not the case, and we cannot adopt this procedure. Instead, we have adopted what is now a standard procedure for treating zero observations when the number of zeroes is large. This procedure was developed in Battese, George E. (1997), "A Note on the Estimation of Cobb-Douglas Production Functions when Some Explanatory Variables Have Zero Values", *Journal of Agricultural Economics* 48, pp. 250-252. For any variable x (which has zeroes), this procedure consists of the following steps. First, create a dummy d equal to one if x is zero, and to zero otherwise. Second, multiply x by d . Now x is equal to one whenever it was zero before. Third, take the log of x , which is zero anytime x is one. Add both x and d to the regression model. Repeat the procedure for any other variable that has numerous zeroes. The coefficients on the d 's represent adjustment factors and are meaningless in model interpretation. As such, we have not reported these coefficients.

redefinition of such factors (i.e. setting different thresholds for the zone in terms of DPD and BDs) might be desired.

- 7.9 We have estimated our cost models using bottom-up data for 1,375 DOs supplied by Royal Mail in the ZCM file, and OLS regression techniques⁵⁷. The remainder of this section discusses the results of the econometric estimation.

Review of Royal Mail's ZCM zones

- 7.10 The table below reports the results of the cost model estimated with zonal variables representing Royal Mail's zonal classification. In order for a variable to be statistically significant, its p-value has to be smaller than 0.05. We have highlighted the zonal variables in yellow.

Table 33: Estimate DO cost model with Royal Mail's ZCM zones

Variable	Coefficient	P-value
Mail volume	0.78	0.00
Wage rate	1.26	0.00
Outdoor vehicle rate	0.01	0.10
Driver wage rate	0.06	0.87
LD vehicle rate	0.00	0.30
% RM2000 sorting frames	0.00	0.68
% Mail walksorted at the IMC	-0.01	0.44
Zonal variable L	0.27	0.00
Zonal variable A	-0.01	0.64
Zonal variable B	0.07	0.00
Zonal variable C	0.08	0.00
Zonal variable DE	0.10	0.00
Constant	-1.53	0.18
Adjusted R ²	0.9359	

Source: LECG calculations based on data from ZCM file.

- 7.11 The coefficients on mail volume and the wage rate are highly significant. The coefficients on other factor price variables are not. Labour costs represent about

⁵⁷ All regressions had heteroscedastic errors, so we used the White correction for heteroscedasticity.

86% of total DO costs, whereas LD labour costs (i.e. drivers' pay) account for 3.1% of total DO costs, and LD vehicle costs account for 1.1%. Given this, we would expect that if driver wage rates were to increase (while all other variables in the regressions stayed the same) then the impact on total costs would be insignificant (and this is what a statistically insignificant coefficient means). The same reasoning can be applied to outdoor vehicle costs, which represent 3.7% of total DO costs. The variables % RM2000 sorting frames and % Mail walksorted at the IMC are also not statistically significant. This result was also obtained in the PCR model.

- 7.12 With respect to the geographic variables, they are all significant apart for zonal variable A. This indicates that there is strong evidence that costs vary with geography, but that zone A should not be used as a separate zone.
- 7.13 Our results also indicate that the London zone has a significant impact on total costs, even *after* having accounted for the effect of volumes and wages. This suggests that the London zone should be a separate postal zone. However, it also suggests that it is not only wages that drive higher costs in the London zone, but that geographic factors are important in London as well. This casts doubts on Royal Mail's approach to defining the London zone based entirely on wages: whether the London zone can be further divided is discussed next.

A cost model with London costs allowed to vary across zones

- 7.14 We now consider the case where total costs in London, as well as in the rest of the country, are allowed to vary across zones. The table below shows the results of using Royal Mail's zones A, B, C and DE, plus the same zones for London (noting that zone DE in London only contains postcode sectors that are zone D, as there are no postcode sectors in London located in zone E).

Table 34: Estimate DO cost model with zones A, B, C, and DE in London and outside

Variable	Coefficient	P-value
Mail volume	0.78	0.00
Wage rate	1.33	0.00
Outdoor vehicle rate	0.00	0.15
Driver wage rate	0.00	0.99
LD vehicle rate	0.00	0.24
% RM2000 sorting frames	0.00	0.91
% Mail walksorted at IMC	-0.01	0.38
Zonal variable A	-0.01	0.67
Zonal variable B	0.07	0.00
Zonal variable C	0.07	0.00
Zonal variable DE	0.10	0.00
Zonal variable London A	0.14	0.00
Zonal variable London B	0.12	0.00
Zonal variable London C	0.11	0.00
Zonal variable London DE	-0.12	0.20
Constant	-1.10	0.37
Adjusted R ²	0.9354	

Source: LECG calculations based on data from ZCM file.

- 7.15 The zonal variables in the model above need to be interpreted as follows⁵⁸. For each zonal variable, say zone B, the coefficient indicates the percentage by which total costs in DOs outside of London increase if zone B postcode sectors were to increase by 1%. For the same zone B, the coefficient on zonal variable London B tells us by how much (in percentage terms) the effect would be higher in London. Hence, the overall effect in London of increasing zone B postcode sectors by 1% is given by the sum of the coefficients on zonal variable B and zonal variable London B.

⁵⁸ In technical terms, we have added so called interactive dummy variables for London. We give the example here for zonal variable A, which we call X here for simplicity. Also, call d a dummy variable that is equal to 1 if the DO is in London and to 0 otherwise. Then we create a variable $X_d = X \cdot d$, and introduce both X and X_d in the cost model. This allows for a change in the coefficient of the variable X between London and the rest of the country. The coefficient on X is -0.01, and that of X_d is 0.14. Then, when d is zero, outside of London, the effect of a change in X is -0.01, but when d=1, in London, the effect is -0.01+ 0.14.

- 7.16 For DOs outside of London, zonal variable A is not significant, while all the other zonal variables are. For DOs in London, zonal variables are significant with the exception of zone DE⁵⁹. The high significance of the London zonal variables shows that geography matters in London, and that the impact of geography on *total* costs in London is different (higher) than outside. For example, adding 1% more postcode sectors B in London increases total costs by an additional 0.12% than adding an extra 1% postcode sectors B in the rest of the country.
- 7.17 Our econometric analysis shows that there is evidence that geographical factors, as well as higher wages, have a significant impact on total costs in London, and that there is scope to allow for more than one London zone.

A cost model with London costs allowed to vary across zones, and zones D and E separated

- 7.18 We have also tested whether there is evidence that the zone DE (outside of London, could be further split into two separate zones). The results of this test are shown in the table below.

⁵⁹ In London, there are only 22 postcode sectors in zone DE, and they are all D postcode sectors. They are located in 16 DOs. There are 1,359 zero values in the variable London zone DE (1,375-16), and this explains the low significance. In technical term, this variable does not vary enough. In practical terms, the number of D postcode sectors is so small in comparison to the total, that it cannot affect costs.

Table 35: Estimate DO cost model with zones A, B, C, D, and E in London and outside

Variables	Coefficient	P-value
Mail volume	0.79	0.00
Wage rate	1.27	0.00
Outdoor vehicle rate	0.00	0.12
Driver wage rate	-0.14	0.69
LD vehicle rate	0.00	0.26
% RM2000 sorting frames	0.00	0.72
% Mail walksorted at IMC	0.00	0.75
Zonal variable A	-0.01	0.61
Zonal variable B	0.06	0.00
Zonal variable C	0.07	0.00
Zonal variable D	0.07	0.00
Zonal variable E	0.10	0.00
Zonal variable London A	0.14	0.00
Zonal variable London B	0.12	0.00
Zonal variable London C	0.11	0.00
Zonal variable London DE	-0.08	0.39
Constant	-0.80	0.51
Adjusted R ²	0.9352	

Source: LECG calculations based on data from ZCM file.

- 7.19 The only result that needs commenting, in addition to the previous comments made, is that the zonal variables D and E outside of London are both highly significant. The significance of zonal variable E indicates that this zone should be treated separately.

Conclusions

- 7.20 We have performed an econometric analysis to test whether there is evidence that the zonal differences in unit costs across postal zones originate from a differential impact of geography on total costs. The econometric analysis allowed us to consider whether, after having allowed for the impact of mail volumes and

factor prices, total costs still varied across zones. The results of our modelling of total DO costs are that:

- there is no evidence that zone A has an impact on total costs. What makes zone A different from either zone B or C is the proportion of BD. The econometric results suggest that this definition is not correct, because increasing the proportion of postcode sectors in A does not have a significant impact on DO costs, however increasing the proportion of postcode sectors in B or C does. This suggests that there is a need to adjust the DPD threshold for zone A, or the BD threshold, or both. Another possibility would be that, when considering costs at DO, rather than the postcode sector level, BD is not a relevant cost driver, which might be why the zonal cost variable A is not significant;
- there is evidence that the costs of zones D and E should be considered separately; and
- there is evidence that the London zone should be split into more than one zone.

7.21 We have found evidence that the zones in the original ZCM can be further refined to reflect better the impact of geographic variability in costs. In line with the results summarised in Section 6, we have found consistent evidence that both *unit* and *total* costs are affected by geography in London, which is treated as a single zone in the ZCM, while they are not in zone A, which is a separate zone. There is *no* evidence that the unit costs of delivering mail differ between the average DOs in zones A and B.

7.22 Our analysis suggests that the costs of delivering mail are not uniform. However, we cannot say with confidence whether the zonal classification proposed by Royal Mail is better than other possible definitions, based on alternative zonal thresholds. One might want to test whether adding the variables that are used to define the zones (i.e. DPD and BD) would yield significant coefficients for those variables. If that were the case, it would mean that the thresholds for DPD and BD chosen to define the zones do not capture all the cost variation that is caused by geography. Postcomm and Royal Mail might want to investigate this further.

Appendices

Appendix 1: Review of data

Introduction

- A.1.1 This appendix provides further support to Section 4, where we discussed the data review process performed by LECG. The appendix contains further details for those DOs that were considered outliers by LECG.

Changes in DPD and BD values with respect to the PCR data

- A.1.2 The table below shows the change in BD for each of the 7 DOs that were found to have changes in BD between 2003 and 2005 in excess of 10% in paragraph 4.5.

Table A 1: DOs with significant differences in BD between ZCM and PCR data

DO name	Change in BD
LEICESTER CENTRAL	-11%
EC1-EC4	-11%
BIRMINGHAM CENTRAL	-11%
MANCHESTER	-13%
WDO	-13%
LIVERPOOL CDO 1-3	-15%
BRISTOL 1	-23%

Source: LECG calculations based on data from ZCM file and PCR file.

- A.1.3 The table below shows the change in DPD for each of the DOs that were found to have outlying changes in DPD between 2003 and 2005 in paragraph 4.6.

Table A 2: DOs with significant differences in DPD between ZCM and PCR data

DO name	% change in DPD
GORSEINON	-44%
LOW FELL	-40%
MARKET DEEPING	-36%
WHITBY	-20%
LLANIDLOES	-20%
LEICESTER NORTH	19%
HENFIELD	20%
DUNGANNON	24%
BALLYMONEY	37%
GATESHEAD	54%
NOTTINGHAM SOUTH	112%
MUMBLES	202%

Source: LECG calculations based on data from ZCM file and PCR file.

Changes in the allocation of DOs to postal zones when using postcode sector data

- A.1.4 The table below lists the DOs that experienced zonal classification changes between 2003 and 2005, as discussed in paragraph 4.7, as well as the classification changes.

Table A 3: Zonal differences across zones calculated using PCR and ZCM data

DO office names	PCR file zone	ZCM file zone
CAMP HILL	A	B
COLESHILL	C	D
BIRKENHEAD	A	B
BLACKPOOL	A	B
CARNOUSTIE	D	C
SALFORD	A	B
GATESHEAD	C	B
LOW FELL	B	C
NORTH TYNESIDE	C	B
STONE	D	C
THATCHAM	C	D
AVONMOUTH	A	C
GLASGOW G40	A	B

Source: LECG calculations based on data from ZCM file and PCR file.

ZCM internal consistency: LD costs

- A.1.5 The table below lists the 29 DOs that have a number of journeys higher than twice the standard deviation from the DOs mean. For those DOs highlighted in yellow, to the high number of journeys corresponds a volume per journey that is excessively low. These 9 DOs have been considered outliers, as discussed in paragraph 4.12

Table A 4: LD costs - DOs with high number of daily journeys to IMC compared to unweighted traffic

DO Name	Unweighted Traffic	Number of Journeys per day	Unweighted traffic per journey*
Glasgow G1 - G4	████████	█	██████
Huddersfield	████████	█	██████
Dundee West	████████	█	██████
Bedford MK40-42 and Rural	████████	█	██████
Leith 5	████████	█	██████
Leith 6	████████	█	██████
Edinburgh West Central	████████	█	██████
Stafford	████████	█	██████
St. Albans	████████	█	██████
Exeter	████████	█	██████
Lincoln	████████	█	██████
Ayr	████████	█	██████
Chelmsford	████████	█	██████
Bradford South 1	████████	█	██████
Victoria	████████	█	██████
Craigavon	████████	█	██████
Craigavon Lurgan	████████	█	██████
Hereford and Rural	████████	█	██████
Colchester	████████	█	██████
Hollywood	████████	█	██████
Belfast 10 and 11	████████	█	██████
Perth	████████	█	██████

Edinburgh Central 1 and 2	████████	█	████████
Taunton	████████	█	████████
Wakefield	████████	█	████████
Bath	████████	█	████████
Newport West	████████	█	████████
Stoke-Hanley	████████	█	████████
Northampton and SPDOs	████████	█	████████

Source: LECG calculations based on data from ZCM file. * Unweighted traffic per journey is obtained by dividing unweighted traffic by 306 (the number of delivery days in 2005-2006) and by the number of journeys per day.

ZCM internal consistency: outdoor versus delivery support costs

- A.1.6 The two tables below show those DOs, which were considered outliers due to inconsistencies between recorded outdoor delivery and delivery support costs, as discussed in paragraph 4.15. The tables show the DO names, and the values of the relevant cost variables.

Table A 5: DOs with high outdoor delivery costs in comparison to delivery support costs

DO Name	Outdoor Labour Costs (£)	Delivery Support Costs (£)
Derby and Rurals	████████	████████
Northampton and SPDOs	████████	████████
Wolverhampton	████████	████████

Source: LECG calculations based on data from ZCM file.

Table A 6: DOs with high delivery support costs compared to outdoor delivery costs

DO Name	Outdoor Labour Costs (£)	Delivery Support Costs (£)
Willesden SDO	██████	██████
Harrow	██████	██████
CV North, East, South and West	██████	██████
WC	██████	██████
Burnley	██████	██████
NW	██████	██████
W	██████	██████
EC1-EC4	██████	██████

Source: LECG calculations based on data from ZCM file.

Sensitivity to the exclusion of outlying DOs from the analysis

A.1.7 The table below reports DO delivery costs estimated by Royal Mail's ZCM when the 97 DOs identified by LECG as outliers are dropped from the analysis. Table 15 in the report shows the corresponding percentage changes, which have been calculated prior to rounding the unit cost figures to two decimal points, and which therefore cannot be replicated based on the values shown below.

Table A 7: ZCM unit cost estimates after dropping 97 outliers

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	■	■	■	■	■	■
A	■	■	■	■	■	■
B	■	■	■	■	■	■
C	■	■	■	■	■	■
DE	■	■	■	■	■	■
Total	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Appendix 2: List of outlying DO

Introduction

A.2.1 In section 4, we reviewed the data used by Royal Mail in the ZCM and found 97 outlier DOs. These are listed below, together with the reasons why each DO has been considered an outlier. We excluded these DOs from the analysis in order to test the robustness of Royal Mail's ZCM estimates. The resulting estimate changes are shown in Table 15.

Table A 8: The 97 DOs that were considered to be outliers by LECG

Delivery office name	Reason for dropping the delivery office
Altens	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Ashford (Kent)	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Ashton Under Lyne	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Avonmouth	Zonal classification changes from Price Control Review ("PCR")
Ayr	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Ballymoney	Questionability of DPDs
Banchory	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Belfast 10 and 11	Differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Beverley	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Birkenhead	Zonal classification changes from PCR
Birmingham Central	Questionability of BPs
Blackpool	Zonal classification changes from PCR
Bristol 1	Questionability of BPs
Burnley	Questionability of outdoor and delivery support costs
Camp Hill	Zonal classification changes from PCR
Carnoustie	Zonal classification changes from PCR
Cheltenham	Zonal classification changes from the "Data" worksheet to "DO

	data" and "DO Cost Function"
Coleshill	Zonal classification changes from PCR
Craigavon	Questionability of number of journeys
Craigavon Lurgan	Questionability of number of journeys and; zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
CV North, East, South, West	Questionability of number of journeys; and questionability of outdoor and delivery support costs
Daventry	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Derby and Rurals	Questionability of number of journeys; and outdoor and delivery support costs
Dore	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Dungannon	Questionability of DPDs
EC1-EC4	Questionability of a) number of journeys; b) outdoor and delivery support costs; and c) BPs
Edinburgh Central 1 and 2	Questionability of number of journeys
Edinburgh NW	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Edinburgh West	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Galashiels	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Gateshead	Questionability of DPDs; zonal classification changes from the PCR data
Glasgow G20 - G23	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Glasgow G40	Zonal classification changes from PCR
Gorseinon	Questionability of DPDs
Harpings Road	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Harrogate	Zonal classification changes from the "Data" worksheet to "DO

	data" and "DO Cost Function"
Harrow	Questionability of outdoor and delivery support costs
Henfield	Questionability of DPDs
Hollywood	Questionability of number of journeys
Ifracombe	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Inverness	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Keynsham	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Kidlington	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Kings Lynn	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Kirkcudbright	Significant differences in costs and unweighted traffic relationship
Kirkwall	Questionability of the distance and journey time to MC
Leicester Central	Questionability of BPs
Leicester North	Questionability of DPDs; zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Leith 5	Questionability of number of journeys
Leith 6	Questionability of number of journeys
Lerwick	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Leyburn	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Lincoln	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Liverpool CDO 1-3	Questionability of BPs
Llandrindod Wells	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Llanidloes	Questionability of DPDs
Londonderry	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Low Fell	Questionability of DPDs; zonal classification changes from the PCR data
Maldon and SPDOs	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"

Manchester	Questionability of BPs
Market Deeping	Questionability of DPDs
Maybole	Significant differences in costs and unweighted traffic relationship
Mumbles	Questionability of DPDs
Newport West	Questionability of number of journeys
North Tyneside	Zonal classification changes from PCR
Northampton and SPDOs	Questionability of number of journeys; questionability of outdoor and delivery support costs
Norwich	Differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Nottingham North	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Nottingham South	Questionability of DPDs
NW	Questionability of outdoor and delivery support costs
Oldham	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"; and there are differences in DPD when calculated in "Data" worksheet and "DO data" and "DO Cost Function"
Penzance	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Peterborough PDO	Questionability of number of journeys
Port Ellen and Rurals	Significant differences in costs and unweighted traffic relationship
Salford	Zonal classification changes from PCR
Sandwich	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Sandy and Rurals	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
St Austell	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Stafford	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Stoke-Hanley	Questionability of number of journeys
Stone	Zonal classification changes from PCR
Stornoway	Questionability of the distance and journey time to MC
Taunton	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Thame	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"

Thatcham	Zonal classification changes from PCR
Vale Of Glamorgan	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Warwick	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Watford (WD)	Questionability of indoor staff and meal relief costs
WC	Questionability of outdoor and delivery support costs
W	Questionability of outdoor and delivery support costs; and of BPs
Westbury Do Bs	Questionability of the distance and journey time to MC
Whitby	Questionability of DPDs
Whitehaven	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
Willesden SDO	Questionability of outdoor and delivery support costs
Wolverhampton	Significant differences in costs and unweighted traffic relationship; and questionability of outdoor and delivery support costs
Worcester APC	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"
York central	Zonal classification changes from the "Data" worksheet to "DO data" and "DO Cost Function"

Source: LECG analysis based on data from ZCM and PCR data file.

Appendix 3: Sensitivity analysis details

Introduction

- A.3.1 This appendix provides further details to the Sensitivity Analysis discussed in Section 5. For each of the sensitivity scenarios presented in the report, we show the relevant estimates of the unit delivery costs and, when not shown in the report, the percentage change with respect to Royal Mail's ZCM unit costs estimates.
- A.3.2 All the unit cost figures in this Appendix have been rounded to two decimal points, while the figures for percentage changes have been rounded to the nearest integer. One should refrain from calculating percentage changes from the rounded figures shown in the tables, as they would not correspond to the percentage figures shown, due to rounding.

Excluding DOs based on prior PCR work

- A.3.3 The table below reports DO delivery costs estimated by the ZCM after excluding the DOs identified by Royal Mail during the PCR as having poor volume data. Table 16 shows the corresponding percentage changes.

Table A 9: DO unit costs after dropping the DOs with poor volume data quality

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	■	■	■	■	■	■
A	■	■	■	■	■	■
B	■	■	■	■	■	■
C	■	■	■	■	■	■
DE	■	■	■	■	■	■
Total	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Re-allocating DOs to postal zones based on postcode sector

A.3.4 In Section 4, we found that 42 DOs had different zonal classifications according to whether postcode sector or DO level DPD and BD were used to allocate DOs to zones. The table below reports delivery costs estimated by the ZCM when these 42 DOs are reassigned to zones based on postcode sector data. Table 17 in Section 5 shows the corresponding percentage changes.

Table A 10: DO unit costs after reallocating 42 DOs to alternative zones

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Using unweighted IMC volumes to allocate top-down IMC volumes

A.3.5 In Section 5, paragraphs 5.7 to 5.9, we discussed the results of a sensitivity analysis performed by first using unweighted mail volumes at the IMC to allocate top-down IMC volumes, and then distribute each IMC allocated volumes to zones using MCS volumes. The table below reports delivery costs estimates from this sensitivity analysis. Table 18 shows the corresponding percentage changes.

Table A 11: DO unit costs obtained using unweighted IMC volumes to allocate top-down volumes across IMCs

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Using weighted DO and IMC volumes to allocate top-down volumes

A.3.6 In Section 5, paragraphs 5.10 to 5.14, we discuss the results of a sensitivity analysis performed by using weighted rather than unweighted DO and IMC volumes to allocate top-down volumes. The table below reports delivery costs estimates from this sensitivity analysis. Table 19 shows the corresponding percentage changes.

Table A 12: DO unit costs obtained using weighted volumes at IMC and DOs to allocate top-down volumes

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	████	████	████	████	████	████	████
A	████	████	████	████	████	████	████
B	████	████	████	████	████	████	████
C	████	████	████	████	████	████	████
DE	████	████	████	████	████	████	████
Total	████	████	████	████	████	████	████

Source: LECG calculations based on data from ZCM file.

Adjusting lorry loading times in the calculation of LD costs

- A.3.7 In paragraph 5.15 we discuss the results of a sensitivity analysis performed by allowing lorry loading times for LD to be higher than the 15 minutes assumed by Royal Mail. Here we provide further details for this sensitivity analysis.
- A.3.8 In the ZCM, LD costs are given by the sum of three components: LD staff costs, LD vehicle costs, and “other LD costs”. Top-down staff costs represent █████ of LD costs, vehicle costs represent █████, and “other LD costs” make up the remaining █████. DO level figures for LD costs are only available for staff and vehicles, not for “other LD costs”. Royal Mail use DO LD staff and vehicle costs to allocate the corresponding top-down figures, while top-down “other LD costs” are allocated among the DOs using the proportion of LD staff plus vehicle costs at each DO. Thus, when allocated LD staff or vehicle costs change in the DOs, so do allocated “other LD costs”.
- A.3.9 Allocated staff costs at the DO are a function of and thus change with, changes in loading times. This is in line with expectations. Allocated vehicle costs are invariant to changes in loading times, again in line with expectations. Allocated “other LD costs” also vary with loading times (contrary to expectations), because allocated staff costs are used to allocate “other LD costs”.

- A.3.10 As loading times change, staff costs change for individual DOs, and therefore the weight applied to allocate top-down “other LD costs” changes as well. For any given DO, this weight can increase or decrease; if the weight decreases, then allocated “other LD costs” for that DO will decrease as well. As a result, overall LD costs for a particular zone may *decrease* as loading time increases, if the increase in staff costs allocated to DOs in that zone is more than offset by a decrease in “other LD costs” allocated to DOs in that zone. This is counter-intuitive and would warrant a better definition of the allocation methodology for LD costs if the overall impact of changing loading times on unit costs per zone were material. However, this is not the case, because LD costs are such a minor proportion of total unit costs.
- A.3.11 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail’s ZCM) when the loading time is assumed to be 10 minutes, i.e. 5 minutes less than assumed by Royal Mail.

Table A 13: Adjusting the loading time to 10 minutes in the calculation of LD costs

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	■	■	■	■	■	■
A	■	■	■	■	■	■
B	■	■	■	■	■	■
C	■	■	■	■	■	■
DE	■	■	■	■	■	■
Total	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 14: Adjusting the loading time to 10 minutes in the calculation of LD costs, percentage changes with respect to Royal Mail's ZCM results

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	-4%	0%	0%	0%	0%	0%
A	-9%	0%	0%	0%	0%	0%
B	-5%	0%	0%	0%	0%	0%
C	0%	0%	0%	0%	0%	0%
DE	2%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

A.3.12 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail's ZCM) when the loading time is assumed to be 20 minutes, i.e. 5 minutes more than assumed by Royal Mail.

Table A 15: Adjusting the loading time to 20 minutes in the calculation of LD costs

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	■	■	■	■	■	■
A	■	■	■	■	■	■
B	■	■	■	■	■	■
C	■	■	■	■	■	■
DE	■	■	■	■	■	■
Total	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 16: Adjusting the loading time to 20 minutes in the calculation of LD costs, percentage changes with respect to Royal Mail's ZCM results

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	4%	0%	0%	0%	0%	0%
A	7%	0%	0%	0%	0%	0%
B	4%	0%	0%	0%	0%	0%
C	0%	0%	0%	0%	0%	0%
DE	-2%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

A.3.13 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail's ZCM) when the loading time is assumed to be 25 minutes, i.e. 10 minutes more than assumed by Royal Mail.

Table A 17: Adjusting the loading time to 25 minutes in the calculation of LD costs

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	■	■	■	■	■	■
A	■	■	■	■	■	■
B	■	■	■	■	■	■
C	■	■	■	■	■	■
DE	■	■	■	■	■	■
Total	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 18: Adjusting the loading time to 25 minutes in the calculation of LD costs, percentage changes with respect to Royal Mail's ZCM results

Zones	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total (excl IMC costs)
L	7%	0%	0%	0%	0%	0%
A	14%	0%	0%	0%	0%	0%
B	8%	0%	0%	0%	0%	0%
C	0%	0%	0%	0%	0%	0%
DE	-3%	0%	0%	0%	0%	0%
Total	0%	0%	0%	0%	0%	0%

Source: LECG calculations based on data from ZCM file.

Reducing IMC costs

- A.3.14 The tables in this section show the results of the sensitivity analysis discussed in paragraphs 5.16 and 5.17, where we assessed the impact on the ZCM estimates of reducing IMC costs by 10%, 20% and 30% to account for possible misallocation of time spent performing tasks at the mail centre.
- A.3.15 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail's ZCM) when IMC costs are reduced by 10%.

Table A 19: Unit costs obtained by reducing IMC costs by 10%

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 20: Reducing IMC costs by 10%: percentage change in unit costs with respect to Royal Mail's ZCM estimates

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	-10%	0%	0%	0%	0%	0%	-1%
A	-10%	0%	0%	0%	0%	0%	-1%
B	-10%	0%	0%	0%	0%	0%	-1%
C	-10%	0%	0%	0%	0%	0%	-1%
DE	-10%	0%	0%	0%	0%	0%	-1%
Total	-10%	0%	0%	0%	0%	0%	-1%

Source: LECG calculations based on data from ZCM file.

A.3.16 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail's ZCM) when IMC costs are reduced by 20%.

Table A 21: Unit costs obtained by reducing IMC costs by 20%

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 22: Reducing IMC costs by 20%: percentage change in unit costs with respect to Royal Mail's ZCM estimates

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	-20%	0%	0%	0%	0%	0%	-2%
A	-20%	0%	0%	0%	0%	0%	-3%
B	-20%	0%	0%	0%	0%	0%	-2%
C	-20%	0%	0%	0%	0%	0%	-2%
DE	-20%	0%	0%	0%	0%	0%	-2%
Total	-20%	0%	0%	0%	0%	0%	-2%

Source: LECG calculations based on data from ZCM file.

A.3.17 The two tables below report unit cost estimates (and relative percentage changes with respect to the original estimates in Royal Mail's ZCM) when IMC costs are reduced by 30%.

Table A 23: Unit costs obtained by reducing IMC costs by 30%

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Table A 24: Reducing IMC costs by 30%: percentage change in unit costs with respect to Royal Mail's ZCM estimates

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
L	-30%	0%	0%	0%	0%	0%	-3%
A	-30%	0%	0%	0%	0%	0%	-4%
B	-30%	0%	0%	0%	0%	0%	-3%
C	-30%	0%	0%	0%	0%	0%	-3%
DE	-30%	0%	0%	0%	0%	0%	-3%
Total	-30%	0%	0%	0%	0%	0%	-3%

Source: LECG calculations based on data from ZCM file.

Including Central London only in the L postal zone

A.3.18 In paragraphs 5.18 to 5.20 we discuss whether the ZCM cost estimates change substantially when London is defined as containing only those postcode sectors that are in *Central* London. The table below reports delivery costs estimates from this sensitivity analysis. Table 20 shows the corresponding percentage changes.

Table A 25: Unit costs obtained by including Central London only in the L zone

Zones	IMC	LD	Indoor Del Staff	Outdoor Del Staff	Delivery Vehicles	Other Delivery	Total
Central London	■	■	■	■	■	■	■
A	■	■	■	■	■	■	■
B	■	■	■	■	■	■	■
C	■	■	■	■	■	■	■
DE	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■

Source: LECG calculations based on data from ZCM file.

Appendix 4: Statistical testing

Introduction

- A.4.1 In this appendix, we present the results of the tests that underlie the analysis of Royal Mail's and the alternative zonal classifications discussed in Section 6. For each zonal classification and for each DO cost component we have run tests for the equality of the average unit costs across pairs of zones. The results of these tests are presented in detail in the tables below. There are six tables for each zonal classification, reporting test results for each activity costs: average total unit costs; average LD unit costs; average indoor delivery staff unit costs; average outdoor delivery staff unit costs; average delivery vehicle unit costs; and average other delivery unit costs.
- A.4.2 In each table, for each zonal pair we present the difference in the average unit costs, and the P-value for the (Bonferroni) test that this difference is not statistically different from zero. P-values of 0.05 and less are taken to indicate that the difference is statically different from zero and that, therefore, average unit costs in that particular zonal pair are statistically different at the 5% significance level. Those zonal pairs in which costs are not statistically different have been highlighted in yellow.

Original ZCM (zones L, A, B, C, and DE)

- A.4.3 The six tables below report in detail the test for Royal Mail's zonal classification, which are summarised in Table 22 of the report. The results for average total unit costs (table below) show that these are not statistically different between zones A and B.

Table A 26: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 0.540			
C	█ 0.007	█ 0.002		
DE	█ 0.000	█ 0.000	█ 0.000	
L	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 27: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 1.000			
C	█ 1.000	█ 0.317		
DE	█ 0.000	█ 0.000	█ 0.000	
L	█ 1.000	█ 1.000	█ 0.922	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 28: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 1.000			
C	█ 1.000	█ 0.903		
DE	█ 1.000	█ 1.000	█ 0.002	
L	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 29: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 0.000			
C	█ 0.000	█ 0.002		
DE	█ 0.000	█ 0.000	█ 0.000	
L	█ 0.000	█ 0.003	█ 1.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 30: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 1.000			
C	█ 1.000	█ 0.000		
DE	█ 0.000	█ 0.000	█ 0.000	
L	█ 1.000	█ 0.599	█ 0.071	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 31: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	DE
B	█ 1.000			
C	█ 1.000	█ 1.000		
DE	█ 1.000	█ 0.001	█ 0.000	
L	█ 1.000	█ 0.000	█ 0.000	█ 1.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Unit costs with zones A and B combined

A.4.4 The six tables below report in detail the test for the ZCM with zones A and B collapsed into one, and the other zones as per Royal Mail’s classification, which are summarised in Table 24 of the report.

A.4.5 The results for average total unit costs (table below) show that these are statistically different between all zonal pairs.

Table A 32: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 0.000		
DE	█ 0.000	█ 0.000	
L	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 33: Test for the equality of average local distribution unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 0.131		
DE	█ 0.000	█ 0.000	
L	█ 1.000	█ 0.552	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 34: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 0.405		
DE	█ 1.000	█ 0.001	
L	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 35: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 0.000		
DE	█ 0.000	█ 0.000	
L	█ 0.000	█ 1.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 36: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 0.000		
DE	█ 0.000	█ 0.000	
L	█ 0.402	█ 0.043	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 37: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values			
Zones	AB	C	DE
C	█ 1.000		
DE	█ 0.001	█ 0.000	
L	█ 0.000	█ 0.000	█ 1.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Unit costs with access configuration (zones A, B, C, D and E)

A.4.6 The six tables below report in detail the test for Royal Mail’s access tariff zonal classification, which are summarised in Table 26 of the report.

A.4.7 The results for average total unit costs (table below) show that these are not statistically different between zones A and B, A and C, and B and C.

Table A 38: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 1.000		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 39: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 0.052		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 40: Test for the equality of average indoor delivery staff unit costs.

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 0.135			
C	█ 0.000	█ 0.000		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.220	█ 1.000	█ 0.262	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 41: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 0.000			
C	█ 0.000	█ 0.045		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 42: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 0.000		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 43: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 0.884	█ 0.622		
D	█ 1.000	█ 1.000	█ 0.015	
E	█ 0.947	█ 0.001	█ 0.000	█ 0.003

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Assessment of the London zone vis-à-vis the rest of the UK.

A.4.8 In Section 6 we have considered whether the London zone should be treated as a single zone, or whether London unit costs vary across London geographic zones. We show test details for this in the section below.

A.4.9 We have also performed an additional analysis, not discussed in the report, where we have tested whether average unit costs in the rest of the UK differ among zonal pairs. The purpose of this analysis was to ascertain whether average unit costs for zones D and E in the rest of the UK are statistically different once London DOs are eliminated from the sample. The results of this analysis are discussed under the heading “Rest of the UK” below.

London

A.4.10 There are 207 DOs in London (zone L). The following tables report the results of the Bonferroni tests for these DOs, which are summarised in Table 28. The table below shows that in London, average total unit costs in zone A are different from those in the other two zones, B and C. Average total unit costs in zones B and C are not statistically different.

Table A 44: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 0.000	
C	█ 0.000	█ 0.940

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 45: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 0.135	
C	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 46: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 0.000	
C	█ 0.000	█ 1.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 47: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 1.000	
C	█ 0.710	█ 0.426

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 48: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 0.659	
C	█ 0.842	█ 1.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 49: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values		
Zones	A	B
B	█ 0.000	
C	█ 0.000	█ 0.604

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Rest of the UK

A.4.11 There are 1,168 DOs outside of London (i.e. in the rest of the UK). The following tables report the results of the Bonferroni tests for these DOs. These results are briefly discussed in footnote 40 in the main report. The table below, relative to average total unit costs, shows that these are different across all zonal pairs (*including D and E*) but they are not different between zones A and B.

A.4.12 The results show that total average unit costs in zones D and E in the rest of the UK are statistically different.

Table A 50: Test for the equality of total average unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 0.408			
C	█ 0.003	█ 0.001		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 51: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 0.336		
D	█ 0.002	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 52: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 0.698		
D	█ 1.000	█ 0.729	█ 0.000	
E	█ 0.095	█ 0.001	█ 0.011	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 53: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	A	B	C	D
B	█ 0.000			
C	█ 0.000	█ 0.001		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 54: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values				
Col	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 0.000		
D	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 55: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values				
Col	A	B	C	D
B	█ 1.000			
C	█ 1.000	█ 1.000		
D	█ 1.000	█ 0.026	█ 0.009	
E	█ 0.058	█ 0.000	█ 0.000	█ 0.005

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Unit costs with zones L-A, L-Rest, AB, C, and DE

A.4.13 The assessment of the London zone (see paragraphs 6.17 to 6.20) shows that average unit costs in London differ between zone A and the other zones. We therefore proceeded with splitting the L zone in two (L-A and L-Rest); unit cost estimates for this zonal classification are shown in Table 29. The six tables below report in detail the test for this zonal classification, which are summarised in Table 30 of the main report.

A.4.14 The results for average total unit costs (table below) show that these are not statistically different between zones L-A and DE.

Table A 56: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 0.036			
AB	█ 0.000	█ 0.000		
C	█ 0.001	█ 0.000	█ 0.000	
DE	█ 1.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 57: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 1.000			
AB	█ 1.000	█ 1.000		
C	█ 1.000	█ 1.000	█ 0.218	
DE	█ 0.028	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 58: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 0.000			
AB	█ 0.000	█ 0.000		
C	█ 0.000	█ 0.000	█ 0.597	
DE	█ 0.000	█ 0.000	█ 1.000	█ 0.001

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 59: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 1.000			
AB	█ 1.000	█ 0.000		
C	█ 1.000	█ 1.000	█ 0.000	
DE	█ 0.058	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 60: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 1.000			
AB	█ 1.000	█ 0.788		
C	█ 1.000	█ 0.061	█ 0.000	
DE	█ 0.001	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 61: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A	L-Rest	AB	C
L-Rest	█ 0.052			
AB	█ 0.001	█ 0.001		
C	█ 0.002	█ 0.000	█ 1.000	
DE	█ 0.029	█ 1.000	█ 0.001	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Unit costs with zones L-A, L-Rest, AB, C, D, and E

A.4.15 The results in Table 30 show that average total unit delivery costs do not differ significantly between zones L-A and DE. The results in table A50 show that average total unit delivery costs differ between zones D and E. We have therefore separated these two zones to test whether total unit delivery costs in zone L-A are statistically the same as those in zones D and E, or as those of one of these two zones only. The resulting zonal classification is L-A, L-Rest, AB, C, D and E, for a total of six zones. The following six tables report in detail the tests for this zonal classification

A.4.16 The table below, relative to average total unit costs, shows that these are different across all zonal pairs but they are *not* statistically different between zones L-A and D. Based on these conclusions, we have then estimated unit delivery costs for the zonal classification in Table 31.

Table A 62: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	■ 0.018				
AB	■ 0.000	■ 0.000			
C	■ 0.000	■ 0.000	■ 0.000		
D	■ 0.322	■ 0.000	■ 0.000	■ 0.000	
E	■ 0.000	■ 0.000	■ 0.000	■ 0.000	■ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 63: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	█ 1.000				
AB	█ 1.000	█ 1.000			
C	█ 1.000	█ 1.000	█ 0.212		
D	█ 0.119	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 64: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	█ 0.000				
AB	█ 0.000	█ 0.000			
C	█ 0.000	█ 0.000	█ 0.861		
D	█ 0.000	█ 0.000	█ 1.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.001	█ 0.023	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 65: Test for the equality of average outdoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	█ 1.000				
AB	█ 1.000	█ 0.000			
C	█ 1.000	█ 1.000	█ 0.000		
D	█ 0.247	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 66: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	█ 1.000				
AB	█ 1.000	█ 0.671			
C	█ 1.000	█ 0.026	█ 0.000		
D	█ 0.003	█ 0.000	█ 0.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 67: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values					
Zones	L-A	L-Rest	AB	C	D
L-Rest	█ 0.074				
AB	█ 0.002	█ 0.001			
C	█ 0.003	█ 0.000	█ 1.000		
D	█ 0.026	█ 1.000	█ 0.019	█ 0.007	
E	█ 1.000	█ 0.084	█ 0.000	█ 0.000	█ 0.004

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Unit costs with zones L-A plus D, L-Rest, AB, C, and E

A.4.17 Having established that average total unit delivery costs are statistically the same in zones L-A and D, we have estimated the following zonal classification: L-A plus D; L-Rest; AB; C; and E. The following six tables report in detail the test for this zonal classification. This is presented in Table 32 of the main report.

A.4.18 The results for average total unit costs (table below) show that these are statistically different between all zonal pairs.

Table A 68: Test for the equality of average total unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	■ 0.000			
AB	■ 0.000	■ 0.000		
C	■ 0.000	■ 0.000	■ 0.000	
E	■ 0.000	■ 0.000	■ 0.000	■ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 69: Test for the equality of average LD unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	█ 0.000			
AB	█ 0.000	█ 1.000		
C	█ 0.000	█ 0.881	█ 0.144	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 70: Test for the equality of average indoor delivery staff unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	█ 0.000			
AB	█ 1.000	█ 0.000		
C	█ 0.004	█ 0.000	█ 0.735	
E	█ 0.000	█ 0.000	█ 0.002	█ 0.029

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 71: Test for the equality of average outdoor delivery staff costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	█ 0.000			
AB	█ 0.000	█ 0.000		
C	█ 0.000	█ 1.000	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 72: Test for the equality of average delivery vehicles unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	█ 0.000			
AB	█ 0.000	█ 0.457		
C	█ 0.000	█ 0.019	█ 0.000	
E	█ 0.000	█ 0.000	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.

Table A 73: Tests for the equality of average other delivery unit costs

Differences in average unit costs between zonal pairs and P-Values				
Zones	L-A plus D	L-Rest	AB	C
L-Rest	█ 1.000			
AB	█ 0.006	█ 0.001		
C	█ 0.001	█ 0.000	█ 1.000	
E	█ 0.004	█ 0.058	█ 0.000	█ 0.000

Source: LECG calculations. Data from ZCM file. Highlighted cells indicate insignificant differences.