



Cost adjustment claim to fund additional retail costs from transience

9 June 2023

PR24_TMS_Cost Adjustment
Claim_002 (Transience)

Executive summary

Population transience (transience) is the propensity of people to migrate between addresses, both within the UK, and internationally. Transience impacts the efficient residential retail costs in two main ways. First, it increases our debt-related costs, because the more customers relocate, the harder it is to recover debt from them. Second, our non-bad debt-related costs also increase as we process our customers' change of address, for example to open, close or modify their accounts, issue new and final bills and proceed to related customer contacts.

At PR19, Ofwat allowed all companies their efficient retail costs related to transience by capturing the effect of transience in its retail cost models. At PR24, Ofwat no longer proposes to include a transience variable in its residential retail model as it states that "*transience does not have a material impact on bad debt costs*" based on its assessment of its retail cost models¹.

We disagree with this statement and consider that transience should remain included in cost models and make concrete proposals on the best way of doing so². We consider that the exclusion of transience from the retail cost models will result in companies being under-rewarded or over-rewarded relative to their true efficient costs. Given that we have the highest level of transience in the sector³, we will in effect be under-funded for our retail costs.

Therefore, should Ofwat continue with its current approach to cost modelling, we would like to submit a cost adjustment claim to recover our efficient retail costs related to transience. We have estimated the adjustment claim at £83 million.

We commissioned Economic Insight to review the impact of transience on our retail costs and provide input to our adjustment claim. We provide a summary of our analysis and rationale below, with references to their main report. Our cost adjustment claim has also been reviewed by Deloitte as part of our assurance process.

In line with Ofwat's guidance, the rationale for our cost adjustment claim is based on the particular circumstances we face, high materiality, and management control

Firstly, we have the highest level of transience across the sector with a total migration rate of over 18%, which is around 6 percentage points above the average level of transience. This is presented in the figure below.

We have unique circumstances as we are also a clear outlier in terms of population transience. Our analysis indicates that most companies have a rate of population transience similar to the average. The average total migration rate (calculated as the sum of inflows and outflows) is 12%, and 11 out of 17 companies have a total migration rate between 10% and 14%. This contrast well with our total migration rate of 18%⁴.

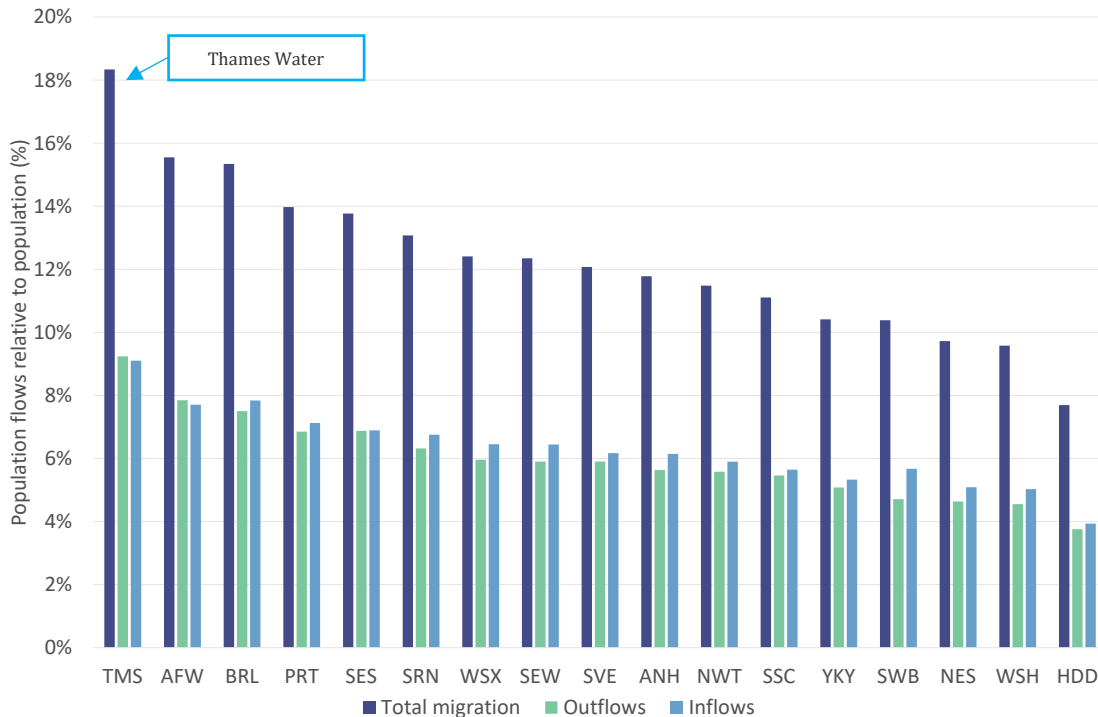
¹ 'Econometric base cost models for PR24.' Ofwat (April 2023); page 64.

² Chapter 5 of Economic Insight's report.

³ Figure 1 of Economic Insight's report

⁴ Figure 2 of Economic Insight's report for more detail

Figure 1- Measures of overall transience by water company (2013-14 to 2019-20)



Source: Economic Insight’s report, section 3C. Analysis based on ONS data.

Secondly, transience is irrefutably outside of management control, and we have taken steps to reduce the impact of transience on our retail costs. For example, we have:

- Proactively identified opportunities to reduce costs when customers move home;
- Improved our processes to reduce the costs of identifying a transient customers;
- Re-engineered our ‘move home’ customer journey process to reduce the handling time for these interactions; and
- Promoted direct debit payments to reduce the time we spend on chasing and managing customers’ payments.

Thirdly and lastly, transience has a material impact on our costs. Economic Insight’s cost benchmarking models, which are based on peer reviewed models in an academic journal, show a statistically significant impact of transience on efficient retail costs. Our own econometric modelling at industry level indicates that transience is an important driver of retail costs⁵. This conclusion is corroborated in our ‘within-Thames’ analysis which finds a positive and statistically significant relationship (at the 1% level) between transience and our debt-related (unit) costs⁶.

The significance of the impact of transience on our retail costs warrants a cost adjustment. Without such adjustment, Thames Water’s retail cost allowance will be insufficient to cover transience related costs. Using Ofwat’s models, we estimate the impact of excluding transience would result in our total operating costs being set 9% below the efficient level⁷.

We have valued our cost adjustment claim at £83.2 million

The table below sets out the summary of our CAC calculations.

⁵ Chapter 4 of Economic Insight’s report for more detail on the models used and results.

⁶ Chapter 6 of Economic Insight’s report.

⁷ This is calculated as $[B - A] / A$ in Table 1.

Table 1 - Thames transience CAC figures

	5-year value (£m, 2022-23 prices)
[A] Gross cost adjustment	889.2
[B] Implicit allowance	806.1
[A – B] CAC	83.2

Source: Economic insight report, Chapter 7.

For both the gross adjustment and implicit allowance, we use Ofwat’s PR24 retail cost consultation models. We use Ofwat’s models for the implicit allowance because the implicit allowance should be reflective of Thames Water’s expected retail cost allowance at PR24. Ofwat has stated that *“the implicit allowance captures the proportion of the claim which is covered by our modelled cost baselines.”*⁸

We triangulate in-line with the approach adopted by Ofwat at PR19. We apply 75% weight to top-down models and 25% to bottom-up. We weigh models equally within each category (i.e. total cost, bad debt cost, and other cost).

In terms of symmetrical adjustment, we propose to calculate a ‘unit cost’ of transience, which is the cost per transience above / below the industry average per connected household. We recommend accounting for any other companies who submit a transience CAC, by using the combined unit cost for all companies with a successful transience claim. This ‘unit cost’ should then be scaled for each company who did not submit a transience CAC, by multiplying by their transience above / below average and number of households. We propose this approach because it accounts for each company’s unique transience rate, and the potential impact on costs.

Further detail on the calculations and methodology are set out in Economic Insight’s report, section 7.

Our cost adjustment claim is aligned with Ofwat’s guidance

We summarise below how we have met Ofwat’s criteria and sub-criteria for cost adjustment claims, along with appropriate references to Economic Insight’s report.

Table 2 - Ofwat’s criteria for cost adjustment claims

Criteria	Sub-criteria	Questions	Thames Water’s evidence	Reference
Need for adjustment	Particular circumstances	(a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	Yes, Thames Water is a notable outlier with the highest level of transience across the sector, with a total migration rate of over 18%. This is around 6 percentage points above the average level of transience.	Figure 1 in Economic Insight’s report

⁸ PR24 Final Methodology: Appendix 9 Setting expenditure allowances. Ofwat (December 2022); page 30.

Criteria	Sub-criteria	Questions	Thames Water's evidence	Reference
		(b) Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers?	Yes, transience is a material and statistically significant driver of retail costs in the industry. Our 'within-Thames' analysis has found a positive and statistically significant relationship between transience and bad debt (unit) costs.	Chapters 4 and 6 Economic Insight's report
		(c) Is there compelling evidence of alternative options being considered, where relevant?	N/A – the alternative option is for Ofwat to include a transience variable in its retail cost models. Ofwat has stated it does not intend to do this.	N/A
	Management control	(d) Is the investment driven by factors outside of management control?	Yes, the transience rate within our supply area is entirely outside of management control.	Chapter 1B of Economic Insight's report
		(e) Have steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Yes, we have improved processes to reduce the costs of: (a) reporting moves and bill payments for customers; and (b) customer identification and billing for debt-management agents (see further details in the report). In any case, CAC is based on efficient costs across the industry.	Chapter 2D of Economic Insight's report
	Materiality	(f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes, econometric cost benchmarking is a useful tool to identify efficient retail cost but does not appropriately reflect the impact of high levels of transience. We have identified a clear positive and statistically significant relationship between transience and retail costs.	Chapters 4, 5, and 6 of Economic Insight's report
		(g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?	Yes, our 'within-Thames' analysis has quantified the impact of transience on various aspects of our bad-debt retail costs.	Chapter 6 of Economic Insight's report

Criteria	Sub-criteria	Questions	Thames Water's evidence	Reference
	Adjustment to allowances	(h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Yes, Ofwat's PR24 base cost consultation models do not include transience as a driver of costs.	N/A
		(i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes, the claim meets Ofwat's materiality threshold. The sensitivities around the implicit allowance are set out in Table 13.	Chapter 7 of Economic Insight's report
		(j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	Yes, Thames Water has carefully considered possibility of offsetting other costs but has not identified any material cost savings. In particular, Thames Water considered the possibility of offsetting meter reading costs, but this is not material (see section 2C).	Chapter 7 of Economic Insight's report
		(k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	Yes, the size of the claim is above Ofwat's materiality threshold.	N/A
		(l) Has the company taken a long-term view of the allowance and balanced expenditure requirements	Yes, transience is an ongoing driver of retail costs for Thames Water and, therefore, will need to be included in long-term allowances (see section 2C).	N/A

Criteria	Sub-criteria	Questions	Thames Water's evidence	Reference
		<p>between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?</p>		
		<p>(m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?</p>	<p>Ofwat's PR24 base cost models do not include transience as a control.</p>	<p>N/A</p>
Cost efficiency		<p>(a) Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?</p>	<p>Yes, the CAC is based on the upper-quartile efficiency challenge based on Ofwat's PR24 base costs models.</p>	<p>Chapter 7 of Economic Insight's report and Annex B for further detail</p>
		<p>(b) Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?</p>	<p>Yes, the approach is detailed in Economic Insight's report.</p>	<p>Chapter 7 of Economic Insight's report and Annex B for further detail</p>
		<p>(c) Does the company provide third party assurance for the robustness of the cost estimates?</p>	<p>Yes, the CAC claim has been developed by Economic Insight and has been subject to assurance by Deloitte.</p>	<p>N/A</p>

Structure of this report

The remainder of this document is Economic Insight's full report. It is structured as follows:

- Chapter 1 is a summary of the report and conclusions.
- Chapter 2 sets out the mechanisms by which population transience is expected to influence retail costs.
- Chapter 3 provides an analysis of how transience varies across companies.
- Chapter 4 sets out the results of our econometric modelling suite, where we include transience as an explanatory variable.
- Chapter 5 presents the results of Ofwat's PR24 retail models with transience as an explanatory variable.
- Chapter 6 presents our 'within-Thames' analysis.
- Chapter 7 calculates a cost adjustment claim for Thames Water.



COST ADJUSTMENT CLAIM TO FUND ADDITIONAL RETAIL COSTS FROM TRANSIENCE

A REPORT FOR THAMES WATER

CONTENTS

1	Introduction and summary	13
1A.	Population transience has a material impact on water companies' efficient retail costs	13
1B.	Thames Water has the highest rates of transience, which is outside of its management control.....	14
1C.	Ofwat previously acknowledged the impact of transience on efficient retail costs at PR19.....	14
1D.	Ofwat has omitted transience from its preliminary PR24 models due to modelling challenges	15
1E.	There are practical solutions which Ofwat can take to overcome these modelling challenges	16
1F.	We have overcome the modelling challenges in our own suite of published retail cost models	17
1G.	Using the same approach in Ofwat's PR24 models shows robust results consistent with PR19.....	18
1H.	It is imperative that Ofwat allows Thames Water efficient retail costs which arise from its higher transience rate	18
1I.	Structure of this report	18
2	Impact of transience on efficient retail costs	20
2A.	Introduction	20
2B.	There are multiple definitions of transience	20
2C.	How transience affects costs.....	21
2D.	Thames Water's efforts to mitigate transience-related costs	23

3	Transience across companies.....	25
3A.	Introduction	25
3B.	Data and measures of transience.....	25
3C.	Variation in transience across water companies.....	26
3D.	Practical implications for efficient cost assessment.....	28
4	Results of the EI retail cost model suite	29
4A.	Introduction	29
4B.	Addressing the modelling challenge of missing data	29
4C.	Transience is a robust and significant driver of retail costs.....	31
4D.	Effect of transience on efficient retail costs	34
5	Results of Ofwat’s preliminary PR24 retail cost model suite.....	36
5A.	Introduction	36
5B.	We find robust results by including transience in Ofwat’s preliminary PR24 retail cost models.....	36
5C.	Our results are not sensitive to the method for forecasting for missing transience data.....	42
6	Results of the within-company analysis	43
6A.	Introduction	43
6B.	Econometric models and underlying data	43
6C.	Results.....	45
6D.	Data constraints and limitations	45
6E.	Summary and conclusions	46
7	Calculating the CAC.....	47
7A.	Summary of CAC calculation	47

7B.	Symmetrical adjustment.....	49
-----	-----------------------------	----

Annex A: Ofwat’s CAC criteria52

Annex B: CAC methodology.....54

B1.	Gross cost adjustment claim calculation	54
-----	---	----

B2.	Implicit allowance calculation.....	58
-----	-------------------------------------	----

B3.	CAC calculation.....	59
-----	----------------------	----

B4.	Data table definitions	59
-----	------------------------------	----

Annex C: Impact of Covid-19 on transience.....63

C1.	Impact of Covid-19 on international migration.....	63
-----	--	----

C2.	Impact on internal migration.....	65
-----	-----------------------------------	----

Annex D: EI model suite.....67

D1.	Overview of our modelling approach	69
-----	--	----

D2.	Cost drivers included in our model suite	70
-----	--	----

It is imperative that Ofwat allows Thames Water efficient retail costs¹ (estimated to be £83 million over the PR24 period)² which arise from much higher population transience in its supply area compared to the industry average. This is because, as Ofwat itself noted at PR19, there is strong economic and engineering rationale that transience affects efficient retail costs.³ At PR24, Ofwat has suggested that “transience does not have a material impact on bad debt costs” based on its assessment of its preliminary retail cost models.⁴ However, the economic and engineering rationale that transience affects efficient retail costs has not changed since PR19. Therefore, Thames Water needs efficient retail costs arising from its higher transience in order to deliver efficient outcomes for its customers. We recognise that Ofwat faces some practical challenges in including transience in retail cost models. However, these cannot be allowed to detract from the economic and engineering rationale. Furthermore, as we show, there are pragmatic ways to overcome these challenges, which are consistent with Ofwat’s approach at PR19.

1 Introduction and summary

1A. Population transience has a material impact on water companies’ efficient retail costs

Population transience (transience) is the propensity of people to migrate between addresses, both within the UK (‘internal’ transience⁵), and internationally (‘international’ transience).

As we detail this further in section 2C, transience impacts efficient retail costs that water companies incur in the following ways.

¹ In this report, ‘retail costs’ refer to ‘residential retail costs’.

² All the figures in this report have been reported in 2022-23 prices (unless otherwise stated).

³ ‘PR19 Draft Determinations: Securing cost efficiency technical appendix.’ Ofwat (July 2019); page 81.

⁴ ‘Econometric base cost models for PR24.’ Ofwat (April 2023); page 64.

⁵ This includes movements both within and between water company supply areas.

- **Debt related costs (i.e. the combination of doubtful debt and debt management costs) are higher with increased transience.** This is because, the more customers relocate, the 'harder' it is to recover debt from them. Therefore, debt related costs increase, either because: (a) debt management costs are increased, to achieve the same level of default; and / or (b) companies face higher levels of doubtful debt (i.e. recovery / collections go down), if it does not invest more effort and resource into debt management to address its higher transience.
- **Non-bad debt related costs (other costs) increase with transience because when customers move address, companies need to 'process' that change of address.** For example, this includes processes associated with opening, closing or modifying accounts; issuing new and final bills; and related customer contacts.

Consistent with this, our analysis of retail costs within Thames Water's own supply area demonstrates that the areas with higher levels of transience have higher retail costs, after controlling for other factors. We discuss this further in Chapter 6.

1B. Thames Water has the highest rates of transience, which is outside of its management control

Thames Water (Thames) has notably higher levels of transience than other water companies.⁶ Specifically, in the period 2013-14 to 2019-20, Thames had total migration rate of 18% compared to the industry average of around 12%.⁷ We detail this further in Chapter 3.

The geographic coverage of a water company's supply area, and the extent to which customers move within its supply area, is outside of management control. Although companies can, and Thames Water does, take steps to mitigate the effect of transience on retail costs, the efficient retail costs for companies with a higher level of transience will be higher.

For instance, as we detail in section 2D, Thames Water has taken steps to: (a) proactively identify opportunities to reduce costs when customers move home; (b) improve its processes to reduce the costs of identifying a transient customer (both, for customers themselves, and for the third-party agents it employs for debt management purposes); (c) re-engineer its 'move home' customer journey process to reduce the handling time for these interactions; and (d) promote direct debit payments to reduce the time it would have spent chasing and managing customers' payments.

1C. Ofwat previously acknowledged the impact of transience on efficient retail costs at PR19

At PR19, Ofwat noted that "*Transience [...] drives bad debt and debt management costs.*"⁸ It took this into account by including a transience variable in several models within its

⁶ This also applies to a small number of other companies, such as Affinity Water.

⁷ Please see Section 3C for further detail.

⁸ 'PR19 Draft Determinations: Securing cost efficiency technical appendix.' Ofwat (July 2019); page 81.

retail benchmarking model suite. Specifically, it said: “Affinity Water and Thames Water expressed concerns that the impact of the transience variable on our modelling result is diluted because it is included in only one model within our modelling suite. A second change we have made since the initial assessment of plans is adding total migration as a driver to one of our total retail cost models. This increases the overall weight of this variable on our modelling results.”⁹

1D. Ofwat has omitted transience from its preliminary PR24 models due to modelling challenges

At PR24, Ofwat is no longer proposing to include a transience variable in its retail cost models, as it states “***the transience variable is highly unstable, often presenting a counterintuitive, negative estimated coefficient, and is highly statistically insignificant in almost all models... [and] the ONS has discontinued the international migration dataset that we use to construct this variable.***”¹⁰ (emphasis added)

In summary, the modelling challenges Ofwat have identified are:

Modelling Challenge 1: Transience data availability. Data on migration rates in the UK is unavailable beyond 2019-20 due to the ONS discontinuing the publication of its dataset on local area migration indicators.

Modelling Challenge 2: Not finding a correctly signed and significant transience coefficient across its models. This challenge consists of finding an unstable and / or statistically insignificant coefficient for the transience variable, when it is included in Ofwat’s preliminary PR24 retail cost models (as detailed in its consultation).

Ofwat’s decision, to omit a transience variable from its preliminary PR24 retail cost models, appears to be a pragmatic one, given the modelling challenges set out above. Our position, however, is that transience should be accounted for in any retail cost assessment, for the following reasons.

- **The economic and engineering rationale for how and why transience affects efficient retail costs has not changed since PR19.** As discussed above, and detailed in Chapter 2, there is strong economic and engineering rationale for how and why transience affects efficient retail costs that Ofwat acknowledged at PR19. Therefore, failure to consider the impact of transience in setting retail cost allowances will result in companies being under-rewarded, or over-rewarded, relative to their true efficient costs.

⁹ ‘PR19 Draft Determinations: Securing cost efficiency technical appendix.’ Ofwat (July 2019); page 8.

¹⁰ ‘Econometric base cost models for PR24.’ Ofwat (April 2023); page 64.

- **The modelling challenges that Ofwat faces should not detract from the economic and engineering rationale for acknowledging transience as a driver of efficient retail costs.** Econometric cost benchmarking, while a useful tool, can only identify efficient costs if the models recognise the key factors that drive efficient costs. Importantly, no econometric model can determine causality (or lack thereof) between explanatory drivers and costs.¹¹ Therefore, identification of the explanatory drivers that should be included in cost models needs to be driven by economic and engineering rationale, not the other way around. This is critical, in order to ensure that companies are allowed efficient costs, and therefore that they can deliver efficient outcomes for their customers.
- **There are practical solutions which Ofwat can take to overcome these modelling challenges.** We discuss these below, and detail them further in Chapters 4 and 5.

1E. There are practical solutions which Ofwat can take to overcome these modelling challenges

Given the strong economic and engineering rationale, there are practical steps that Ofwat can (and should) take to allow it to account for transience in its retail cost assessment.

On **Modelling Challenge 1**, we understand that the ONS' discontinuation of data on transience measure is a challenge. However, there are a number of alternative solutions, which can be used to overcome this challenge, including: (a) using alternative data sources / metrics; and/or (b) forecasting forward based on historical available data. Indeed, Ofwat faced a similar challenge at PR19 since the ONS had changed its methodology for reporting on the transience measures in 2016-17. Therefore, Ofwat's transience measure for PR19 was also based on forecasting forward, based on the most recent year of available data.¹²

At PR24, Ofwat faces a further challenge in terms of forecasting forward, because Covid-19 could have affected: (i) transience during the Covid-19 period; and (ii) transience after the Covid-19 period.

On (i), the method that Ofwat chooses to forecast transience forward during the Covid-19 period should have little impact on its retail cost models, since the dummy variables Ofwat has used should capture the unprecedented impact of Covid-19 on retail costs.

On (ii), the evidence available suggests that Covid-19 is unlikely to have had any permanent effect on transience since the overall level of international migration in the UK has returned to pre-Covid levels.¹³ Therefore, forecasts based on historical data will remain reliable. Moreover, to the extent that Thames Water's transience rates post-Covid remain above the industry average (i.e. Thames' transience rates are not

¹¹ *'Introductory Econometrics: A Modern Approach (5th edition).'* Wooldridge, J.M. (2012); page 12.

¹² *'PR19 Final Determinations Feeder model 3: Retail – Forecast of retail cost drivers.'* Ofwat (December 2019).

¹³ Please see Annex C for further details.

disproportionately affected by Covid-19 compared to other companies'), then Thames Water's efficient retail costs would be higher.

On **Modelling Challenge 2**, we understand that there may be practical challenges in modelling the relationship between transience and retail costs. This is driven by the fact that, while a small number of companies (including Thames) are outliers, many companies experience similar levels of transience. This implies that there may not be sufficient variation in the transience data, which may make it difficult for certain econometric model specifications to identify a significant across-industry relationship. This likely contributes to Ofwat's preliminary finding that including transience as an explanatory variable does not always produce 'intuitive' results.

We note, however, that this modelling challenge is not 'new' and was also present at PR19. As at PR19, there are options to deal with this challenge.

- **Relax the conditions for including transience in retail cost models.** We consider it appropriate to re-consider the conventional benchmark used for statistical significance for the transience variable. Given the strong economic and engineering rationale, it can be important to keep correctly signed but statistically insignificant variables in the models. This approach is used in relation to retail cost models in Williams *et al.* (2018) who take a more liberal view of statistical significance, and include variables which are 'correctly signed' at significance levels of up to 15%.¹⁴
- **Award a CAC to companies with particularly high transience.** By using a separate transience-related cost adjustment, transience can be omitted from the retail cost models. This 'off model' adjustment still ensures that Thames Water is provided efficient retail costs.

Our methodology for calculating a transience-related CAC is set out in Chapter 7, with further detail in Annex B: CAC methodology.

1F. We have overcome the modelling challenges in our own suite of published retail cost models

On **Modelling Challenge 1**, we have forecast transience across companies based on historical data. In order to consider the possible impact of Covid-19, we have considered different scenarios of how Covid-19 might have affected transience, but find no material effect of the choice of scenario on our finding showing a significant relationship between transience and retail costs.

On **Modelling Challenge 2**, contrary to Ofwat's findings detailed in its consultation, we find a robust relationship between transience and retail costs, which is consistent with our findings at PR19.

We detail this further in Chapter 4.

¹⁴ *'Benchmarking Water Retail Cost Efficiency in England and Wales.'* *International Journal of the Economics of Business* (July 2020); page 16.

1G. Using the same approach in Ofwat’s PR24 models shows robust results consistent with PR19

Using the same approach to overcome the modelling challenges as we do in our own suite of retail cost models, we find that including transience as an explanatory driver does produce robust results in Ofwat’s PR24 retail cost models. Specifically, we find that the coefficient on our preferred transience measure is significant and positive, and other coefficients are significant and of the expected sign, in a subset of Ofwat’s preliminary PR24 retail cost models. Notably, these are the equivalent models where Ofwat included transience as an explanatory driver at PR19.

We detail this further in Chapter 5.

1H. It is imperative that Ofwat allows Thames Water efficient retail costs which arise from its higher transience rate

Given the importance of reflecting the impact of transience on retail costs, it is critical that Ofwat allows Thames Water efficient retail costs related to its higher transience rate in one of the following ways:

- **Include transience as a driver in its retail cost models.** As discussed above, there are practical ways to overcome the modelling challenges in Ofwat’s preliminary PR24 retail cost models, and doing so produces robust results in Ofwat’s PR24 models.
- **Award a CAC.** Ofwat could award a cost adjustment claim (CAC) if it does not ultimately include a transience measure in its retail cost models. Using Ofwat’s suggested method in its guidance, we derive a CAC for Thames Water of £83m for the upcoming price control. We set out our methodology for this in Chapter 7.

We note that our assessment of Thames Water’s CAC is based on our understanding of Ofwat’s preliminary PR24 retail cost models as set out in its consultation. To the extent that Ofwat’s final PR24 retail cost models are different, and do not already include a transience measure, then we would advise Ofwat to calculate the appropriate CAC for Thames Water (for which it could use the same methodology as we set out) to identify Thames Water’s efficient costs.

1I. Structure of this report

The remainder of this report is structured as follows.

- Chapter 2 sets out the mechanisms by which transience influences retail costs.
- Chapter 3 provides an analysis of how transience varies across companies.

- Chapter 4 sets out the results of our econometric modelling suite, where we include transience as an explanatory variable.
- Chapter 5 presents the results of Ofwat's preliminary PR24 retail cost models with transience included as an explanatory variable.
- Chapter 6 presents our 'within-Thames' analysis.
- Chapter 7 calculates a cost adjustment claim for Thames Water.

This report is supported by the following Annexes:

- Annex A: Ofwat's CAC criteria summarises the evidence against each of Ofwat's criteria for a CAC.
- Annex B: CAC methodology sets out our methodology for calculating the CAC for Thames Water.
- Annex C: Impact of Covid-19 on transience summarises the evidence on the impact of Covid-19 on transience.
- Annex D: EI model suite sets out the details of our own retail cost models.



2 Impact of transience on efficient retail costs

2A. Introduction

In this chapter, we set out:

- (i) our definitions of transience;
- (ii) how transience affects water companies' efficient retail costs (both, bad debt related and non-bad debt related costs);
- (iii) Thames Water's efforts to mitigate the impact of higher transience on its retail costs; and
- (iv) the 'in principle' reasons why transience should be included in Ofwat's assessment of efficient retail costs.

2B. There are multiple definitions of transience

Transience can be defined by both the direction of population movements and its geography.

Transience can be divided into the following categories by direction:

- **Inflows**, which are defined as population flows into an area.
- **Outflows**, which are defined as population flows out of an area.
- **Total migration**, which are defined as the sum of inflows and outflows.

In terms of geography, it is useful to consider:

- **Within-company transience**, whereby customers of a water company move from one property to another, both of which are within the water company's supply area.
- **Within-UK transience**, whereby customers of a water company move into, or out of, a water company's supply area, to / from another location within the UK.
- **International transience**, whereby customers move into, or out of, a water company's supply area, to / from a location outside of the UK.

2C. How transience affects costs

Bad debt related costs

Bad debt related costs consist of costs related to both 'debt management' and 'doubtful debt'. There is a trade-off between the two, since water companies choose between: (i) investing more effort and resource in debt management; and (ii) having higher levels of doubtful debt.

The mechanisms by which transience increases bad debt related costs are set out below.

- **The more customers move around, the 'harder' it is to recover debt from them.** For example, if a customer in arrears moves location, companies are likely to incur additional costs, both in tracing that customer and in recovering any monies owed. This additional cost could stem from either a water company having to: (i) devote more of its own resources to locating said customer; or (ii) acquire an external debt collection agency to locate the transient customer.
- **Debt management is more costly for higher rates of transience.** Specifically, transience has the effect of increasing the costs of debt management activities required to achieve a given level of doubtful debt. Therefore, if water companies do not invest more effort / resource into debt management, they will face higher levels of doubtful debt.

Non-bad debt related costs

With respect to non-debt related costs, the main impacts of transience are as follows.

- **Account management.** As the propensity of customers to migrate increases, the level, and therefore cost, of 'account management' incurred by a water company will increase. For example, additional costs may arise due to (i) the opening, closing or modifying of customers' accounts; and (ii) the issuance of new / final water bills. Although the levels, and thus cost, of account management can increase for all types of transience (i.e., inflows and outflows), the *extent* of its effect may vary by transience type.¹⁵

¹⁵ For instance, 'within-company' transience may be less time consuming and costly for a water company than 'within-UK' transience, as the latter would require the company to set up a new account for new customers to the water company's supply area, as opposed to simply modifying an existing customer's address.

- Metering costs.** Related to the above, the issuance of new / final water bills may also require water companies to read more meters. Offsetting this, some customers may submit their own meter readings, as they move into new properties / leave existing properties. In theory, this would reduce the number of meter readings a water company needs to make (and, therefore, also the associated meter reading costs). However, Thames Water considers this cost impact to be limited, since there are economies of scale related to meter reading. For instance, it is more cost effective to read all the meters on a road at once, which implies that a customer on that road submitting a meter reading does not result in significant cost savings.

Overview of the expected impacts of transience

In summary, there is a strong economic and engineering relationship between higher level of transience and a higher level of retail costs for a given water company, all else equal.

Table 1 summarises the expected impacts of transience on retail costs. The “double arrows” indicate *larger* expected impacts, with “single arrows” denoting *smaller* expected impacts.

Table 1. Expected impact of transience on efficient retail costs

Geography	Direction	Non-bad debt		Bad debt
		Account management	Metering	Debt management & Doubtful debt
Within-company	Inflow	↑↑	↓↑	
	Outflow	↑↑		↑↑
Within-UK	Inflow	↑↑	↓↑	↑
	Outflow	↑↑		↑↑
International	Inflow	↑↑	↓↑	↑
	Outflow	↑↑		↑↑

Source: Economic Insight assessment based on Thames Water’s input.

The main practical implications of the above for cost assessment are that: (i) a range of transience measures might need to be considered; and/or (ii) the chosen measure might need to be sufficiently ‘broad’ to appropriately capture the various effects set out here.

At PR19, Ofwat used total inflows and outflows of internal and international migration rates (i.e., total migration) to address the different types of transience that water companies face. Ofwat stated that “*internal migration captures migration between local authorities within the UK, and international migration captures migration to and from the UK*”.¹⁶

We note that transience is an ongoing cost to Thames Water, and thus the existence of transience-related costs are likely to persist at PR24 and at future price controls.

We agree with Ofwat that this is the most appropriate measure (total migration) and use the same measure in our analysis in Chapters 4 and 5.

2D. Thames Water’s efforts to mitigate transience-related costs

Thames Water has notably higher levels of transience than other water companies.¹⁷ Specifically, as we set out in section 3C, Thames had total transience rate over 18% compared to the industry average of around 12% in the period 2013-14 to 2019-20.

Due to Thames Water’s uniquely high level of transience, it has experienced significantly higher retail costs. Although such costs are, irrefutably, outside of management control, Thames have made considerable effort to try to mitigate these transience-related costs where possible. The measures that Thames Water have taken are as follows.

- **Commissioned EY to help identify weak points in their ‘home move’ (HMV) process so as to identify key cost-reducing opportunities.** This internal review identified weak points relating to (i) data capture; (ii) multiple notifications of a change of tenancy; and (iii) errors caused by system complexity.
- **Subsequently, Thames Water re-engineered their HMV process.** This included redesigning the HMV systems to streamline the process a customer follows, whilst reducing or maintaining call duration. The ways in which the process has been streamlined include: (i) reducing the number of screens an agent needs to follow to process a change of tenancy; and (ii) increasing data capture.¹⁸ The effect of these measures has been an increase in self-serve sign up from 41% pre-June 2022¹⁹ to 53% as of May 2023.²⁰

¹⁶ *‘Supplementary technical appendix: Econometric approach.’ Ofwat (2019); page 31.*

¹⁷ *This also applies to a small number of other companies, such as Affinity Water.*

¹⁸ *Whereby data capture refers to the gathering of relevant customer data that helps in the collection of customer debts. By increasing data capture, Thames are able to ensure sound communication with a customer from early on in their move which significantly helps Thames to help customers pay their bills in a timely manner – thus further avoiding a buildup of arrears and increased likelihood of customer default.*

¹⁹ *Before the re-engineering of the HMV process.*

²⁰ *‘Homemove Channel Mix.’ Thames Water (May 2023).*

- **Promoting direct debit (DD) / payment plans by making it a ‘default’ part of onboarding.** By encouraging customers to switch to DD, Thames are: (i) avoiding the additional costs of using card networks to receive payments; and (ii) reducing the time they would have spent otherwise chasing and managing customers’ payments. As a result of its actions, Thames has noted an increase in direct debit take up of 6% between 2020 and 2023 (which equates to c.300,000 customers).²¹
- **Leading process improvements in the Landlord Tap Ltd²² (LTap) process and gaining buy-in from all other suppliers.** The three key changes Thames Water have helped make are: (i) a complete refresh of the postcode data in LTap, enabling a more efficient and effective processing of property moves; (ii) an introduction of a Postcode API to enable authorized users to easily and automatically determine who their service providers and billers are within a given postcode; and (iii) improving the quality of data submitted by landlords, managing agents and third parties. These changes are helpful in reducing transience-related costs as they (i) ensure that customers receive their bill shortly after they occupy a property; and (ii) enable customers to engage in conversations about payment plans and appropriate tariffs prior to the build-up of debt. In addition to the measures Thames Water has taken so far, it is looking to further simplify its systems throughout 2023-2024 by:
 - Aligning the HMV journey across all channels.
 - Creating a “one-click” payment scheme transfer option for customers.
 - Offering an instalment plan option online for customers moving out with arears.
 - Implementing a ‘First Year Value’ experience for its customers that identifies key moments of truth in the customer’s lifecycle.²³

²¹ *‘DD penetration charts – for the Transience CAC paper.’ Thames Water (May 2023).*

²² *LTap is wholly owned by water companies and was set up by the water industry to deliver a commitment the industry made to the Government to provide a single, national website for landlords, to provide details of those responsible for the payment of charges.*

²³ *The intuition behind this being that the proactive intervention would help mitigate potential financial difficulties arising for the customer.*

3 Transience across companies

3A. Introduction

In this chapter, we consider how transience varies across water companies. Specifically, we set out:

- (i) the various measures of transience and the data available on them;
- (ii) how a small number of water companies, including Thames Water, are outliers in terms of transience; and
- (iii) the practical implications of the above for identifying **true** efficient retail cost allowances.

3B. Data and measures of transience

The data on UK migration, used by Ofwat at PR19, is published at the local authority level by the Office for National Statistics (ONS). This data on local area migration indicators distinguishes between population inflows and outflows at the *internal* and *international* level. In this data:

- internal flows capture migration between local authorities;²⁴ and
- international flows capture migration to and from locations outside the UK.

We use this ONS data to generate nine measures of transience for each water company supply area.²⁵ Table 2 summarises the measures of transience we consider in our across-industry analysis.

The transience rate tells us what proportion of a water company's supply area population is 'transient' and is therefore more insightful in comparing transience between water companies. An alternative metric is the 'level' of transience which provides the *number* of transient customers in a water company's supply area. Naturally, this could be highly misleading given the varying sizes of water companies, and thus we use migration rates as our preferred transience measure in this report.

²⁴ No data is available on migration *within* UK local authorities.

²⁵ We use Ofwat's local authority to water company mapping to convert local authority data to the water company level.

Table 2. Measures of transience based on ONS' local area migration indicators dataset

Transience measure		Description
A	Internal inflow	Inflows from other local authorities
B	Internal outflow	Outflows to other local authorities
C	International inflow	Inflows from outside the UK
D	International outflow	Outflows to outside of the UK
E	Total inflow	A + C
F	Total outflow	B + D
G	Total internal	A + B
H	Total international	C + D
I	Total migration	A + B + C + D

*Note: All measures expressed as a proportion of the population for a water company supply area.
Source: Economic Insight analysis of ONS data.*

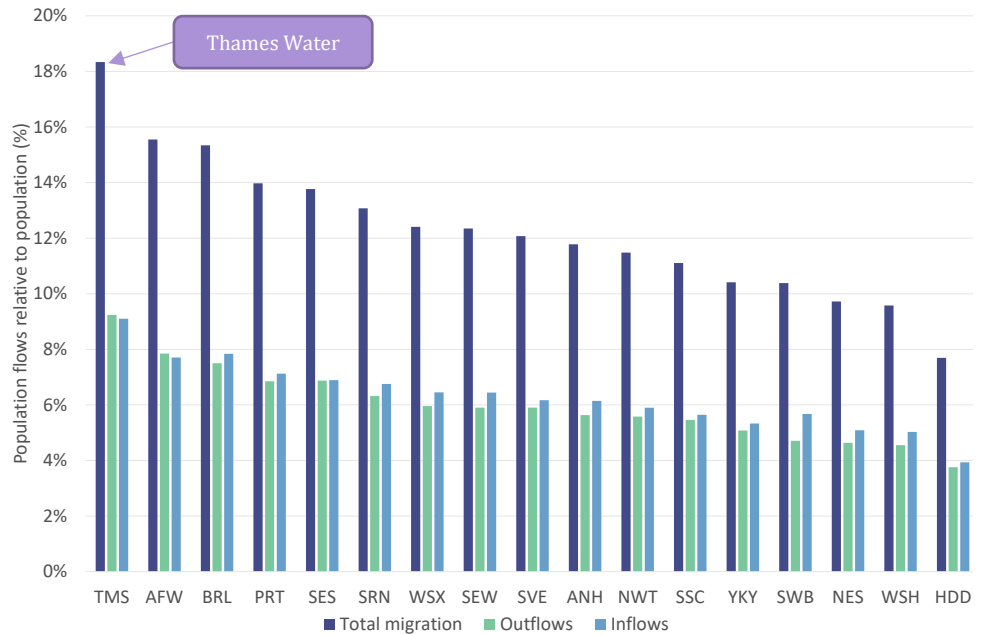
3C. Variation in transience across water companies

Figure 1 presents the average rates of overall transience (i.e. transience measures: E, F and I above) for all water companies for the period 2013-14 to 2019-20.

The figure shows that the majority of water companies have a transience rate of similar to the average. For example, the average total migration rate (calculated as the sum of inflows and outflows) is 12%, and 11 out of 17 companies have a total migration rate between 10% and 14%.

Thames Water is a notable outlier with the highest level of transience across the sector, with a total migration rate of over 18%. This is around 6 percentage points above the average level of transience.

Figure 1. Measures of overall transience by water company (2013-14 to 2019-20)

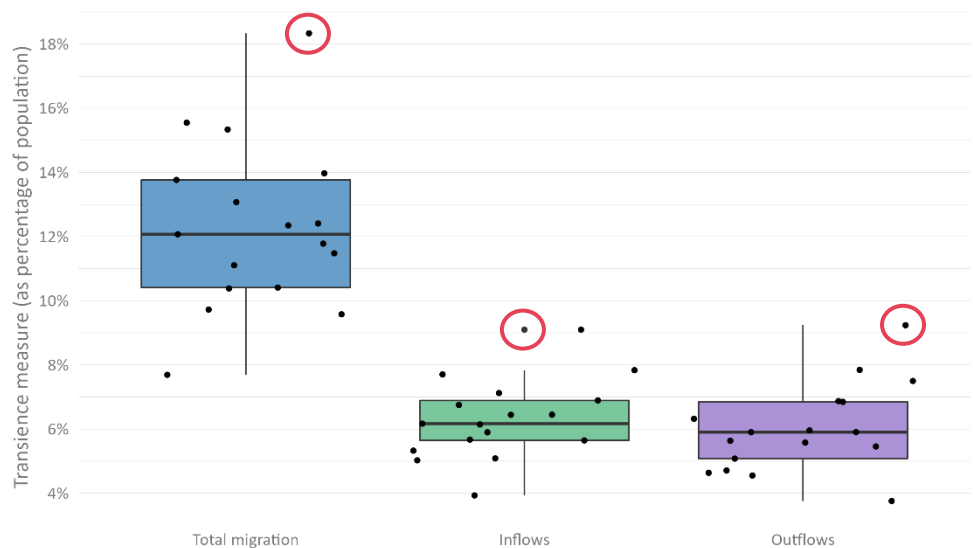


Note: For consistency with Ofwat's approach at PR19, we use the 2016-17 value for the years 2013-14, 2014-15, 2015-16, and 2016-17, to account for changes in the ONS methodology.

Source: Economic Insight analysis of ONS data.

The 'clustering' of companies around the average can be seen more clearly in Figure 2. The figure shows: (a) narrow interquartile ranges, which indicates many companies are close to the median; but (b) larger absolute ranges, which indicates a small number of companies are outliers (with high levels of transience).

Figure 2. Box plots of measures of overall transience (2013-14 to 2019-20)



Note: Dots represent water companies. Thames Water is highlighted using the red circles.

Source: Economic Insight analysis of ONS data.

3D. Practical implications for efficient cost assessment

The presence of 'transience outliers' has important practical implications for the setting of 'efficient' retail cost allowances. These are as follows.

- **Companies with high levels of transience may receive retail cost allowances below the 'efficient' level if transience is not accounted for.** Population transience is relatively 'high' for a small number of companies. This, combined with the robust relationship between transience and efficient retail costs (which we present in the following chapter), indicates outlier companies would receive retail cost allowances below the efficient level if transience is not accounted for in the retail cost assessment.
- **There might be insufficient variation in the data for all econometric cost modelling techniques to capture significant effect of transience on efficient costs.** Some econometric model specifications may fail to identify any across-industry transience effect or understate its effect due to 'clustering' around the average. Furthermore, the understated effect suggests it may be appropriate to consider wider confidence intervals in terms of the statistical significance of transience measures (e.g., beyond the conventional 10% level).

Together, this implies that while econometric cost benchmarking is a useful tool, in order for it to identify the efficient retail costs for Thames Water, the explanatory drivers included in the cost models need to be driven by economic and engineering rationale, not statistical significance. This is critical, in order to ensure that companies are allowed efficient costs, and therefore that they can deliver for their customers.



4 Results of the EI retail cost model suite

4A. Introduction

At PR19, we developed our own suite of econometric retail cost models. Our retail cost benchmarking approach was peer reviewed and published in an academic journal (International Journal of the Economics of Business).²⁶

In this chapter, we use our existing model suite to demonstrate:

- (i) our approach to overcoming the modelling challenges identified by Ofwat at PR24; and
- (ii) transience is a robust and significant driver of retail costs in our suite of retail cost models.

4B. Addressing the modelling challenge of missing data

At PR19, Ofwat calculated its measures of transience using data on the local area migration indicators published by the ONS. The ONS stopped publishing this in 2019-20.²⁷ The missing years of data is one of Ofwat's concerns in including a transience measure in its retail cost models at PR24.

We recognise that the missing years of data is an issue, but note that seeking to fill data gaps is consistent with the regulatory approach taken at previous price controls. This is preferable to excluding a relevant variable with strong economic and engineering rationale from the retail cost models.

Below, we detail the various options to forecast migration data (so as to reflect transience) to account for missing years, using either historical data and / or other ONS forecasts.

Forecasting methods

A frequently used, solution to fill the data gap would be to forecast forward based on the available historical data. Indeed, Ofwat faced a similar challenge at PR19 when the ONS changed its methodology for reporting on the transience measures in 2016-17.

²⁶ *'Benchmarking Water Retail Cost Efficiency in England and Wales.'* International Journal of the Economics of Business (July 2020).

²⁷ That is, the last available year that this data is available is 2019-20.

Therefore, Ofwat's transience measure at PR19 was also based on forecasting forward, based on the most recent year of available data.²⁸

At PR24, Ofwat faces a further challenge in terms of forecasting forward, because Covid-19 could have affected:

- (i) transience during the Covid-19 period (2019-20 and 2020-21);²⁹ and
- (ii) transience after the Covid-19 period (2021-22 onwards).

On (i), the method that Ofwat chooses to forecast transience forward during the Covid-19 period should have little impact, since in its retail cost models Ofwat has used dummies to capture the unprecedented impact of Covid-19 on retail costs. Therefore, we have used the 2019-20 transience value for 2020-21, since 2019-20 value will reflect at least some of the impact of Covid-19 on transience.

On (ii), we consider three possible scenarios:

- **Scenario 1: Covid-19 has a lingering effect on recent transience.** For this scenario, we use the 4-year historical average (between 2016-17 to 2019-20 for which data is available)³⁰ to forecast forward (for 2021-22). This average takes into consideration (a) a return to 'normality' post-Covid; but (b) a 'dampening' effect of Covid, as the 2019-20 estimate is incorporated into the average.
- **Scenario 2: Transience permanently remains at Covid-19 levels.** For this scenario, we use the transience rate for 2019-20 (which, as Ofwat highlighted, is the only year affected by Covid-19 for which data is available)³¹ to forecast forward (for 2021-22). This assumes that whatever impact Covid-19 had on transience in 2019-20 will continue post-Covid.
- **Scenario 3: Covid-19 has no lasting effect on transience.** For this scenario, we use the ONS forecast transience for 2021-22. Although it has stopped publishing actual figures, the ONS published migration projections in 2020, which extend to 2043.³² These forecasts were produced based on 2018 data, and therefore would reflect projected transience, were Covid-19 to have never happened.

The evidence available suggests that Covid-19 is unlikely to have had any permanent effect on transience since the overall level of international migration in the UK has returned to pre-Covid levels (**Scenario 2**).³³ However, to remain conservative in our forecasts, we want to account for the possibility that Covid-19 has a lingering impact, and therefore our preferred method is **Scenario 1** rather than **Scenario 3**.

²⁸ *'PR19 Final Determinations Feeder model 3: Retail – Forecast of retail cost drivers.'* Ofwat (December 2019).

²⁹ *Ofwat has identified these years to be significantly impacted by Covid-19 in its consultation.*

³⁰ *We note that for the years prior to 2016-17, we use the 2016-17 value, due to a change in ONS measurement. This is consistent with Ofwat's approach at PR19.*

³¹ *'Econometric base cost models for PR24.'* Ofwat (April 2023); Chapter 6.

³² *'Population projections incorporating births, deaths and migration for regions and local authorities: Table 5.'* ONS (2020).

³³ *Please see Annex C for further details.*

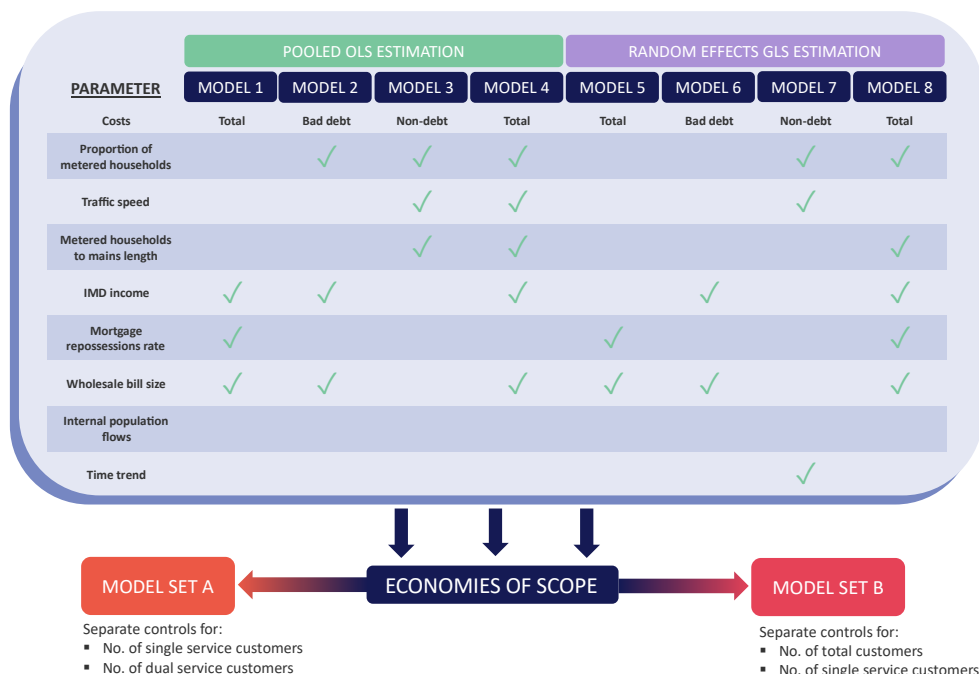
Our method is consistent with Ofwat’s approach to forecasting transience at PR19. Specifically, at PR19, Ofwat ‘rolled forward’ the latest year of data for transience (2017-18) to forecast forward.³⁴ We consider our method in line with this because, had Covid-19 not happened, we would roll the latest year of data forward. However, we must account for Covid-19, and therefore roll 2019-20 forward to 2020-21, and roll the 4-year average forward from 2022-23 onwards (to account for the potential impact of Covid-19).

4C. Transience is a robust and significant driver of retail costs

Using our existing econometric model suite and the latest PR24 data, we consider the inclusion of various measures of transience to assess whether transience is a valid driver of retail operating costs.

Figure 3 below provides a summary of the specifications of our eight retail cost models. This includes four pooled OLS models and four random effects GLS models.³⁵ These eight models are the basis of our two model sets: Set A and Set B. Set A includes scale and scope factors through using separate variables for the numbers of *single* and *dual* service customers, while Set B uses separate variables for the *total* number of customers and the number of *single* service customers.

Figure 3. Summary of our econometric modelling suite



Source: Economic Insight analysis.

As set out in section 3B, Table 2 provides an overview of the nine transience measures we consider separately within our analysis, as an additional variable to our existing

³⁴ 'PR19 Final Determinations Feeder model 3: Retail – Forecast of retail cost drivers.' Ofwat (December 2019).

³⁵ OLS stands for Ordinary Least Squares and GLS stands for Generalised Least Squares.

suite of models. That is, we run separate models for each individual transience measure, forecast using the method outlined in section 4B.³⁶

Table 3 below summarises the performance of the nine transience variables across our suite of models for Set A and Set B, respectively. We use: (i) **green asterisks (***)** to denote cases in which the transience variable is statistically significant at 1%; (ii) **purple asterisks (**)** to show cases in which it was statistically significant at between 1% and 5%; and (iii) an **orange asterisk (*)** to show cases in which it was statistically significant at between 5% and 10%.

Our analysis shows that:

- All transience coefficients which are statistically significant also have a positive sign. Furthermore, across all of our models, we find no statistically significant transience variables which are negative. Overall, this suggests that it is highly likely that there is a positive relationship between higher rates of transience and retail costs (bad debt as well as non-bad debt costs).
- All nine measures of transience are significant (at least at the 10% level) across all four bad debt models in our suite (A2, A6, B2 and B6), with international inflow being the one exception for model B6. For Set A, all measures of transience are statistically significant at the 1% level in both bad debt models.
- Related to the above, which measure of transience is used appears to have limited impact on the statistical significance between models in Set A, since all are statistically significant in every model except for the international inflow and total international measure.

We note that our results are also consistent with previous empirical work for Thames Water at PR19, where we found evidence that transience is an important driver of retail / bad debt related costs.³⁷

³⁶ We therefore also include Covid-19 dummies in our model using separate dummy variables for the financial years 2019-20 and 2020-21.

³⁷ 'Population transience as a driver of household retail costs.' *Economic Insight* (March 2018).

Table 3. Statistical significance of different transience measures by retail cost model (Sets A and B)

Transience measure (%)	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	B6	B7	B8
	Total costs	Bad debt costs	Non-debt costs	Total costs	Total costs	Bad debt costs	Non-debt costs	Total costs	Total costs	Bad debt costs	Non-debt costs	Total costs	Total costs	Bad debt costs	Non-debt costs	Total costs
Internal inflow	***	***	***	**	**	***	**	**	***	***		***	*	**	*	*
Internal outflow	***	***	***	***	**	***	***	**	***	***		***		*	**	
International inflow	***	***	***	***	**	***	***	**	***	***		***			**	
International outflow	***	***	***	**		***			**	***		**		**		
Total inflow	***	***	***	***	***	***	***	**	***	***		***		**	**	*
Total outflow	***	***	***	***	**	***	***	*	***	***		***		**	*	
Total internal	***	***	***	***	**	***	***	**	***	***		***		**	**	*
Total international	***	***	***	***	*	***	*		***	***		***		**		
Total migration	***	***	***	***	***	***	***		***	***		***		**	**	*

Source: Economic Insight analysis, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4D. Effect of transience on efficient retail costs

Having established a positive relationship between measures of transience and retail costs, we now illustrate the impact of omitting transience on the allowed efficient costs for water companies with 'low' and 'high' transience.

Specifically, we test the impact of transience on the efficient retail costs by using:

- (i) our Set A models from our existing model suite, as they produce a credible set of models, with a range of intuitively sensible drivers of retail costs, all of which are strongly statistically significant; and
- (ii) *Total migration rate* as our preferred transience measure – the same measure that Ofwat previously used in its PR19 retail cost models.

In our analysis, we compare the predicted annual efficient retail costs with and without transience included in our Set A models. We do this for companies with 'low' transience (defined as those with transience below the industry-median rate) and 'high' transience (defined as those with transience above the industry-median rate).

- Companies with 'low' transience could have retail costs set 8% higher in the models where transience is excluded. In other words, 'low' transience companies would receive higher allowances when transience is omitted from retail cost models.
- Companies with 'high' transience could have efficient retail costs set 7% lower in the models where transience is excluded. In other words, 'high' transience companies would receive lower allowances when transience is omitted from retail cost models.
- For Thames Water specifically, the impact of excluding transience would result in its total costs being set at around 20% below the 'efficient' level.

We note that, in practice, the 'full' impact of including or excluding a measure of transience on allowed retail costs will depend on other factors such as: (i) the number (and specification) of bottom-up and top-down models; and (ii) the weightings applied across models under any triangulation. Finally, we note that to calculate the CAC for Thames Water, we use Ofwat's model suite, for the reasons we set out in section 7.

Table 4. Effect of transience on predicted annual efficient retail costs (Set A, outturn prices)

	Transience as measured by migration rate (%)	Predicted efficient costs excluding transience (£m)	Predicted efficient costs including transience (£m)	Difference (£m)
Thames Water	18.4	113.1m	141.2m	-28.1
Companies with transience <u>below</u> the median level	<12.3	284.9m	263.4	+21.6
Companies with transience <u>above</u> the median level	>12.3	307.6m	330.8	-23.2

Source: Economic Insight analysis.



5 Results of Ofwat's preliminary PR24 retail cost model suite

5A. Introduction

In this chapter, we show that:

- (i) including transience as an explanatory driver does produce robust results in Ofwat's preliminary PR24 retail cost models, which is consistent with its PR19 approach; and
- (ii) this result is not sensitive to the choice of method used to forecast transience forward.

5B. We find robust results by including transience in Ofwat's preliminary PR24 retail cost models

In this section, we outline the results when our various measures of transience are included as explanatory drivers in Ofwat's preliminary PR24 retail cost models. We find that including transience produces robust results in Ofwat's preliminary PR24 retail cost models.

Our proposed transience measure and selected models

First, we present results when our preferred transience driver total migration rate (for reasons set out in section 2C), is included in Ofwat's preliminary PR24 models. Table 5 below presents the fitted coefficient on total migration rate in Ofwat's preliminary PR24 retail cost model suite.

Here, we focus on results for when the models are estimated with random effects. This is because Ofwat used random effects models at PR19, and the consultation suggests that they are likely to be Ofwat's preferred models again at PR24.

Table 5. Fitted coefficient on total migration rate, Ofwat's preliminary PR24 retail cost models

	Model	Other cost drivers (excluding migration rate)	Total migration rate coefficient	Total migration rate p-value	All other cost drivers of expected sign?
Total cost models	RTC1	Average bill size Percentage of households with payment default Separate Covid dummies for 2019-20 and 2020-21 Total number of households	0.0230**	0.0380	✓
	RTC2	Average bill size Average number of County Court Judgements/Partial Insight Accounts per household Separate Covid dummies for 2019-20 and 2020-21 Total number of households	0.0245*	0.0564	✓
	RTC3	Average bill size Income deprivation score (interpolated) Separate Covid dummies for 2019-20 and 2020-21 Total number of households	0.0420***	0.00842	✓
	RTC4	Average bill size Percentage of households with payment default Separate Covid dummies for 2019-20 and 2020-21	0.000795	0.947	✓

Total cost models	RTC5	Average bill size Average number of County Court Judgements/Partial Insight Accounts per household Separate Covid dummies for 2019-20 and 2020-21	0.00357	0.752	✓
	RTC6	Average bill size Income deprivation score (interpolated) Separate Covid dummies for 2019-20 and 2020-21	0.0154	0.127	✓
Bad debt cost models	RBDC1	Average bill size Percentage of households with payment default Separate Covid dummies for 2019-20 and 2020-21	-0.0163	0.548	✓
	RBDC2	Average bill size Average number of County Court Judgements/Partial Insight Accounts per household Separate Covid dummies for 2019-20 and 2020-21	-0.00721	0.778	✓
	RBDC3	Average bill size Income deprivation score (interpolated) Separate Covid dummies for 2019-20 and 2020-21	0.0314	0.162	✓
Other cost models	ROC1	Proportion of dual households	0.0137	0.114	✓
	ROC2	Proportion of dual households Total number of households	0.0443***	0.00541	✓

Source: Economic Insight analysis.

The results above show that **including transience as an explanatory driver in Ofwat’s preliminary PR24 retail cost models give robust results**. Specifically, in line with PR19, the above demonstrates that:

- Model results are robust:
 - The coefficient on ‘Total migration rate’ has a positive sign and is significant to a 15% level in these models, with the exception of RBDC3, where it is just short of the 15% level. Moreover, in the models that the coefficient is negative (e.g. RBDC2), it is also highly insignificant.
 - All other cost drivers are of the expected sign.
- RBDC3 and RTC3 are equivalent to the models for which transience was included as an explanatory variable in PR19³⁸, and there is evidence transience affects other costs.
- Magnitude of coefficients are similar to that at PR19.
 - Ofwat noted in its consultation that the fitted coefficient is significantly smaller than at PR19, and claimed this indicates that *“transience does not have a material impact on bad debt costs”*.³⁹ However, our fitted coefficient in RTC3 is larger than that at PR19, and for RBDC3 it is only slightly smaller than at PR19.
 - Additionally, the magnitude of the coefficient compared to that at PR19 should not be a determining factor in whether transience is included in the models. Total migration rate is statistically significant in the models and there is strong economic and econometric rationale for including it.

We do not consider it an issue that transience is not significant in all of Ofwat’s retail cost models. This is because a suite of models is used and triangulated precisely because there may be effects which are only captured by some models. Ideally, all relevant cost drivers could be included in one robust model. However, this is not the case in practice, which is why a suite of models are used, all of which have different specifications. For example, we note that transience drivers were only included in two retail cost models at PR19.

Therefore, to the extent that Ofwat maintains its suite of retail cost models at PR24, we would suggest at least including transience as an explanatory driver in the following models: RBDC3, ROC1 and ROC2, and RTC3.

PR24 retail cost models with different transience measures

Below, we present model results when different transience measures are included as explanatory drivers in Ofwat’s preliminary PR24 retail cost models, as a sensitivity. We

³⁸ *With the exception of the percentage of dual service households, as this driver has been excluded at PR24.*
³⁹ *‘Econometric base cost models for PR24.’ Ofwat (April 2023); page 64.*

find that almost all alternative measures are significant in the same models as total migration rate.

Table 6 overleaf shows the significance of various transience measures in Ofwat's preliminary PR24 retail cost models. We note that **all significant coefficients are positive**. We use: (i) **green asterisks (****)** to denote cases in which the transience variable is statistically significant at 1%; (ii) **purple asterisks (***)** to show cases in which it was statistically significant at between 1% and 5%; (iii) **orange asterisks (**)** to show cases in which it was statistically significant at between 5% and 10%; and (iv) a **blue asterisk (*)** to show cases in which it was statistically significant at between 10% and 15%.

Table 6. Statistical significance of different transience measures in Ofwat’s preliminary PR24 retail cost models

Transience measure (%)	RBDC1	RBDC2	RBDC3	ROC1	ROC2	RTC1	RTC2	RTC3	RTC4	RTC5	RTC6
Internal inflow			*	*	**	**	*	***			**
Internal outflow				**	***	***	***	*****			**
International inflow						**	**	**			
International outflow			***								
Total inflow				*	***	**	**	***			
Total outflow				*	***	***	***	*****			*
Total internal				**	***	***	**	*****			**
Total international						**	*	*			
Total migration				*	**	***	**	*****			*

Note: All transience variables are forecast using the method detailed in section 4B and models are fit using random effects, in line with Ofwat’s preliminary approach.

Source: Economic Insight analysis, **** $p < 0.01$, *** $p < 0.05$, ** $p < 0.1$, * $p < 0.15$.

5C. Our results are not sensitive to the method for forecasting for missing transience data

Table 7 below presents the fitted coefficients of total migration rate in the models that we propose Ofwat includes transience for each possible forecasting scenario detailed in section 4B above. It shows that total migration rate is significant in all models (all but two are significant to a 15% level, and even those are very close to that level).


Table 7. Coefficients on total migration rate, under various forecasting scenarios

Scenario	RTC3	RBDC3	ROC1	ROC2
1	0.0420***	0.0314 (0.162)	0.0128*	0.0297**
2	0.0361***	0.0435 (0.135)	0.0239**	0.0417***
3	0.0197***	0.0320***	0.00773*	0.0136*

Note: P-values for coefficients not significant to a 10% level are presented in parentheses.

Source: Economic Insight analysis.

This indicates that the lack of ONS data for recent years does not prevent transience being included in the PR24 retail cost models. No matter the approach Ofwat chooses to forecast the missing values, transience is still an important cost driver (based on economic and engineering rationale), and the results indicate the coefficients will likely still be statistically significant and positive.



6 Results of the within-company analysis

6A. Introduction

In this chapter, we present our ‘within-Thames’ analysis, which suggests there is evidence of a positive relationship between transience and debt related costs within Thames Water’s own supply area.

Specifically, we construct a set of models which examines the relationship between transience and retail costs, by comparing transience across geographic areas (postcode districts) *within* Thames Water’s supply area.⁴⁰ Ideally, we would use the same across-industry models as we relied on in the previous chapters, applied to variations in Thames Water’s own supply area. In practice, there are significant data constraints and limitations which lead us to constructing an alternative model, including that reliable data is only available for debt related costs.

The remainder of this section sets out: (i) the econometric models and data used for our within-company analysis; (ii) a summary of the model results and its limitations; and (iii) the overall conclusions of our within-company analysis.

6B. Econometric models and underlying data

We construct two sets of models to test the relationship between transience and debt related retail costs within Thames Water’s supply area, controlling for other factors. The first set is based on *total* costs and the second set is based on *unit* costs, where the relevant variables in the latter set are expressed on a per unit basis or share.⁴¹

Within each set, we use postcode district data on:

- Thames Water’s customer debts recorded at the end of 2022-23.
- Thames Water’s average customer bills for 2022-23.
- Thames Water’s customer metrics related to transience.
- Publicly available deprivation data published by the Ministry of Housing, Communities and Local Government (2019).

Further details on our ‘within-Thames’ models are summarised in Table 8 below.

⁴⁰ Whereas the cross-industry models compare transience *between* water companies.

⁴¹ For example, if debt related costs are 100 for a postcode district, this value is used in the total costs models but in the unit cost models it would be divided by the number of customers first.

Table 8. Summary of within-Thames econometric models

Model component	Description
Dependent variable	
$\log(\textit{Debt related costs})$	<p>Thames Water’s debt related costs for 2021/22 distributed by the postcode-level shares of Thames Water’s customer debt write-offs.</p> <p>This is divided by the number of customers in the unit cost models.</p>
Control variables	
$\log(\textit{Average bill size})$	Thames Water’s average bill size recorded by postcode district, as provided by Thames Water.
$\textit{IMD income score}$	The percentage income score as published in the Indices of Multiple Deprivation (IMD) for 2019. This is mapped onto postcode districts using the ONS’ postcode district to Local Super Output Area (LSOA) mapping.
Transience variables	
$\log(\textit{Number of 'move' tickets})$	<p>A count of all inbound, non-automated service tickets from contacts (telephony, webchat, live person) where the ticket category is ‘move’.</p> <p>This variable is used in the ‘total cost’ models.</p>
Number of ‘move’ tickets (as a share of total tickets)	<p>A count of all inbound, non-automated service tickets from contacts where the ticket category is ‘move’, as a share of the total service tickets.</p> <p>This variable is used in the ‘unit cost’ models.</p>
$\log(\textit{Number of total welcome letters})$	<p>A count of welcome to service letters sent out between 1st April 2022 and 31st March 2023 by postcode.</p> <p>This variable is used in the ‘total cost’ models.</p>
Number of total welcome letters (as a share of total customers)	<p>A count of welcome to service letters sent out between 1st April 2022 and 31st March 2023 by postcode, as a share of the total number of customers.</p> <p>This variable is used in the ‘unit cost’ models.</p>

Source: Economic Insight analysis.

6C. Results

The model results are shown in Table 9 below. The table shows that all four models point to a strong positive relationship between the measure of transience and debt related (unit) costs. The transience coefficient in all models is positive and statistically significant at the 1% significance level.

- Model 1 indicates a 1% increase in the number of welcome to service letters is, on average, associated with a 0.2% increase in debt related costs.
- Model 2 indicates a 1% increase in the number of contact tickets which relate to moving is, on average, associated with a 0.2% increase in debt related costs.
- Model 3 indicates a 1% increase in the welcome to service letters as a proportion of total customers is, on average, associated with a 0.3% increase in debt related unit costs.
- Model 4 indicates a 1% increase in the share of total contact tickets which relate to moving is, on average, associated with a 0.5% increase in debt related unit costs.

Table 9. Results summary of within-Thames econometric model

	Model	Transience metric used	Coefficient	Other control variables with expected sign
'Total costs' models	1	(log) No. of welcome letters	0.203***	Yes
	2	(log) No. of contact tickets mentioning 'move'	0.210***	Yes
'Unit cost' models	3	No. of welcome letters (as a share of total customers)	0.305***	Yes
	4	No. of contact tickets mentioning 'move' (as a share of total contact tickets)	0.537***	Yes

Source: Economic Insight analysis, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6D. Data constraints and limitations

There are a number of important limitations to our within-Thames econometric analysis. Specifically, there are significant constraints on the data available to construct our econometric models:

- **Time period of data available.** Postcode-level data provided by Thames Water on debt costs, average bill, customers, and transience metrics were only available for a single year (2022-23). This limits not only the period over which it is possible to construct a ‘within-area’ model, but also means that exogenous shocks such as Covid-19 cannot be controlled for separately.
- **Costs and explanatory drivers data available.** The data for non-debt related costs and additional explanatory drivers (e.g., those included in our cross-industry models) is not recorded by Thames Water at a postcode-level. Therefore, we are unable to: (a) test the robustness of the ‘within’ models to additional specifications; and (b) compare the results of the model to our cross-industry models.
- **The extent to which transience is captured in Thames Water’s metrics.** The data provided by Thames Water provides metrics related to transience, such as welcome to service letters and service tickets related to moving. It is not, however, possible to compare how well these metrics capture transience relative to the various transience measures we use in our cross-industry models.

6E. Summary and conclusions

Our ‘within-company’ analysis suggests that there is a strong positive relationship between transience and debt related costs for Thames Water. Therefore, it is an important factor for Ofwat to consider in setting efficient cost allowances, as it did in PR19. However, we note that given the data limitations set out above, we do not think a reliable CAC could be derived from our ‘within’ analysis alone.

We draw the following conclusions from our within-company analysis.

- We find evidence that Thames Water’s transience measures are positively related to its debt related costs, consistent with our cross-industry analysis. Again, this suggests that there is evidence that transience is positively related to retail costs.
- The positive relationship between transience and retail costs within Thames Water, suggests that transience is a valid driver of retail costs for Thames Water, and it is unlikely that Thames Water’s higher retail costs are entirely driven by any company-specific levels of efficiency.



7 Calculating the CAC

In Chapter 5, we showed that there are practical ways to overcome the modelling challenges identified by Ofwat, in including transience as a cost driver in its preliminary PR24 retail cost models, which would be consistent with its approach at PR19.

However, should Ofwat choose not to include transience drivers in its final PR24 retail cost models, an off-model adjustment must be made for companies who are significant outliers in transience (like Thames Water), to ensure efficient retail cost allowances. Without such an adjustment, Thames Water's retail cost allowance will be insufficient to cover transience related costs. We therefore calculate a CAC for transience related costs, in the event transience is not included in the PR24 retail cost modelling suite.

This chapter summarises our approach to this calculation. We set out how we (i) calculate the gross adjustment claim; (ii) calculate the implicit allowance; and (iii) outline our approach to the symmetrical adjustment. We provide further detail on this in Annex B: CAC methodology.

7A. Summary of CAC calculation

The CAC is the difference between the gross adjustment claim and the implicit allowance.

For both the gross adjustment and implicit allowance, we use Ofwat's preliminary PR24 retail cost models, as per Ofwat's advice in the PR24 CAC template.⁴² We use Ofwat's models for the implicit allowance because the implicit allowance should be reflective of Thames Water's expected retail cost allowance at PR24. Ofwat has stated that "*The implicit allowance captures the proportion of the claim which is covered by our modelled cost baselines.*"⁴³

We therefore also use Ofwat's preliminary PR24 retail cost models for the gross adjustment to ensure a 'fair' comparison with the implicit allowance, although we consider our models set out in Chapter 4 to be a better estimate of efficient retail costs.

In both cases, we triangulate in-line with Ofwat's approach at PR19. We apply 75% weight to top-down models and 25% to bottom-up models. We weight models equally within each category (i.e. total cost, bad debt cost, and other cost).

⁴² "Companies should submit claims based on the set of econometric models we published for consultation in April 2023 alongside this template." Please see the 'Cover' tab in '[PR24 cost adjustment claim template](#),' Ofwat (April 2023).

⁴³ '[PR24 Final Methodology: Appendix 9 Setting expenditure allowances](#),' Ofwat (December 2022); page 30.

Summary of results

The table below sets out the summary of our CAC calculations for Thames Water. The sections below detail how we arrive at these figures.

Table 10. Thames Water transience CAC figures

	1-year value (£m, 2022-23 prices)	5-year value (£m, 2022-23 prices)
[A] Gross cost adjustment	177.8	889.2
[B] Implicit allowance	161.2	806.1
[A – B] CAC	16.6	83.2

Source: Economic Insight analysis.

Gross cost adjustment

To calculate the gross cost adjustment, we fit the models set out in section 5B (i.e. RBDC3, ROC1, ROC2, and RTC3), including the total migration rate as a cost driver. We triangulate following the method set out above.

We then calculate efficiency scores using the last 5 years of data, and apply the upper quartile benchmark efficiency challenge, which is consistent with Ofwat’s approach to setting the catch-up efficiency challenge at PR19. We do so to ensure the gross adjustment reflects potential efficiencies.

We do this for two potential sets of models:

- (i) RBDC3, ROC1, ROC2, and RTC3, all including total migration rate;
- (ii) RBDC3 and RTC3 including total migration rate; and ROC1 and ROC2 not including a transience driver.

We do so because, although we consider that there is strong economic and engineering rationale for transience to be included in non-debt cost models, Ofwat did not include transience drivers in non-debt cost models at PR19.

Therefore to be conservative in our gross adjustment figure, we take a simple average of the results from (i) and (ii).

Implicit allowance

To calculate the implicit allowance, we use Ofwat’s full preliminary PR24 retail cost model suite, without any transience drivers. We triangulate as set out above, calculate the efficiency scores using the last 5 years of data, and apply an upper quartile efficiency challenge.

We use models in Ofwat’s preliminary PR24 retail cost models to ensure the implicit allowance is reflective of expected PR24 retail cost allowances (when not accounting for transience), absent the final PR24 retail cost model suite.

We also run the following sensitivities for the implicit allowance, when alternative models are used:

- Using only the models with which we calculate the gross adjustment (RBDC3, ROC1, ROC2, and RTC3).
- Using only RTC3.

The results of these sensitivities are presented in Table 11 below. We note that our approach to the implicit allowance is the most conservative.

Table 11. Sensitivities of implicit allowance adjustment

Models used	5-year implicit allowance (£m, 2022-23 prices)
Entire PR24 consultation suite (used in the CAC calculation submitted)	806.1
RTC3, RBDC3, ROC1, and ROC2	764.1
RTC3	760.0

Source: Economic Insight analysis.

7B. Symmetrical adjustment

One of Ofwat’s criteria for a CAC is the identification of the symmetrical adjustments for other companies. We note that there is no perfect approach to identify the necessary symmetrical adjustment and, ultimately, this is at Ofwat’s discretion. The table below sets out our independent view of the estimated symmetrical adjustment for each water company, under the assumption that both Thames Water and Affinity Water are awarded a CAC – these companies were the only two to have a cost adjustment claim at PR19, and therefore we consider the same scenario at PR24. We outline the method for calculating these figures in Annex B: CAC methodology. This method can be used to account for the scenario where more or less companies claim for a CAC.

Table 12. Estimated symmetrical adjustment

Company	Unit cost adjustment from transience (£m / connected property, 2022-23 prices)	Total cost adjustment from transience (£m, 2022-23 prices)
Combined transience CAC across companies	12.3	87.0 ⁴⁴
Symmetrical adjustments		
Anglian Water	-0.8	-2.2
Bristol Water	8.5	4.3
Hafren Dyfrdwy	-11.3	-1.1
Northumbrian Water	-5.4	-10.6
United Utilities Water	-1.1	-3.4
Portsmouth Water	4.8	1.4
SES Water	4.0	1.1
South East Water	0.8	0.7
Southern Water	2.6	5.2
South Staffs Water	-2.1	-1.4
Severn Trent Water	0.8	3.3
South West Water	-4.3	-4.3
Welsh Water	-5.8	-8.4
Wessex Water	0.8	1.0
Yorkshire Water	-3.8	-8.5

Source: Economic Insight analysis.

In summary, we propose to calculate a ‘unit cost’ of transience, which is the *cost per transience above / below the industry-average per connected household*. We recommend accounting for any other companies who submit a transience CAC, by (i) combining the

⁴⁴ This is the total CAC for Thames Water (83.2m) and Affinity Water (3.8m).

CAC across all companies, and (ii) symmetrically adjusting other companies' (i.e. those without a CAC) unit costs accordingly.

Unit costs (for companies who did not submit a transience CAC) are symmetrically adjusted by multiplying by: (a) their transience above / below average; and (b) its number of households. We propose this approach because it accounts for each company's unique transience rate, and the potential impact on costs.

We note that the unit costs of these adjustments are perfectly symmetric (the first column of Table 12 sums to zero). As a result, after accounting for the size of water companies (i.e. scaling by the number of connected properties), the total £ adjustment will not net to zero. Companies who have the same level of transience are adjusted differently based on their size. For example, both Welsh Water and Northumbrian Water have a low (and similar) level of transience – and therefore their allowances are downwards adjusted. However, as Northumbrian Water is larger than Welsh Water, the £ value of its adjustment will be larger. See Annex B: CAC methodology for further information on why we consider this to be appropriate.

We note that this is consistent with Ofwat's growth adjustment at PR19, where Ofwat has said "*there could be instances where downwards adjustments do not exactly offset the upwards adjustment*".⁴⁵

⁴⁵ *'PR24 Final Methodology: Appendix 9 Setting expenditure allowances.'* Ofwat (December 2022); page 162.

Annex A: Ofwat's CAC criteria

This annex sets out the required Ofwat criteria and sub-criteria for a CAC, and the supporting evidence provided by Thames Water. We exclude the following 'where appropriate' criteria from the table below: (i) need for investment; (ii) best option for customers; and (iii) customer protection.

Table 13. Ofwat's CAC criteria and Thames Water's evidence

Criteria	Sub-criteria	Questions	Thames Water's evidence
Need for adjustment	Unique circumstances	(a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?	Yes , Thames Water is a notable outlier with the highest level of transience across the sector, with a total migration rate of over 18%. This is around 6 percentage points above the average level of transience. Please see Figure 1.
		(b) Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers?	Yes , transience is a material and significant driver of retail costs, please see Table 3, and Table 9.
		(c) Is there compelling evidence of alternative options being considered, where relevant?	N/A – the alternative option is for Ofwat to include a transience variable in its retail cost models. Ofwat has stated it does not intend to do this.
	Management control	(d) Is the investment driven by factors outside of management control?	Yes , the transience rate within the supply area is entirely outside of management control.
		(e) Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?	Yes , Thames Water has improved processes to reduce the costs of: (a) reporting moves and bill payments for customers; and (b) customer identification and billing for debt-management agents (please see further details in section 2D). In any case, the CAC is based on efficient costs across the industry.
	Materiality	(f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?	Yes , please see evidence in Chapters 4, 5, and 6.
		(g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?	Yes , please see evidence in Chapters 4 and 6.

Adjustment to allowances	(h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?	Yes , Ofwat's preliminary PR24 retail cost models do not include transience as a driver of costs.
	(i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	Yes , the claim meets Ofwat's materiality threshold. The sensitivities around the implicit allowance are set out in Table 11.
	(j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	Yes , Thames Water has carefully considered possibility of offsetting other costs but has not identified any material cost savings. In particular, Thames Water considered the possibility of offsetting meter reading costs, but this is not material (see section 2C).
	(k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	Yes , the size of the claim is above Ofwat's materiality threshold.
	(l) Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?	Yes , transience is an ongoing driver of retail costs for Thames Water and, therefore, will need to be included in long-term allowances (see section 2C).
	(m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?	Yes , Ofwat's PR24 base cost models do not include transience as a control.
Cost efficiency	(a) Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?	Yes , the CAC is based on the upper-quartile efficiency challenge based on Ofwat's preliminary PR24 retail cost models. Please see Chapter 7 and Annex B for further details.
	(b) Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?	Yes , please see details in Chapter 7 and Annex B.
	(c) Does the company provide third party assurance for the robustness of the cost estimates?	Yes , the CAC claim has been developed by Economic Insight and has been subject to assurance by Deloitte.

Source: Economic Insight analysis.



Annex B: CAC methodology

This annex sets out our methodology for calculating Thames Water's cost adjustment claim due to transience.

The steps to calculating this are summarised as follows.

- **Gross adjustment (section B1).** We first find a set of robust retail cost models that include a transience measure in it. In particular, we use a set of Ofwat's proposed retail cost models as set out in its PR24 consultation, which includes a transience measure. We calculate Thames Water's efficient allowance from these models by applying the upper quartile benchmark to Thames Water's modelled retail costs.
- **Implied allowance (section B2).** We run the full set of Ofwat's PR24 consultation models (i.e. without a transience measure, as they are specified) and triangulate them. We then calculate Thames Water's efficient allowance from these models by applying the upper quartile benchmark to Thames Water's modelled retail costs. This provides an estimate of the efficient allowance that Ofwat will set at PR24 if transience is not taken into account.
- **CAC (section B3).** To calculate the CAC, we subtract the implicit allowance from the gross adjustment. We note that we have two estimates of the CAC, which use two methods of calculating the gross adjustment. We average these values to calculate the final CAC.

We also outline our proposed methodology for symmetric adjustments in Section 0.

B1. Gross cost adjustment claim calculation

The gross adjustment is calculated from a set of Ofwat's PR24 consultation models with a transience variable included. In this section, we outline in turn:

- the transience measure we use;
- the models that we include the transience measure in;
- method of applying the efficiency challenge; and
- forecasting costs over the PR24 period.

Transience measure

We use the total migration rate (the same measure that Ofwat used at PR19), as our measure of transience, as provided by the ONS. We map the ONS data from LAD to

water companies using the retail area mapping methodology used by Ofwat.⁴⁶ We then calculate the various migration rates by dividing the relevant inflows and / or outflows by population.

We note that the last year of data for this metric is 2019-20. We have therefore forecasted this forward, using (i) the 2019-20 transience value for 2020-21, and (ii) the average of transience in the years 2016-17, 2017-18, 2018-19, and 2019-20 for the year 2021-22. The rationale for this is provided in section 4B of our main report. To summarise:

- We choose the 2019-20 value for 2020-21 as our estimate of transience in this year, as 2019-20 was also affected by Covid (and experienced lower transience). Although 2020-21 was far more significantly impacted by Covid than 2019-20, we consider it captures some impact from Covid. We note that Ofwat considers both 2019-20 and 2020-21 Covid years, and includes dummies for each year individually. Therefore the further effects on transience in 2020-21 from Covid will be accounted for through the Covid dummy.
- For the 2021-22 value (the first 'post-Covid' year), it is unknown to what extent Covid has impacted transience. We consider various options, set out in section 4B and 5B of our main report, including transience returning to pre-Covid levels, and transience remaining at the 2019-20 level. We opt to take the 4 year average total migration between 2016-17 to 2019-20 for the purposes of calculating the CAC as:
 - 2016-17 to 2019-20 is all of the historical data available on transience.⁴⁷
 - This average provides a sensible estimate for future migration levels at AMP8. As we set out below, we calculate both gross and implicit allowances by projecting Thames Water's efficient modelled retail costs in 2021-22 – which uses the transience measure in 2021-22. This average takes into consideration (i) a return to 'normality' post-Covid, as pre-Covid values are used, and (ii) a 'dampening' effect of Covid, as the 2019-20 estimate is incorporated into the average, which allows us to remain conservative in our forecasts.

Models

We use a subset of Ofwat's PR24 models with total migration rate included to calculate Thames Water's retail cost allowance, to account for the impact that transience has on retail costs.

Ofwat has set out that the implicit allowance should be based on its consultation models: *"Companies should submit claims based on the set of econometric models we published for consultation in April 2023"*⁴⁸ and *"The implicit allowance captures the proportion of the claim which is covered by our modelled cost baselines."*⁴⁹ Therefore, we

⁴⁶ *'Residential retail external data mapping.'* Ofwat (October 2022).

⁴⁷ *Excluding the earlier years prior to measurement change. We also use the 2016-17 value for earlier years due to a change in the ONS's measurement process. This is in-line with Ofwat's approach at PR19.*

⁴⁸ *Cover sheet in 'Early cost adjustment claim template.'*

⁴⁹ *'PR24 Final Methodology: Appendix 9 Setting expenditure allowances.'* Ofwat (December 2022); page 30.

use Ofwat’s models for the gross cost adjustment as it ensures a fair comparison to the implicit allowance. As set out in Chapter 4 of our report, we also consider our own suite of models, which are fit with pooled OLS and use different drivers. We do not use these models to calculate the gross adjustment for this reason.

These models we use to calculate the gross adjustment claim are:⁵⁰

- (i) total cost 3 (RTC3), with a transience variable;
- (ii) debt cost 3 (RDC3), with a transience variable; and
- (iii) non-debt cost 1 and 2 (ROC1 and ROC2), with a transience variable.

The models are fit using random effects, consistent with Ofwat’s intended approach. The table below shows the coefficients estimated by these models with transience included.

Table 14: Coefficients from models RDC3, ROC1, ROC2, and RTC3 with transience variable

Variable	RDC3	ROC1	ROC2	RTC3
% total internal and international migration	0.031 {0.162}	0.0128* { 0.0931}	0.0297** {0.0193}	0.042*** {0.008}
Average bill size	1.047*** {0.000}			0.697*** {0.000}
% income deprivation (interpolated)	0.102*** {0.001}			0.039** {0.014}
Covid 2019-20 dummy	0.460*** {0.000}			0.216*** {0.000}
Covid 2020-21 dummy	0.274*** {0.003}			0.094*** {0.000}
% of dual service customers		0.00209** { 0.022}	0.00492*** {0.000}	
Number of connected households (log)			-0.112*** {0.008}	-0.136*** {0.002}

Source: Economic Insight analysis. Numbers in { } are p-values.

As set out in section 5B of our report, we use these models as (i) the transience coefficient is of expected sign, and (ii) the RDC3 and RTC3 models have transience

⁵⁰ Please see ‘PR24 Econometric Base Cost Models Consultation’, section A4.4. Model numbers correspond to those shown in Tables 7.18, 7.20, and 7.21.

coefficients that are similar to those in Ofwat’s PR19 final retail cost models. We note that RDC3 and RTC3 are the equivalent models to those that Ofwat included transience in at PR19.⁵¹ While the coefficient of transience on RDC3 is not statistically significant at the 95% confidence level, we explained in section 5B and 2F why this does not preclude the use of transience in this model.

We consider two options to calculate the gross allowance. First, using all the models above, and second, only using the total cost and debt cost models with transience (i.e. the non-debt cost models do not include transience). This is summarised in the table below.

Table 15: Models used for gross cost adjustment

Model	Method 1	Method 2
Total costs	TC3 with migration rate	TC3 with migration rate
Bad debt costs	BD3 with migration rate	BD3 with migration rate
Other costs	OC1 with migration rate	OC1 without migration rate
	OC2 with migration rate	OC2 without migration rate

Source: *Economic Insight*

The rationale for this is as follows:

- We consider that there is strong economic and engineering rationale for transience to be included in non-debt cost models (please see Chapter 2). The transience variable is statistically significant (or close to being statistically significant) in these models.
- However, we note that at PR19, Ofwat included transience in debt cost and total cost models, and did not include transience in its non-debt cost models.

Therefore, to adopt a conservative approach, we calculate the gross adjustment claim under the two potential specifications above and average them for the purposes of calculating the CAC. We consider averaging the two gross adjustments is an appropriate approach, as it accounts for the impact of transience on other costs, while still remaining conservative by accounting for Ofwat’s PR19 approach to exclude transience drivers from other cost models.

Finally, we note that in both methods, we triangulate the models using the following method:

- 75% weight on top-down (total costs)
- 25% weight on bottom-up (bad debt + other costs)

⁵¹ The only difference is (i) the proportion of metered customers, which Ofwat is no longer using in any of its models at PR24, and (ii) the addition of Covid dummies in Ofwat’s PR24 models.

Efficiency challenge

Finally, we ensure our gross cost estimate is reflective of efficient retail costs by identifying the industry benchmark and applying the relevant efficiency challenge. We do this for each method outlined above, and: (i) calculate the efficiency scores using the last five years of actual total costs, and the triangulated costs outlined above; (ii) identify the upper quartile of these efficiency scores; and (iii) apply this efficiency challenge to the allowance.

This reflects the approach taken by Ofwat in PR19 (Ofwat has yet to comment on its PR24 methodology for setting the efficiency challenge).

Forecasting costs

We adopt a constant forecast approach for simplicity, given that we do not have a full set of forecast cost drivers for the PR24 period. Additionally, the CAC would largely be impacted by changes in migration over time, rather than other cost drivers.

We consider it unlikely that transience will significantly change in the upcoming years. Therefore, the gross cost allowance for each year of PR24 is equal to that calculated for 2021-22. We also note that at PR19, Ofwat used constant forecasts for total migration. It ‘rolled forward’ the latest year of data for transience (2017-18) for forecasts.⁵²

B2. Implicit allowance calculation

The implicit allowance calculation follows the same steps as the gross cost adjustment. Instead of the models with transience, we use Ofwat’s PR24 consultation retail models with no adjustments. This includes six total cost models, three bad debt cost models, and two other cost models.⁵³ Ofwat does not intend to include a transience variable in any of these models.

Absent information on the *exact* set of models that Ofwat will use at PR24, we use all of the models that Ofwat has set out in its consultation in calculating the implicit adjustment. We do so to ensure the implicit allowance is reflective of expected PR24 retail cost allowances (when not accounting for transience). We triangulate these models with the same method as the gross cost adjustment:

- We weight the models equally within each retail cost category (e.g. we weight Ofwat’s three debt cost models equally within the debt cost modelling suite);
- We apply a 75% top-down and 25% bottom-up weighting, consistent with Ofwat’s approach at PR19.

Finally we calculate efficiency scores using the triangulated costs and apply the benchmark efficiency challenge.

⁵² *‘PR19 Final Determinations Feeder model 3: Retail – Forecast of retail cost drivers.’ Ofwat (December 2019).*

⁵³ *That is, all the models in ‘PR24 Econometric Base Cost Models Consultation.’ Ofwat (April 2023), section A4.4.*

We consider other sensitivities in section 7A of our report, where we quantify the CAC using different methods of calculating the implicit allowance. However, our 'base' scenario uses the method above.

B3. CAC calculation

We calculate the final cost adjustment by deducting the implicit allowance from the gross adjustment. As set out above, we do this calculation for both Method 1 and Method 2 and average the two results.

Table 16 below sets out the steps of this calculation.

Table 16: CAC calculation summary (5-year totals, 2022-23 prices)

	Calculation	Amount (£m)
A. Gross cost adjustment – transience included in all models within subset (Method 1)	Please see Section 1A.	896.4
B. Gross cost adjustment – transience included in bad debt and total cost models within subset (Method 2)	Please see Section 1A.	882.0
C. Implicit allowance	Please see Section 1B.	806.1
D. Cost adjustment claim – transience included in all models (Method 1)	A - C	90.4
E. Cost adjustment claim – transience included in bad debt and total cost models (Method 2)	B - C	76.0
F. Final cost adjustment claim	(D + E)/2	83.2

Source: Economic Insight analysis.

We note that this figure is in line with Thames Water's PR19 transience cost adjustment claim (£63 m). We consider this to be an intuitive result because there have only been three years of additional data, two of which are affected by the Covid dummies.

B4. Data table definitions

The table below outlines what figures have been used for each RET4 line in Thames Water's CAC template, excluding rows for which calculations are pre-set by the template. Note that in the CAC template we express all figures in 2022-23 prices.

Table 17: Explanation of figures in RET4 CAC table

Line description	BP reference	Explanation
Total gross value of the claim (res retail)	RET4.5	Thames Water' efficient residential retail costs when accounting for transience, gross of the implicit allowance. This is the average of A and B in Table 16. Please see section 1A for further details.
Implicit allowance (res retail)	RET4.6	Thames Water' residential retail cost allowance using Ofwat's preliminary PR24 models when transience is not included. This is line C in Table 16. Please see section 1B for further details. a
Historic total expenditure (res retail)	RET4.8	Thames Water' historic residential retail total expenditure related to transience. We have used the historic total expenditure related to transience from the PR19 CAC (item reference R202004).
Totex for the control (res retail)	RET4.9	Total expenditure in residential retail. We have used "Total operating expenditure excluding third party services" in the data provided.

Source: Economic Insight analysis.

We note that we use PR19 CAC figures for historical expenditure for consistency with the previous CAC, and our transience expenditure figures are in-line with those from PR19.

Symmetrical adjustment

As set out in Ofwat's PR24 CAC guidelines, if a CAC is awarded for Thames Water, this requires a symmetrical cost adjustment calculation. Ofwat states "*we expect a company to indicate in its cost adjustment claim submission how an upward adjustment to its base cost allowance would impact on cost allowances for other companies.*"⁵⁴

In the first place, we note that, should another company submit a CAC related to transience, Ofwat will need to consider these claims together when calculating the symmetrical adjustments. It is unclear how Ofwat will account for the impact of population transience on costs for each company – i.e. either a CAC or including transience in its modelling suite.

We therefore present one method below to calculate the symmetrical adjustment, under the scenario in which both Thames Water and the other company are awarded a CAC. We note however that Ofwat may adopt a different approach, depending on

⁵⁴ 'Assessing base costs at PR24.' Ofwat (December 2021), p.42.

whether a CAC is awarded or not, and for which company. The method of calculating the symmetrical adjustment is as follows, which we note also accounts for the possibility that more companies are awarded a CAC.

- First, calculate the total CAC for Thames Water and other companies.
- Second, using this combined CAC, calculate the efficient ‘unit cost’ of transience (i.e. the efficient cost per transience rate above the industry average, per property) for Thames Water and other companies.
- Third, calculate the efficient symmetrical adjustment for all companies (excluding Thames and other companies who are awarded a CAC) by multiplying the unit cost by:
 - (i) each company’s transience above the industry-average transience and
 - (ii) the number of connected properties.

The steps of this calculation are detailed in Table 18 below.

Table 18: Methodology for symmetric adjustment

	Calculation
A. Combined CAC	Please see Table 16 Sum of Thames Water CAC and other companies’ CACs
B. Migration above industry average	Considering the companies that have been awarded a CAC as one ‘combined company’, calculate the total migration rate of this hypothetical company. Then, apply: Total migration rate of combined company – Industry average migration rate (4 year average)
C. Efficient transience ‘unit cost’	A / B / Sum of total number of households for Thames Water and other companies awarded a CAC
D. Symmetric adjustment for all other companies	C * migration above / below industry average (for the relevant company) * number of households (for the relevant company)

Source: Economic Insight analysis.

By combining companies together, this allows a single ‘efficient unit cost per unit of transience’ to be calculated (which is then used to calculate the symmetric adjustment), instead of having multiple estimates for each company that has a CAC – this would lead to multiple different possible symmetric adjustments.

We also note that this method allows unit costs to be exactly symmetric across companies (i.e. zero sum). However, we note that this means total costs may not be symmetric after multiplying unit costs by the scale driver for each company. This is appropriate for the following reasons:

- In Ofwat’s retail cost models (which use unit costs as the dependent variable) with transience excluded, some companies will be over-rewarded in terms of its unit costs (i.e. those with low transience) and some companies will be under-rewarded in terms of its unit costs (i.e. those with high transience). Given the unit costs are dependent on transience above / below the industry average, it would be symmetric about this mean. It is therefore important that symmetrical adjustments are made to ensure that total unit costs are symmetric about the mean.
- However, the number of connected properties is not symmetric about the industry average transience. That is, the total properties for companies with higher-than-average transience is not equal to that of companies with lower-than-average transience). Therefore when we scale up the adjustments to account for differences in scale (connected properties), the adjustment is no longer perfectly symmetric. Instead, the overall adjustment is likely to be net positive, because Thames Water is the largest company, with the highest rate of transience.
- If the size of water companies is not factored in (i.e. total costs are forced to be symmetric rather than unit costs), downward symmetrical adjustments will weigh disproportionately on smaller companies. For example, Hafren Dyfrdwy has the lowest transience rate, but is one of the smallest water companies. Performing a symmetrical adjustment without accounting for its size means that Hafren Dyfrdwy will receive the largest downwards adjustment in £, despite having a relatively small total retail cost base. Using our suggested approach, this company will receive a smaller downwards symmetrical adjustment, which reflects its smaller size.

We note that Ofwat also states “*there could be instances where downwards adjustments do not exactly offset the upwards adjustment (e.g. our growth adjustment at PR19). We expect companies to exercise judgement in the calculation of the symmetrical adjustment, depending on the specific claim.*”⁵⁵

⁵⁵ [PR24 Final Methodology: Appendix 9 Setting expenditure allowances.](#) Ofwat (December 2022); page 162.



Annex C: Impact of Covid-19 on transience

This annex sets out further evidence that Covid-19 did not have a lasting effect on variation in transience between companies.

In our modelling adjustment, we assume that Covid-19 did not have a lasting impact on migration in the UK, and on the variation between companies. To further support this, we conduct analysis on the provisional transience figures, and review the available academic literature.

We find that:

- (i) International migration post-Covid has reached even higher levels than pre-Covid.
- (ii) International migration is highly correlated with overall transience.
- (iii) The impact of Covid-19 on internal migration was temporary and has returned to the pre-Covid levels.

When considering these three findings together, we come to the conclusion that transience has returned to similar levels, if not higher, post-Covid.

We outline our analysis for these findings in the following two sections on (i) international migration; and (ii) internal migration.

C1. Impact of Covid-19 on international migration

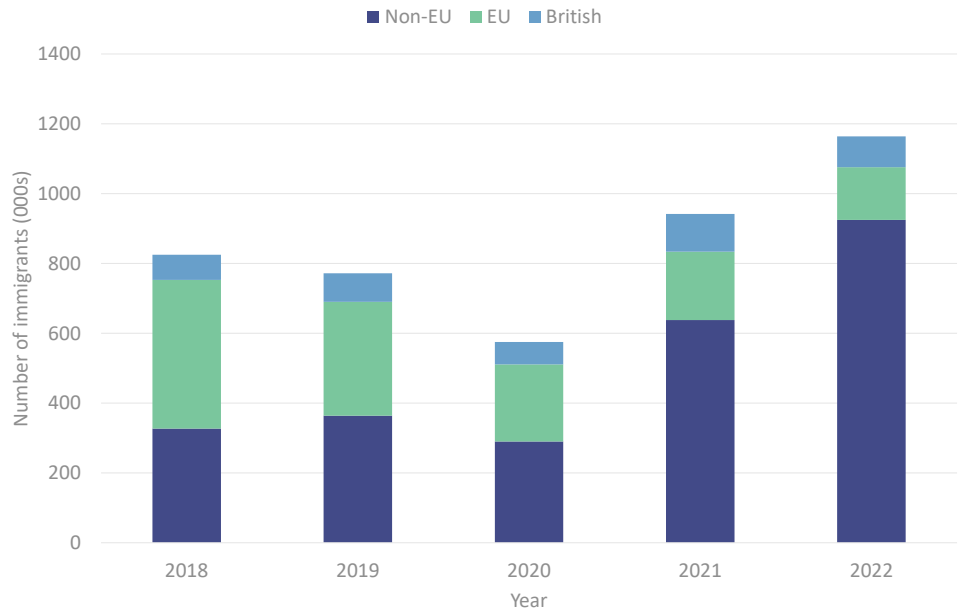
First, we find that the overall level of international migration in the UK appears to have returned to pre-Covid levels.

The ONS has published provisional figures on total long-term international migration flows in the UK.⁵⁶ We note that we do not use this data in our modelling because it is not published on an LAD level, and it is estimated with a different methodology than the historical data.

Figure 4 and Figure 5 below show international immigration (inflows) and emigration (outflows) from this data over the past 5 years.

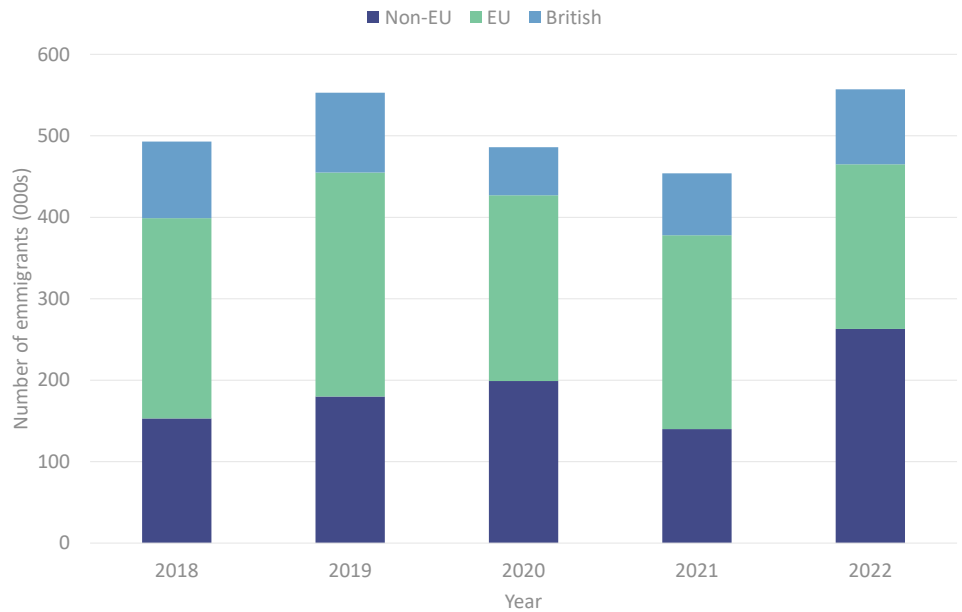
⁵⁶ *'Long-term international migration provisional: year ending December 2022.'* Office of National Statistics (2023).

Figure 4: International immigration flows to the UK, by nationality



Source: ONS, Department for Work and Pensions, Home Office. Long-term international migration, provisional: year ending December 2022. Note: Year = YE in December.

Figure 5: International emigration flows to the UK, by nationality



Source: ONS, Department for Work and Pensions, Home Office. Long-term international migration, provisional: year ending December 2022. Note: Year = YE in December.

As can be seen, both in and outflows in 2022 not only meet but exceed pre-Covid levels. These figures are in levels, rather than rates. However, a similar result can be seen when looking at rates.

Table 19 below shows the international immigration and emigration in 2018 and 2021 as a percentage of the population of England and Wales. We compare to 2021 as

opposed to 2022 because this is the latest year with official population figures from the ONS.

Table 19. International migration rates, 2018 and 2021

	2018	2021
International immigration rate	1.40%	1.58%
International emigration rate	0.83%	0.76%

Source: Office for National Statistics, Department for Work and Pensions, Home Office. Long-term international migration, provisional: year ending December 2022. Note: we use the ONS population figure for 2017-18 from ONS migration data⁵⁷ and the 2021 Census population figure for 2021.⁵⁸

The international immigration rate is higher than pre-Covid, and the emigration rate is just slightly below the pre-Covid rate. Figure 5, however, shows that emigration levels in 2022 are higher than the pre-Covid level. Overall, therefore, we consider there is strong evidence that there has been no lasting impact from Covid-19 on the overall rate of international migration.

C2. Impact on internal migration

Provisional internal migration data is not available from the ONS for the post-Covid period, however, there is strong evidence that international migration is highly correlated with total migration.

The table below shows the correlation coefficient between international migration rate and various other transience indicators, using transience by company from 2013-14 to 2019-20 (i.e. the available ONS data we use in our modelling).

Table 20. Correlation between international migration rate and other transience measures

Transience measure	Correlation with international migration rate
Internal migration rate	0.727
Total migration rate	0.826

Source: Economic Insight analysis.

As can be seen, there is strong positive correlation between international inflows and the other measures. Therefore we consider the findings that Covid-19 had minimal lasting impact on international migration in the post-Covid period, also apply to total migration.

⁵⁷ 'Local area migration indicators, UK (Discontinued after 2020).' ONS (2020).

⁵⁸ 'Population and household estimates, England and Wales: Census 2021.' ONS (2022).

Furthermore, we find evidence in the academic literature that suggests the impact of Covid-19 on internal migration was temporary rather than sustained.

Rowe *et al.* (2023) investigate population transience during the pandemic using Facebook / Meta data.⁵⁹ The paper finds the following conclusions.

- There was a sustained reduction in population movements during the Covid-19 pandemic, specifically due to government restrictions (e.g., due to national or local lockdowns).
- There were higher-than-average movements between high-density areas to low-density areas (e.g. due to space requirements due to government policies on remote working and home-schooling).
- Overall mobility levels have since reverted back to pre-Covid levels, illustrating that any of the above trends were temporary.
- Internal population movements in the UK are at intermediate levels i.e. between those before the pandemic, and the early phases of the pandemic.

In summary, the paper finds *“that while COVID-19 generated shock waves leading to temporary changes in the patterns of population movement in Britain, the resulting vibrations have not significantly reshaped the prevalent structures in the national pattern of population movement.”*

⁵⁹ *'Urban exodus? Understanding human mobility in Britain during the COVID-19 pandemic using Meta-Facebook data.'* Rowe, F. *et al.*, *Population, Space and Place* (2023).



Annex D: EI model suite

This annex sets out the detail of our own econometric retail cost model suite. These models have been peer reviewed and published in an academic journal article (*'Benchmarking Water Retail Cost Efficiency in England and Wales'*, International Journal of the Economics of Business).

Our model suite was developed with independent expert input from known experts in the field of efficiency benchmarking.

- **Professor Anthony Glass** (University of Sheffield). Anthony is a highly regarded expert in the field of econometric cost benchmarking across a wide range of industries, including water.
- **Professor Karli Glass** (Loughborough University). Karli has published numerous articles in the field of efficiency and analysis for leading economic journals, including the Journal of Econometrics and Oxford Economic Papers.

Our model suite consists of sixteen econometric models comprised of two model 'sets':

- **Set A** consists of a suite of eight econometric cost models that incorporate economies of scope (related to serving dual service versus single service customers) by including the (logs of) the number of single and dual service customers as separate variables.
- **Set B** also consists of eight econometric models but with an alternative way of incorporating economies of scope by including, as separate variables, (logs of) the total number of customers and the number of single service customers.

Both sets A and B contain:

- Four 'top-down' models where the dependent variable is total retail operating costs.
- Four 'bottom-up' models consisting of two 'bad debt' and two 'non-bad debt' models, where the dependent variables are bad debt related expenditure and non-bad debt related costs, respectively. Together bad debt and non-bad debt costs sum to total retail operating costs.

An overview of our suite of cost models can be seen in Table 22 below.

Table 21: EI suite of econometric models

Model	Dependent variable	Panel structure	Estimation technique	Approach to number of customers
A1	Total retail operating costs	Pooled	OLS	Separate dual and single service customer variables
A2	Bad debt related retail operating costs			
A3	Non-bad debt related retail operating costs			
A4	Total retail operating costs			
A5	Total retail operating costs	Random effects	Generalised Least Squares	
A6	Bad debt related retail operating costs			
A7	Non-bad debt related retail operating costs			
A8	Total retail operating costs			
B1	Total retail operating costs	Pooled	OLS	Total customers; single service customers
B2	Bad debt related retail operating costs			
B3	Non-bad debt related retail operating costs			
B4	Total retail operating costs			
B5	Total retail operating costs	Random effects	Generalised Least Squares	
B6	Bad debt related retail operating costs			
B7	Non-bad debt related retail operating costs			
B8	Total retail operating costs			

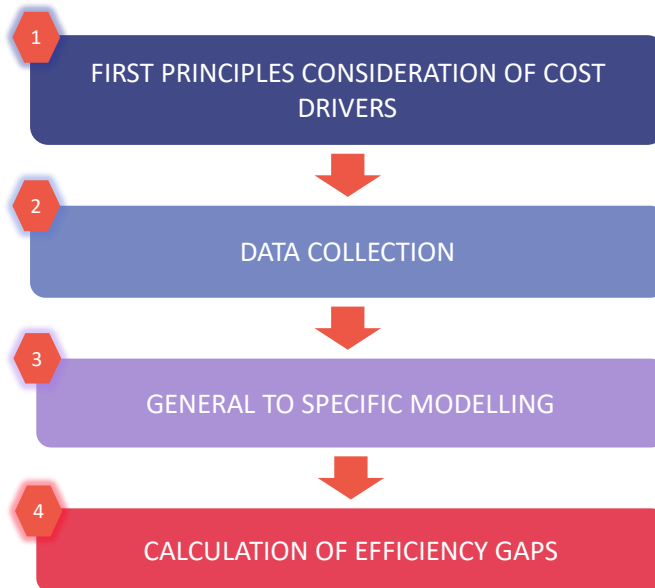
Source: Economic Insight analysis.

D1. Overview of our modelling approach

The modelling approach we used to arrive at our model suite and our associated efficiency gaps, broadly consists of four steps.

The figure below provides an overview of our modelling approach to retail cost benchmarking.

Figure 6: Overview of our modelling approach



Source: *Economic Insight*.

- **First**, we considered the full range of potential cost drivers based on first principles. Specifically, cost drivers included should only drive differences in *efficient* costs, as opposed to drivers of differences in costs that occur due to inefficiency.
- **Second**, we collected the necessary data on expenditure and cost driver data. Our primary data source is the data published by Ofwat. However, this process also involved adjustments to map data to individual water companies.
- **Third**, we used a general to specific modelling approach. This involves beginning with a relatively large number of explanatory variables, and omitting variables that are not statistically significant, or counterintuitively signed.
- **Finally**, we calculate the efficiency gaps based on our econometric model results. This involves triangulating the predicted cost allowances across our ‘top-down’ and ‘bottom-up’ models.

In the following sections, we provide further detail on (i) the final cost drivers included in our model suite; and (ii) how we predict efficient modelled costs and efficiency gaps using our models.

D2. Cost drivers included in our model suite

The table below shows the final list of cost drivers included within our suite of econometric models, alongside the accompanying measures and data sources.

Table 22. Cost drivers included within our model suite

Cost driver	Measure	Source
Scale and scope	Number of single service customers; number of dual service customers	Company data share (Ofwat)
Population transience	Population inflows and outflows relative to population	ONS local area migration indicators
Meter penetration	Proportion of metered households	Company data share (Ofwat)
Meter density	Number of metered households relative to mains length	Company data share (Ofwat)
Housing stock	Percentage of flats relative to total housing stock	ONS
Congestion	Average speed projections on local A roads	DfT
Deprivation	Rate of mortgage reposessions; IMD income score	Ministry of Justice; Ministry of Housing, Communities and Local Government
Wholesale bill size	Average wholesale bill	Company data share (Ofwat)

Source: Economic Insight analysis.

D3. Calculation of efficiency gaps

For each model set (A and B), we can calculate the associated ‘efficiency gaps’, which represent the difference between a water company’s performance in terms of efficiency relative to a chosen ‘benchmark’.

- **First**, we construct the modelled costs. This involves constructing the predicted expenditure for each of the ‘bottom-up’ and ‘top-down’ models.

- **Second**, we 'triangulate' the predicted modelled costs from each of the eight models within each set. Specifically, we weight the models as follows: (i) weight debt and non-debt cost models equally for the 'bottom-up' models; and (ii) weight all 'top-down' models equally; and (iii) weight the averaged 'bottom-up' and 'top-down' models equally. Effectively, we take an average across our model sets.
- **Third**, we calculate the benchmark 'efficiency score'. This is derived using the upper quartile (75th percentile) of the efficiency scores across all water companies. Each company's efficiency score is calculated as its actual historic costs as a proportion of its predicted modelled cost. A value above (below) 1 indicates a water company has higher (lower) actual expenditure than predicted expenditure and is therefore relatively (in)efficient.
- **Fourth**, the difference between a water company's efficiency score and the benchmark represents its 'efficiency gap'. That is, how far an individual company is from the upper quartile in terms of efficiency.

Separately, the benchmark efficiency score can be applied to each water company's predicted modelled cost to derive their efficient modelled cost. This represents the predicted retail costs for a water company if it becomes as efficient as the upper quartile.

WE MAKE ECONOMICS RELEVANT

Economic Insight Limited

125 Old Broad Street

London

EC2N 1AR

+44 207 100 3746

www.economic-insight.com

Economic Insight Ltd is registered in England No. 7608279.

Whilst every effort has been made to ensure the accuracy of the material and analysis contained in this document, the Company accepts no liability for any action taken on the basis of its contents. Economic Insight is not licensed in the conduct of investment business as defined in the Financial Services and Markets Act 2000.

Any individual or firm considering a specific investment should consult their own broker or other investment adviser. The Company accepts no liability for any specific investment decision, which must be at the investor's own risk.

© Economic Insight, 2023. All rights reserved. Other than the quotation of short passages for the purposes of criticism or review, no part of this document may be used or reproduced without express permission.

