09 June 2023

Economic Insight Ltd

COST ADJUSTMENT CLAIM TO FUND ADDITIONAL RETAIL COSTS FROM TRANSIENCE

A REPORT FOR AFFINITY WATER

CONTENTS

It is imperative that Ofwat allows Affinity Water efficient retail costs[1] (estimated to be £3.8 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 retail costs has not changed since PR19. Therefore, Affinity 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 modelling 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' transience[5]), and internationally ('international' transience).

As we detail 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 *As we set out in section 7A, Affinity Water's own bottom up estimates indicate a higher figure of around £8m. We consider that our own estimate may be conservative.*
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 Affinity'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. Affinity has one of the highest rates of transience, which is outside of its management control

Affinity Water (Affinity) has notably higher levels of transience than other water companies.[6] Specifically, in the period 2013-14 to 2019-20, Affinity had total migration rate of 15% 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 Affinity 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, Affinity has taken steps to: (a) increased the share of customers who receive their bills online (reducing the production costs of sending customers a physical bill); (b) review and amend its debt recovery process for closed customer accounts; and (c) promote direct debt payments and reduce the time 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 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*

---

[6] *This also applies to a small number of other companies, such as Thames Water.*
[7] *See Section 3C for further detail.*
[8] *'PR19 Draft Determinations: Securing cost efficiency technical appendix.' Ofwat (July 2019); page 81.*

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).

We consider Ofwat's decision to omit a transience variable from its preliminary PR24 retail cost models, due to the modelling challenges set out above, to be inappropriate. This is because:

- **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 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 Affinity's transience rates post-Covid remain above the industry average (i.e. Affinity's 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 than other companies'), then Affinity'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 Affinity) have higher-than-average levels of transience, 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 Affinity is provided efficient retail costs.

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 impact on our finding showing a significant relationship between transience and retail costs.

On **Modelling Challenge 2**, contrary to Ofwat's findings based on its preliminary PR24 retail cost models, 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.[15] 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 Affinity 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 Affinity 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 Affinity of £3.8m for the upcoming price control. We set out our methodology for this in Chapter 7.

We note that our assessment of Affinity's CAC is based on our understanding of Ofwat's preliminary PR24 retail cost models as set out in its consultation.[16] 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 Affinity (for which it could use the same methodology as we set out) to identify Affinity'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.

---

15 *Where 'robust results' refers to results which are not sensitive to small changes in the specification of the model.*

16 *'Econometric base cost models for PR24.' Ofwat (April 2023).*

- 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-Affinity' analysis.
- Chapter 7 calculates a cost adjustment claim for Affinity.

This report is supported by the following Annexes:

- Annex A summarises the evidence against each of Ofwat's criteria for a CAC.
- Annex B sets out our methodology for calculating the CAC for Affinity.
- Annex C summarises the evidence on the impact of Covid-19 on transience.
- Annex D 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) Affinity'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.[17]

[17] *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, Affinity 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 analysis.

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*".[18]

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. Affinity's efforts to mitigate transience-related costs

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

- **Affinity has increased the number of its customers who receive their bills online.** By increasing the number of customers who receive their bills online, Affinity negate the production cost of sending a customer a physical copy of their bill (which amounts to £0.53 per bill). Since 2020-21, Affinity have increased the penetration of customers receiving an online bill from 36% to 43% (May 2023).[19] Affinity has plans to increase penetration to 50% by 2024-25, through further campaigns and incentives for its customers. In addition, Affinity plans to review and redesign its onboarding process.

- **Affinity has reviewed and amended its debt recovery process for closed customer accounts.** The effect of which has led to a decrease in Affinity's debt recovery costs of approximately 20%.[20] This has been due to the following initiatives:

  - Increasing the level of internal collection actions including more SMS, emails and outbound dialing to customers (which has decreased the volume of accounts placed with external debt collection agents).

  - Working with suppliers to reduce the commission / costs charged to Affinity.

  - 'Debt sales' where Affinity have sold off the outstanding balance from a number of customers that have moved out of its supply area, increasing the amount of cash recovered (rather than customers' debt being written-off to bad debt).

[18] *'Supplementary technical appendix: Econometric approach.' Ofwat (2019); page 31.*
[19] *'Transience – Data request', Affinity Water (May 2023).*
[20] *'Transience – Data request', Affinity Water (May 2023).*

- **Affinity has promoted direct debit (DD) / payment plans by offering its customers ongoing incentives such as vouchers / prizes.** By encouraging customers to switch to DD, Affinity are: (i) avoiding the additional costs of using card networks to receive payments; and (ii) reducing the time it would have spent otherwise chasing and managing customers' payments. As a result of its actions, Affinity has increased the proportion of direct debit take-up from 61% to 64% between 2019-20 and 2022-23. Affinity aims to increase direct debit take-up to 66% by 2024-25.[21]

In addition to the measures Affinity have taken so far, it is looking to further increase its efficiency from 2024-25 onwards.[22] For example, this includes:

  - Improving the efficiency of its 'moving home' process (both online and over the phone) by introducing a new CRM system.

  - Fitting up to 400,000 smart meters in AMP8. Fitting smart meters in properties means meter / consumption data is available on a daily basis. This in turn reduces the number of manual meter reads required for billing purposes, and therefore will reduce Affinity's meter reading costs.

[21] *'Transience – Data request.' Affinity Water (May 2023).*
[22] *'Transience – Data request.' Affinity Water (May 2023).*

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 Affinity have higher-than-average transience; and
- (iii) the practical implications of the above for modelling **true** efficient retail cost allowances.

3B. Data and measures of transience

The data on migration in the UK 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;[23] 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.[24] Table 2 summarises the measures of transience we consider in the our cross-industry analysis.

The transient 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 present our findings by rates.

[23] *No data is available on migration within UK local authorities.*
[24] *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 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%.

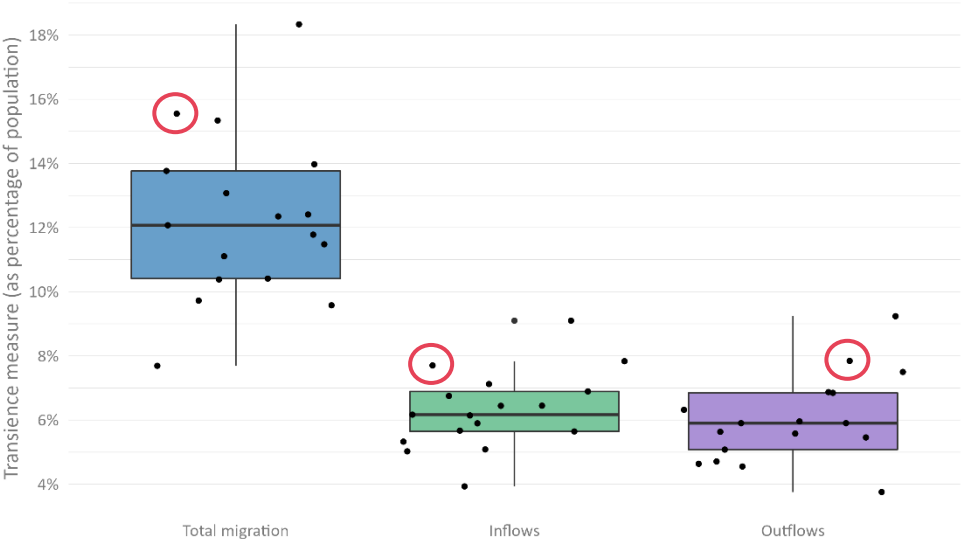
Affinity Water has the second highest level of transience across the sector, with a total migration rate of over 15%. This is over 3 percentage points above the average level of transience.

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. Affinity 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 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 Affinity, the explanatory drivers included in the cost models 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).[25]

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.[26] 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 the logical solution to manage this challenge is not to exclude a relevant variable with strong economic and engineering rationale from the retail cost models, but rather to seek to fill the gap.

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 straightforward, and 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

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

[26] *That is, 2019-20 is the last year for which this data is available.*

measures in 2016-17. Therefore, Ofwat's transience measure at PR19 was also based on forecasting forward, based on the most recent year of available data.[27]

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);[28] 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 the 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)[29] 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)[30] 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.[31] 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**).[32] 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**.

---

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

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

29 *We note that for 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.*

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

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

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

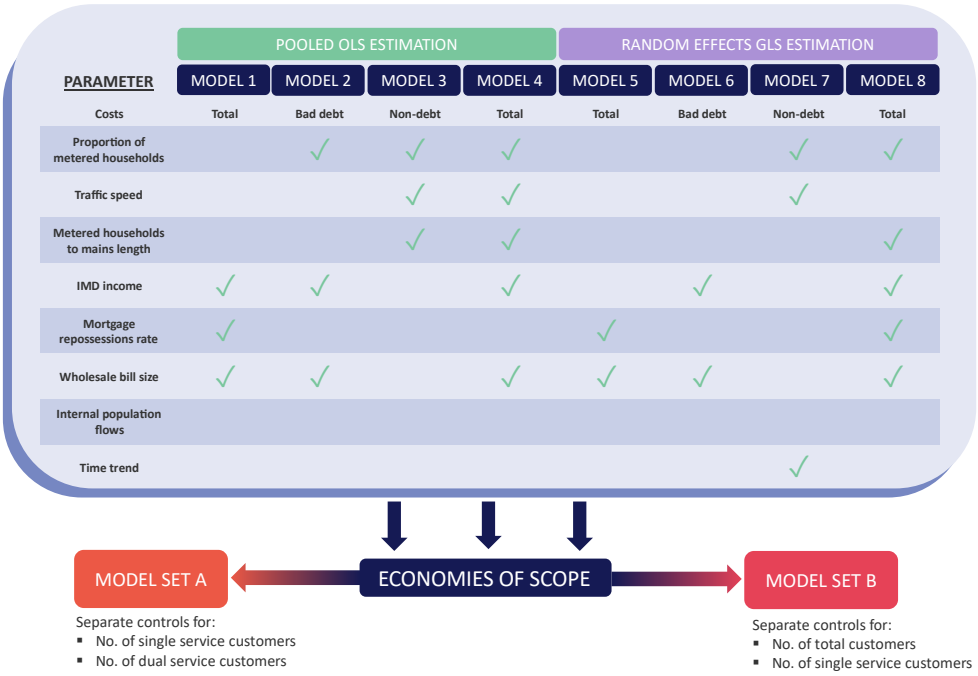
Our method is consistent with Ofwat's approach to forecasting transience at PR19. Specifically, at PR19, Ofwat 'rolled forward' the latest year of data for transience (2017-18) to forecast forwards. We consider our method in line with this because, had Covid-19 not happened, we would roll the latest 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).[33]

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. 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

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

suite of models. That is, we run separate models for each individual transience measure, forecast using our forecasting method outlined in section 4B.[34]

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.[35]

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

[35] *'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 when transience is excluded. In other words, 'low' transience companies would receive higher allowances when transience is omitted.
- Companies with 'high' transience could have efficient retail costs set 7% lower when transience is excluded. In other words, 'high' transience companies would receive lower allowances when transience is omitted.
- For Affinity specifically, the impact of excluding transience would result in its total costs being set at around 5% 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.

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)
Affinity Water	15.5	13.1m	13.8m	-0.7
Companies with transience below the median level	<12.3	284.9m	263.4	+21.6
Companies with transience above the median level	>12.3	307.6m	330.8	-23.2

Source: Economic Insight analysis.

5 Results of Ofwat's 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 PR24 consultation 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	✓
	RTC5	Average bill size	0.00357	0.752	✓

		Average number of County Court Judgements/Partial Insight Accounts per household Separate Covid dummies for 2019-20 and 2020-21			
	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 gives 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 at PR19, and there is evidence transience affects other costs.[36]

- 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".*[37] 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

[36] *With the exception of the percentage of dual service households, as this driver has been excluded at PR24.*
[37] *'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 PR24 retail modelling suite. 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 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 methods

Method	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

In this chapter, we present our 'within-Affinity' analysis, which suggests there is evidence of a positive relationship between transience and debt related costs within Affinity'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* Affinity's supply area.[38] Ideally, we would use the same across-industry models as we relied on in the previous chapters, applied to variations in Affinity'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 (iv) the overall conclusions of our within-company analysis.

6A. Econometric models and underlying data

We construct a 'unit cost' model[39] and a 'total costs' model to test the relationship between transience and debt related retail costs within Affinity's supply area, controlling for other factors. Where relevant, the unit cost variables are expressed on a per unit basis or share.[40]

We use postcode district data for the latest available year (2022/23) on:

- Affinity's customer debts.
- Affinity's average customer bills.
- Affinity's volume of home move contacts.
- Publicly available deprivation data published by the Ministry of Housing, Communities and Local Government (2019).

Further detail on our 'within' models are summarised in Table 8 below.

[38] *Whereas the cross-industry models compare transience between water companies.*
[39] *In accordance with Ofwat's unit cost approach to econometric modelling.*
[40] *For example, if debt related costs are 100 for a postcode district, this value is used in the total costs models. Where in the unit cost models, debt related costs are divided by the number of customers.*

Table 8. Summary of within-Affinity econometric models

Model component	Description
Dependent variable	
log (*Debt related costs*)	Affinity's debt related costs distributed by the postcode-level shares of Affinity's customer debt write-offs. This is divided by the number of customers in the unit cost models.
Control variables	
log (*Average bill size*)	Affinity's average bill size recorded by postcode district, as provided by Affinity.
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 (*Home move contact*)	A count of all unique customers that have contacted Affinity regarding moving homes. This variable is used in the 'total cost' model.
Home move share	A count of all unique customers that have contacted Affinity regarding moving homes as a share of the total number of customers (measured and unmeasured). This variable is used in the 'unit cost' model.

Source: Economic Insight analysis.

6B. Results

The model results are shown in Table 9 below. The table shows that irrespective of how costs are specified, whether on a per unit basis or as the actual cost, both models point to a strong positive relationship between the measure of transience and debt related (unit) costs. The transience coefficient in both models is positive and statistically significant at the 1% significance level, and the other control variables exhibit the expected sign.

- The unit cost model indicates a 1% increase in the number of unique customers contacting Affinity relating to moving homes is, on average, associated with a 3.40% increase in debt related unit costs.

- The total costs model indicates a 1% increase in the number of unique customers contacting Affinity relating to moving homes is, on average, associated with a 0.88% increase in debt related costs.

Table 9: Results summary of within-Affinity econometric model

Model	Transience metric	Coefficient	Other control variables with expected sign
Unit cost	Home move share	3.397***	Yes
Total cost	No. of home move contacts	0.875***	Yes

Source: Economic Insight analysis of Affinity data.

6C. Data constraints and limitations

There are a number of important limitations to our within-Affinity 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 Affinity on debt costs, average bill, customers, and the transience metric was only available for a limited time period. This limits the period over which it is possible to construct a 'within-area' model, and means that it is difficult to adequately capture the effect of Covid-19 given that data prior to the pandemic are missing.

- **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 Affinity 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 Affinity's metric.** The transience metric provided by Affinity, namely, a count of all unique customers that have contacted Affinity regarding moving homes, is certainly a useful and intuitive indicator of transience. It is not, however, possible to compare how well this metric captures transience compared to the various transience measures we use in our cross-industry models.

6D. Summary and conclusions

Our 'within-company' analysis suggests that there is a strong positive relationship between transience and debt related costs for Affinity. 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 Affinity's transience measure is positively related to its debt related costs, consistent with our cross-industry analysis and again suggests that there is evidence that there is a positive relationship between transience and retail costs.

- The positive relationship between transience and retail costs within Affinity's supply area, suggests that transience is a valid driver of retail costs for Affinity, and it is unlikely that Affinity's higher retail costs are entirely driven by any company-specific levels of efficiency.

7 Calculating the CAC

In Chapter 4, 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 have higher-than-average transience (like Affinity), to ensure efficient retail cost allowances. Without such adjustment, Affinity'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 in Annex B.

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.[41] We use Ofwat's models for the implicit allowance because the implicit allowance should be reflective of Affinity'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."*[42]

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).

---

41 *"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).*

42 *'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 Affinity. The sections below detail how we arrive at these figures.

Table 10. Affinity transience CAC figures

	1-year value (£m, 2022-23 prices)	5-year value (£m, 2022-23 prices)
[A] Gross cost adjustment	31.1	155.5
[B] Implicit allowance	30.3	151.7
[A – B] CAC	0.8	3.8

Source: Economic insight analysis.

We recognise that Affinity's CAC may not meet Ofwat's materiality threshold. However, we note that this is not an issue if Affinity receives its efficient retail cost allowances e.g., by including transience within Ofwat's retail cost model suite.

We note that Affinity Water has its own 'bottom-up' estimates of transience-related expenditure. These are higher than our £3.8m estimate (Affinity estimates this to be around £1.7m in 2021-22, which would total to £8.3m over a 5-year period[43]). While we have not independently assured these estimates, we consider that this indicates: (a) it being important that Ofwat accounts for transience, and (b) while our own CAC estimates above may not meet Ofwat's materiality threshold, they may be conservative.

Table 11. Affinity own bottom-up estimates

	1-year value (£m, 2022-23 prices)	5-year value (£m, 2022-23 prices)
[A – B] CAC	1.7	8.3

Source: Affinity Water.

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

[43] *See spreadsheet "Affinity Water Valuation of Historic Transience costs" accompanying Affinity's CAC submission.*

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 12 below. We note that our approach to the implicit allowance is the most conservative.

Table 12. Sensitivities of implicit allowance adjustment

Models used	Implicit allowance (£m, 2022-23 prices)
Entire PR24 consultation suite (used in the CAC calculation submitted)	151.7
RTC3, RBDC3, ROC1, and ROC2	146.9
RTC3	147.0

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.

Our approach to the symmetrical adjustment is further outlined in Annex B.

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 using an average of these unit costs for each company 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: (a) its 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 also note that the final results of this adjustment will not net to zero, because we scale by the number of connected households. The costs per household are perfectly symmetric, as the total migration rates are symmetric around the industry average total migration rate. However, the number of households is not symmetric around the average migration rate. Therefore when the costs per household are scaled using number of households, the resulting adjustment is not symmetric.

We note that Ofwat has said *"there could be instances where downwards adjustments do not exactly offset the upwards adjustment".*[44]

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

Annex A: Ofwat's CAC criteria

This annex sets out Ofwat's criteria and sub-criteria for a CAC, and the supporting evidence provided by Affinity.

Table 13. Ofwat's CAC criteria and Affinity's evidence

Criteria	Sub-criteria	Questions	Affinity'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**, Affinity Water has the second highest level of transience across the sector, with a total migration rate of over 15%. 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**, Affinity Water has improved processes to reduce the costs. Please see section 2D. In any case, 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	**Yes**, Ofwat's PR24 base cost consultation models do not include transience as a driver of costs.

		covered by one or more cost drivers included in the cost models?	
		(i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?	The claim is £3.8m but is unlikely to meet Ofwat's materiality threshold. We however note that Affinity's own bottom-up estimates are higher.[45]
		(j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?	**Yes**, Affinity Water has carefully considered possibility of offsetting other costs but has not identified any material cost savings.
		(k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?	Ofwat does not intend to include a transience driver in its retail costs models. While the claim is unlikely to meet Ofwat's materiality threshold, it is nevertheless a significant driver of retail costs.
		(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 Affinity Water and, therefore, will need to be included in long-term allowances.
		(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 PR24 base costs 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 and internally assured by Economic Insight.

Source: Economic Insight analysis.

[45] *See section 7A. We however use our own estimates to calculate the CAC.*

Annex B: CAC methodology

This annex sets out our methodology for calculating Affinity'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 Affinity's efficient allowance from these models by applying the upper quartile benchmark to Affinity'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 Affinity's efficient allowance from these models by applying the upper quartile benchmark to Affinity'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 Affinity'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 Affinity'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 use Ofwat's models for the gross cost adjustment as it ensures a fair comparison to the

[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.*

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 coefficients that are similar to those in Ofwat's PR19 final retail cost models. We note

[50] *Please see 'PR24 Econometric Base Cost Models Consultation.' Ofwat (April 2023); section A4.4. Model numbers correspond to those shown in Tables 7.18, 7.20, and 7.21.*

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 OC2 with migration rate	OC1 without migration rate OC2 without migration rate

Source: Economic Insight analysis.

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 (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, 2017-18 prices)

	Calculation	Amount (£m)
A. Gross cost adjustment – transience included in all models within subset (Method 1)	Please see Section 1A	155.8
B. Gross cost adjustment – transience included in bad debt and total cost models within subset (Method 2)	Please see Section 1A	155.2
C. Implicit allowance	Please see Section 1B	151.7
D. Cost adjustment claim – transience included in all models (Method 1)	A - C	4.1
E. Cost adjustment claim – transience included in bad debt and total cost models (Method 2)	B - C	3.5
F. Final cost adjustment claim	(D + E)/2	3.8

Source: Economic Insight analysis.

B4. Data table definitions

The table below outlines what figures have been used for each RET4 line in Affinity'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	Affinity's efficient residential retail costs when accounting for transience, gross of the implicit allowance. This is the average of A and B in Table 16. See section 1A for further details.
Implicit allowance (res retail)	RET4.6	Affinity's residential retail cost allowance using Ofwat's preliminary PR24 models when transience is not included. This is line C in Table 16. See section 1B for further details.
Historic total expenditure (res retail)	RET4.8	Affinity's historic residential retail total expenditure related to transience. We have used Affinity's estimates based on its PR19 submission.

Source: Economic Insight analysis.

Symmetrical adjustment

As set out in Ofwat's PR24 CAC guidelines, if a CAC is awarded for Affinity, 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 Affinity and the other company are awarded a CAC. We note however that Ofwat may adopt a different approach, depending on 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 Affinity and other companies.

[54] *'Assessing base costs at PR24.' Ofwat (December 2021); page 42.*

- 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 Affinity and other companies.

- Third, calculate the efficient symmetrical adjustment for all companies (excluding Affinity and other companies who are awarded a CAC) by multiplying the unit cost by:

  (ii) each company's transience above the industry-average transience and

  (iii) 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 Affinity 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 Affinity 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, they 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 the 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.

- 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

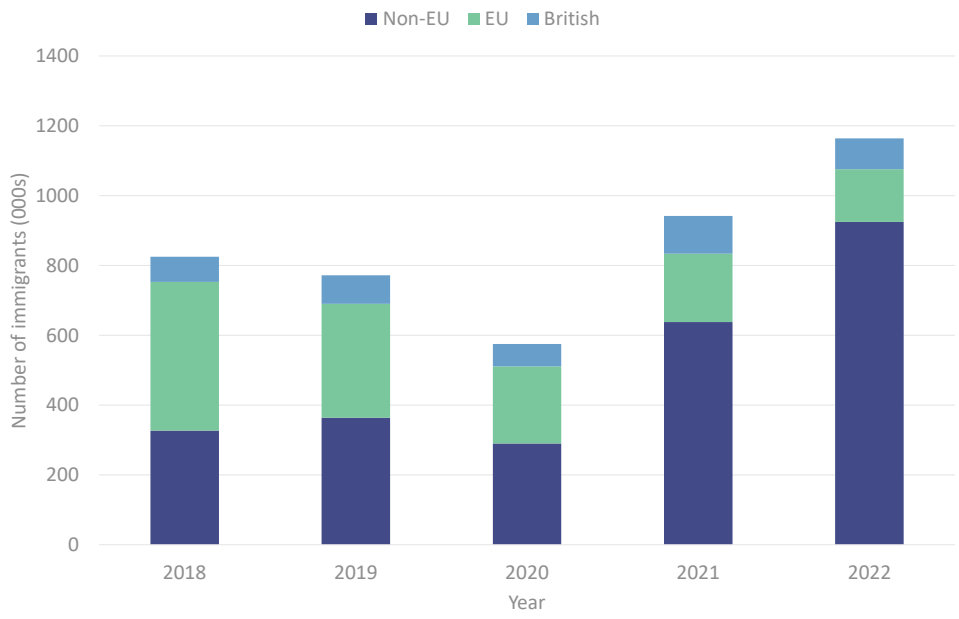
First, we find that the overall level of international migration in the UK appears to have returned to pre-Covid levels.

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.

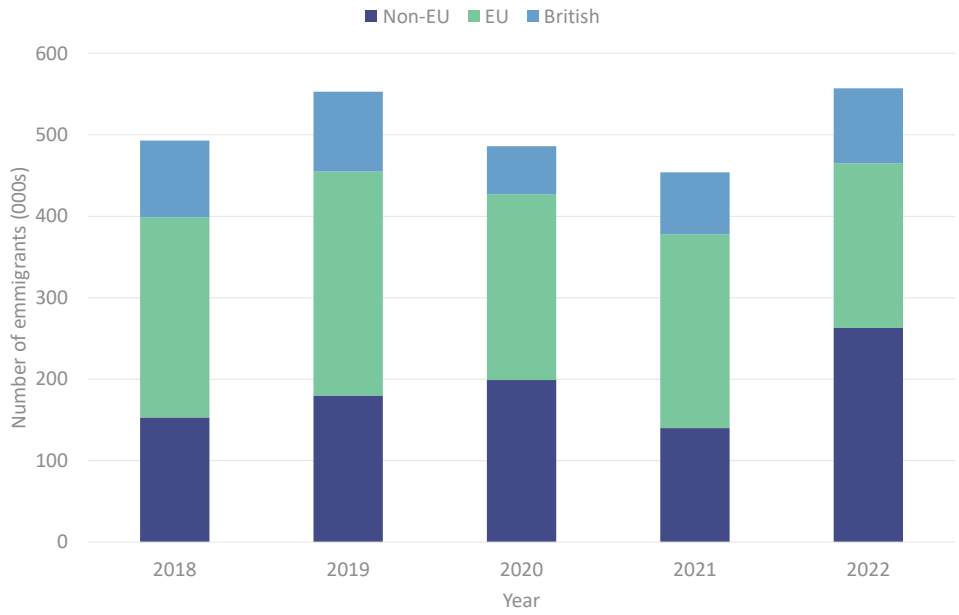
[56] *'Long-term international migration, provisional: year ending December 2022.' ONS (2023).*

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: ONS, 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 data[57] 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 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 21 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			

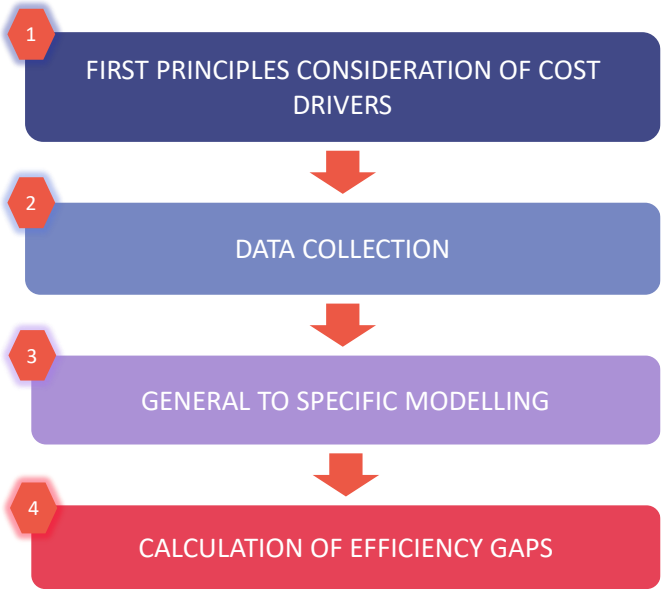
Source: Economic Insight analysis.

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 repossessions; 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 its 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