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Unpacking Fred Lee's CR-GT-ADR black box:
An exercise in the critical realist modelling of water reform in England and Wales

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Abstract:
Fred Lee's CR-GT-ADR schema (Critical Realism-Grounded Theory-Abstract Direct Representation) identifies the preconditions for fulfilling the epistemological promise of heterodox or critical realist modelling: real-world relevance through historical grounding, complete representation of the world, and the researcher's deep engagement with the topic. Building on Lee's insights, the present paper illustrates an initial exercise in the critical realist modelling of water service reform.

The exercise addresses the urgent challenge of ensuring sustainable water and sewerage development in England and Wales after 35 years of privatisation, against the backdrop of recurrent social, political and economic contestation. Drawing on 25 years of empirical work on water service reform in the global North and South, we build alternative scenarios for the governance and regulation of water services. This, with a view to conducting a world-first systematic comparative analysis of the sustainability of water service reforms in England and Wales, an early case of water privatisation. The primary objectives include:

O1) Forecasting progress towards reducing water poverty, mitigating sewage pollution, and modernising infrastructure under two scenarios:
a) The status quo (characterised by privatisation and independent regulation)
b) A system of public ownership and democratic regulation (informed by international best practice)
O2) Assessing the opportunity costs and benefits of institutional change versus inaction at three future points (2030, 2034, and 2039).

The paper aims to use this exercise to unpack Lee's CR-GT-ADR black box, particularly as regards the interplay of ontology and ethics and its modelling implications. This is an aspect of the CR-GT-ADR schema that Lee has left relatively undeveloped. To ascertain the implications of the onto-ethical nexus for the design and usage of critical realist modelling, we deploy Tony Lawson's notion of eudemonic bubbles and explore the emancipatory nature of critical realism.

Keywords: Critical realist modelling; onto-ethical nexus; sustainable development; water service reform; England and Wales

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We welcome comments and criticism on any aspect of the paper.

1. Introduction

The admissibility of modelling as a method of inquiry in heterodox economics[1] is still being debated. The lines have long been drawn between two camps. On the one hand, Tony Lawson and, possibly, John Maynard Keynes in the skeptic field and, among the possibilists, we find Fred Lee, Wendy Olson, Andrew Merman and Paul Downward among others (Lee & Cronin, 2016).

At the risk of oversimplifying, Lawson (1997) cites the impossibility of creating the conditions of closure in social reality that are necessary for econometric predictions to be valid. His argument comes with the corollary that modelers will rely on unrealistic assumptions at the basis of their exercises in order to obtain their results. While we very much share the latter concern, we believe that the former does not justify abandoning the quest for measuring social phenomena. After all, critical realists are aware of the inevitability of approximation to the real and of the imperfection of all methods.

We associate ourselves with the possibilists and we are keen to learn from those who, like Fred Lee, have contributed to identifying the preconditions for fulfilling the epistemological promise of heterodox or of critical realist qua heterodox modelling. With this in mind, we aim to contribute to this debate, while showing how critical realist modelling can be applied to an urgent question of economic policy reform. More precisely, we see critical realist modelling as a potentially useful tool to assess the relative social costs of competing decision on water service reform in England and Wales against the backdrop of 35 years of privatisation and the recurrent social, political and economic contestation.

The paper aims to evaluate this with a view to conducting a world-first systematic comparative analysis of the sustainability of water service reforms in England and Wales, an early case of water privatisation.

1: To clear the air from the start we acknowledge that heterodox economics is not subsumed by what Ben Fine would call critical realist economics. At the same time, a number of observers within and without critical realist philosophy recognise that critical realism has an important role to play for the construction of heterodox economics. Think, for example, of Tony Lawson, Fred Lee, Andrew Nearman among these heterodox economists. Think also about Jefferey Hodgson as an antagonist of heterodox economics. Because of this recognition, we like to make a distinction between critical realist modelling and heterodox modelling. Fred Lee's assumption that critical realism was one of the elements of heterodox modelling, but we think it is important to recognise the importance of critical realist modelling within the broader possibilities of heterodox modelling.

The primary objectives include:
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Fred Lee's (2016) CR-GT-ADR schema (Critical Realism-Grounded Theory-Abstract Direct Representation) outlines the conditions mentioned above, citing the importance of real-world relevance through historical grounding, complete representation of the world, and the researcher's deep engagement with the topic. While one of the apparent merits of this schema is the illumination of ontology, with a view to using heterodox modelling as a tool of explanation, the role of ethics remains to be defined.

In critical realist thought, the onto-ethical nexus constitutes the pulse of critical realistic inquiry. Drawing on critical realist thought, our intuition is that, in addition to ontology, the ethical orientation of the modeler has an important role to play in pursuing an approximation to truth. We concur with Wilson (2021) that an ethical commitment to eudaimonia, or social flourishing, discriminates between critical realist and mainstream modelers, but we suggest that an ethical orientation to eudaimonia has a more important role to play in the design of critical realist modeling than has been recognised thus far. The deployment of Tony Lawson's notion of eudaimonic bubbles is useful to explore the emancipatory nature of critical realism. We consider the achievement of sustainable water development through public-oriented service provision to be an example of this principle (Lawson, 2017).

This work identifies water poverty as one example of the problems of social unsustainability resulting from the private ownership of water. This comes as one subset of the problems with contestation of the perception of water governance in England and Wales. Water poverty is the sole concern of the modelling conducted in this paper, with regards to the potential impact of changes to ownership and regulatory regimes. Additional problems such as environmental degradation are significant to the full understanding of this issue and should be the subject of future work on the sector.

The historical context of water ownership and water poverty in England and Wales, and its immediate future, will be explored in the practical background, as well as the justification behind exploring the mode of ownership as a major factor in the propagation of social unsustainability. We will then explore the basis for undertaking this exercise in critical realist modelling and its grounding in the literature.

This work will then outline how the modelling in this work builds on the work of Lee (2016) and others and define the aspects of our critical realist model. The findings section will present the results and their implications for the analysis conducted into the nature of private sector water, before the final two sections discuss the implications from a practical policy perspective for the

future of England and Wales and from the perspective of critical realist modelling techniques respectively. In this exercise we find that there is a 7.8% increase in the number of households experiencing water poverty by 2029-30, with the cost of eliminating water poverty £245m greater under the current private model of ownership when compared to a public sector comparator based on the structure and financing of the operator Scottish Water.

2. Background (Practical)

This work is centered around the water supply and sanitation (WSS) sector in England and Wales. These services include the provision of drinking water and the maintenance of sewerage networks, as well as the related environmental and sustainability responsibilities that follow. These services were historically the realm of the public sector and continue to be in roughly 90% of large municipalities (Hall & Lobina, 2008). However, there was an increase in interest in private provision models from the late 1980s, with privatisation in England and Wales in 1989 since becoming an internationally recognized example of the practice (Lobina, 2019). The direct exchange of ownership, rather than a lease as was experienced by Paris before its return to public ownership, is a distinctive feature of the system present in England and Wales (Lobina et al., 2019).

In England and Wales, as with much of the global north, these services are, at least nominally, universalised and maintained based on regular revenues from water tariffs (de Oliveira Lette et al., 2022). The major present concern with these services in the global north is sustainable development. This incorporates environmental sustainability, as well as social sustainability, of which affordability and water poverty will be the focus of this research.

Water companies in England and Wales

At present, water and sewerage services in England and Wales are provided by 10 regional companies, which operate as privately-run natural monopolies (notably Welsh Water is run as a not-for-profit company). Additionally, there are several smaller private companies which only provide water services. The geographic spread of these companies is shown in Figure 1, with the colours identifying the larger water and sewerage companies (WASCs).

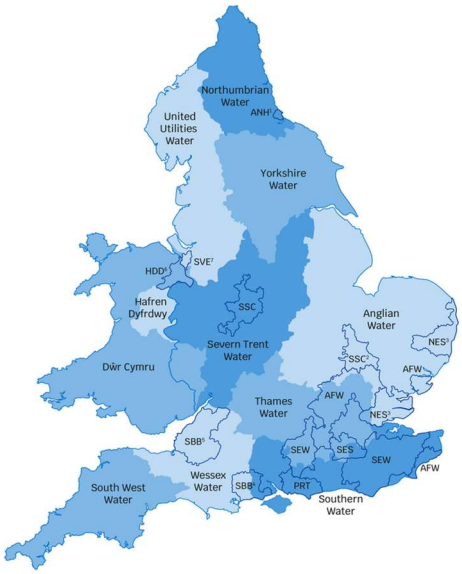

Figure 1: Map of water and sewerage company regions in England and Wales (Ofwat, 2025)

The Water Act (1973) created regional water authorities over similar geographical areas to the companies today, with direct input from local authorities and national government towards their composition. This continued until the passage of the Water Act (1989), which privatised the companies, and subsequent legislation which outlined a regulatory structure to oversee the company's performance on drinking water (the Drinking Water Inspectorate), environmental pollution (the National Rivers Authority, later the Environment Agency) and economic regulation (Ofwat) (Lobina & Hall, 2008; Benson et al., 2015).

Most important for this research, Ofwat is a non-ministerial government department which sets the limits to water tariff rates that companies can charge their customers- this was intended to ensure investment costs could be met while nominally protecting customers from high price increases (Byatt, 2013). Ofwat outlines these price plans in 5-year periods, with the most recent review in 2024 setting the prices until 2029-30 (Ofwat, 2024).

Despite the aim of privatisation improving the economic efficiency of the water system, England and Wales have seen poorer outcomes over the past 35 years. Hall & Lobina (2024) outline that the "gaming" of the regulator by water companies has led to lower investment and higher prices overall to increase profitability, with knock-on effects of poorer environmental management, river pollution and increased water poverty. In 2023-2023 the companies paid out £1.446bn in dividends to shareholders, amounting to nearly 11% of total company revenue, while demonstrably underinvesting in water infrastructure, leaving a diminished capacity within drainage systems and presiding over more than 450,000 sewage overspills in 2023 alone (Hall & Lobina, 2024).

This is not a surprising outcome. It has been demonstrated that private sector water will lead to higher prices for consumers (Zhang et al., 2022), environmental degradation (Hall, 2001) as well as the potential for corruption (Lobina & Hall, 2007). Indeed, one clear example of these problems inherent to private sector water is the broad consensus outside of England and Wales that water and sewerage services are run by the public sector in almost 90% of cases (Hall & Lobina, 2008).

Furthermore, the private ownership of water is also not supported by a majority of the public in England and Wales, with clear majorities in favour of returning water to the public sector (YouGov, 2024). Despite this, successive governments have refused to consider this kind of reform, most recently ruling out the consideration of public ownership from the upcoming review on the water sector (UK Parliament, 2025).

Water poverty in England and Wales

Water bills in England and Wales increased by nearly 70% in real terms in the 30 years following the privatisation of water in 1989 (NIC, 2025). The first years of privatisation saw some of the sharpest price rises, with an increase in the average annual bill of £78 (2021 prices) between 1991 and 1997. The price rises in this initial period were accompanied by a significant increase in the number of households disconnected from the water supply for non-payment, shown in Figure 2, before the practice was banned in 1999 (Lobina & Hall, 2008).

5.14 Disconnections for non payment of charges

non-domestic

Water service companies	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
Anglian	18	46	15	31	49	29
Dwr Cymru	99	92	81	136	72	169
Northumbrian	124	158	200	164	183	189
North West	213	110	177	49	152	198
Severn Trent	94	123	290	414	269	224
Southern	116	187	301	542	203	158
South West	0	9	11	28	27	16
Thames	0	9	93	667	844	1,108
Wessex	2	0	2	7	2	0
Yorkshire	69	141	217	180	126	107
WSCs	**735**	**875**	**1,387**	**2,218**	**1,927**	**2,198**
Water supply companies	852	657	1,004	881	709	587
England & Wales	**1,587**	**1,532**	**2,391**	**3,099**	**2,636**	**2,785**

Figure 2: Post-privatisation water company disconnections (Waterfacts, 1995)

The concept of water poverty has become more prevalent since the banning of water company disconnections as a way of identifying consumers who struggle to pay water costs. Fitch and Price (2002) base their definition of water poverty on the government's threshold for "fuel poverty", as households who spend more than 10% of net income on fuel costs. Fitch and Price define households who spend more than 3% of net income on water costs as living in water poverty.

Importantly, this definition is not nationally adopted by the water companies, who are under no obligation to report these figures, and therefore water poverty estimates have been historically conducted irregularly by bodies like Ofwat, DEFRA and academics and others. Some studies include a 5% net income threshold instead of, or in addition to, the 3% threshold (Sylvester et al., 2023). However, this work will employ the 3% income threshold to define water poverty due to its widespread adoption in research and the notion that a 5% threshold would obscure the impact of high water costs on households (Lobina & Hall, 2008). Figure 3 collates a series of estimates for water poverty figures for the 30-year period between 1998 and 2018. The sources of these figures are listed in the Appendix.

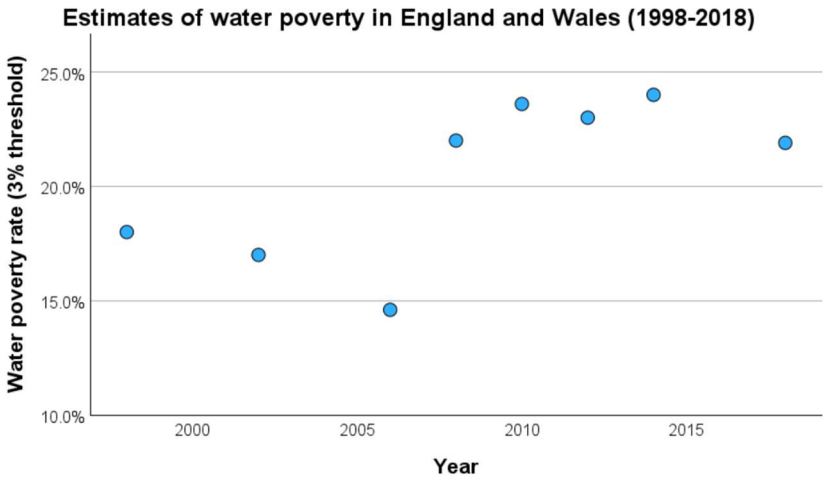

Figure 3: Various water poverty estimates in England and Wales (1998-2018)

Unfortunately, the actors involved in the provision of UK Water have been slow to adopt a unified measure of water poverty, and companies are not obligated to produce annual data on the

prevalence of water poverty. The adoption of a regular measurement of water poverty at a national and company-wide level would provide strong and necessary data to help tackle the issue in England and Wales (CEPA, 2021). Water company data is currently limited to households in water debt, or those assigned to social tariffs.

2024 and beyond

Last year saw the agreement of the 2024 price review (PR24) for the water companies in England and Wales, with the regulator Ofwat agreeing to the largest increase in water bills since privatisation, shown in Figure 4 (Ofwat, 2024). These increases are estimated to push a further 7.2% of households into water poverty by 2029-30 (Castro & Bradshaw, 2025).

These price rises are being justified as a way of increasing investment by £104 bn, as a way of modernising ageing infrastructure and mitigate problems with poor network capacity (Ofwat, 2024). These problems were discussed previously as a result of underinvestment, which has occurred despite periodic increases to water bills above inflation (Hall & Lobina, 2024). In fact, Yearwood (2018) demonstrates investment is 50% lower per household in England and Wales than in Scotland, where water is publicly owned, and similar price rises have not been experienced.

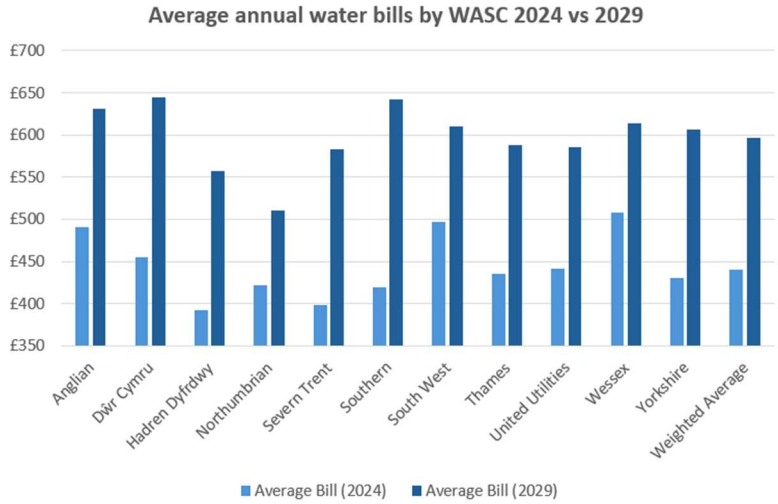

Figure 4: Increases in average annual water bills by water and sewerage company, 2024 vs 2029 (CCW, 2025)

These interrelated problems in English and Welsh water justify an exploration of the potential for alternative solutions to the funding of investment that do not hurt consumers. Hall & Gray (2025) suggests that a publicly owned mode of operation would better prioritise the needs of consumers and prevent excessive profiteering. Therefore, this research seeks to conduct a comparative analysis of potential water service reform in England and Wales, with an eye to learning from the alternative public utilities seen in 89% of the world's water systems (Hall & Lobina, 2008).

It is the hypothesis of this work that there is a direct link between the private ownership of water, which has led to the extraction of revenue as profit in the form of dividends, and the increase in water bill rates over this period. Historical quantitative and qualitative data will be employed to

explore the question of sustainable reform for water in England and Wales, employing the techniques of critical realist modelling outlined in the next section.

3. Background (Theoretical)

Lobina (2019) highlights the strong neoclassical ideology that was present in Thatcher's privatisation of the UK water system, inspired by economists like Littlechild (1978). He argues that these theories which promote privatisation practices preclude issues of distribution and are based on closed-system approaches to modelling.

It is a common critique of mainstream economic approaches from critical realist economists like Lawson (1998) who describe these approaches as engaging in little more than formalistic modelling that oftentimes excludes inconvenient data. We argue that this is less about the methodology itself and more about the approach of the researcher. Olsen (2012) cites that critical realist economists should be aware of observer bias, and we note that researcher awareness is important to let a grounding in data drive the conclusions, rather than the other way around.

Critical realist modelling in practice

The contributions devoted to applying the insights of Lee to heterodox modelling is a small subset of critical realist inquiry, and an even smaller portion of that explores the field of critical realist economics. Wilson (2021) employs the methodology of Fred Lee and linear regression and other more orthodox modelling techniques, with critical realist grounding in historical data, to develop an assessment of the factors impacting lead poisoning in children in Missouri. This is an important application of these techniques in critical realist modelling, although is less applicable to the field of economics being explored by this research. Meanwhile, Hasenberger (2024) explored local government financialisation by employing econometric methods, alongside additional qualitative techniques, to validate the existence of demi-regularities borne out by critical realist analysis.

Both researchers emphasise the care that must be taken with the employment of these techniques, alongside other forms of analysis. The importance of maintaining the critical realist "open system" approach, which acknowledges the complexity of interacting structures and inter-related mechanisms, is advocated by both researchers. They cite the econometric methods employed as useful ways of complementing critical realist analysis, towards a more holistic understanding of the phenomena being researched. Wilson and Hasenberger follow Lee's insights to demonstrate the utility of critical realist modelling. Our analysis in this work seeks to go further by developing the onto-ethical nexus and making it an explicit, rather than implicit, feature of critical realist modelling.

The position of researchers like Lawson (1998) argues that heterodox modelling is differentiated from the mainstream through methodology and argues that the failings in mainstream economics come from a formalistic devotion to unsuitable methods. However, other researchers have argued for the careful admissibility of these methods that contextualise causality inferred from them as conditional on modelling assumptions and subject to debate on omitted variables (Pratschke, 2003). We argue that there is no reason to be sceptical of the methodologies employed by more orthodox methods if appropriate historical grounding is utilised to contextualise the findings and if the work is oriented ethically towards emancipatory justice.

Based on the above, we define the following core aspects of our research as follows. Based on a strong historical understanding and grounded theory we can develop a holistic understanding of the behavioural possibilities of water governance actors In England and Wales. We engage in an open-system approach that considers the power relations that come into play from the actors in UK water governance, rather than considering them as isolated from these forces. We attempt to achieve complete representation of the small world by incorporating the above data and acknowledging the variability within potential future projections of the UK water sector. And finally, we emphasise that the deep engagement of the researcher, through the acknowledgement of the role of the government in setting the policy agenda, is necessary to qualify our conclusions.

The key distinction in our work from previous analysis is the expansion of Fred Lee's (2016) work on critical realist modelling to define an onto-ethical nexus that grounds the research orientation. This is not a focus of Lee's work, and Stevenson (2022) does not consider it in her outline of methodological considerations. Wilson (2021) does make clear that neoclassical economists in his field have methodologically excluded ethics from consideration when it comes to policy considerations for lead industry regulation. He argues that ethical motivations are essential to his research's goal. Our work aligns with this view, and we seek to expand on these principles to call for ethical considerations to become a formalised aspect of CR-GT modelling. We leave the implications of this to future work.
Our employment of these principles allows us to promote a vision of water governance which values the social sustainability and eudaimonic flourishing of public value that is described in Lawson's (2017) work on the UK National Health Service.

The admissibility of quantitative modelling

As this work aims to employ quantitative modelling in its attempt to achieve a holistic representation of water governance in England and Wales, we will attempt to demonstrate a distinction between the orthodox methods which employ these techniques, in the words of Lawson, formalistically, and our employment of these methods towards a more grounded and ethical orientation.

To provide an example, Porcher (2017) models the costs of public and private French water utilities and argues against previous research which suggests that private costs are higher on average (Chong et al., 2006). Porcher argues that this difference disappears when the "hidden costs" of water, based on the assumption that utilities will under-price output and go into debt to invest. This is a large assumption which goes unsubstantiated in the paper and illustrates an unethical tendency in the use of these models to presuppose conclusions. This signifies the importance of contextualising findings in historical data, identifying assumptions and limitations and an ethical orientation which underpins this kind of research.

We also seek to contrast our approach with modelling approaches employed by others who have attempted to define water poverty in England and Wales. The Cambridge Economic Policy Associates (CEPA) is a financial consulting business which was contracted by Water UK, the representative body for UK water companies, to conduct an estimation of the prevalence of water poverty in England and Wales (CEPA, 2021). In their work, CEPA's report clarified its research "is not to provide guidance on

policy options to address water poverty and we were not asked to model or analyse potential water poverty interventions or policies" (CEPA:7).

It is arguable that the motivation behind the report's purely theoretical exploration of water poverty is as an attempt by the water companies in the UK to fend-off calls for renationalisation. This has been done in other ways through the promotion of literature which provides a dramatic over-inflation of the costs of renationalisation at over £90bn (UK Parliament, 2025; Hall & Gray, 2025). We explore the motivation for the water companies and others later in this work but want to use this example to emphasise the importance of ethical grounding in our research. The nature of water poverty is a reality for at least 1 in 5 people in England and Wales, a figure which is certain to increase in the coming years, and research and policy which centres the social impacts of the public should be at the core of critical realist methodology (Castro & Bradshaw, 2025).

We claim in this work that the governance of water matters because the outline of the history we provide in this work demonstrates that it has a real-world impact on the lives of the public. This provides the basis for our ethical motivation to consider the problem of water poverty as a result of a variety of structural factors in England and Wales and employ a variety of methods to demonstrate this. This is the motivation for us to promote the explicit inclusion of the onto-ethical nexus in critical realist methodology. We argue that ontology can only take us so far and that, although all methods of research are limited, the employment of pluralistic research that is grounded in historical context and researcher engagement will provide empirical value towards our work.

4. Methodology

The aim of this work is to construct a model, based on critical realist principles, which accurately reflects the major actors in English and Welsh water governance, their structure, behaviours, motivations and objectives, and use this to describe historic trends since privatisation up to the present day. This model will be informed by strong historical grounding, complete representation of the defined world and a deep engagement with the topic from the researchers.

Significantly, this analysis focusses on incorporating an onto-ethical nexus into this form of critical realist modelling. As noted previously, this orients the work to consider social sustainability and the impact of governance systems and actors on the world through the systems and structures they contribute to. Social sustainability in this work is considered through the lens of water poverty, and the impact this has on societies into the long term. The work of exploring public services should be oriented towards the advancement of social goals, in the case of water this includes the universalisation of access, the human right to water and the creation of social flourishing. This fits with critical realism's place as a theory routed in emancipation.

The actors in question for this model include the UK government (through the Department for Environment, Food and Rural Affairs, DEFRA) alongside the 10 water and sewerage companies and the regulator OFWAT. Their historical actions will be outlined in detail to allow hypotheses to emerge surrounding their motivations and behaviour that fit with qualitative and quantitative data surrounding the water system in England and Wales. This will be combined with analysis surrounding the nature of private sector involvement in water, and historic examples of their activities and short-term economic prioritisations as defined by Lobina (2019).

This historical grounding will provide the researchers with a basis for a predictive comparative analysis surrounding the next 5 years of Ofwat's most recent price review period. This analysis will employ this critical realist historical modelling to project company behaviour into the next 5 years and be combined with econometric modelling to project relative changes to the water poverty rates by 2029-30 and a theoretical cost for eliminating it. This exercise will allow for a comparison with a similar hypothetical public sector comparator for the English and Welsh companies to evaluate the impact that ownership has on the current water system in England and Wales, relating to water poverty as an example of social sustainability.

Use of data

In order to achieve this modelling exercise, data on water bills and household incomes, as well as other broader societal factors, are required. Water bill data is publicly available as an average figure, with the projected increases to water bills in the UK shown in Figure 4. However, the reality of annual water bills exists in a distribution around this figure as a result of regional variation and water usage habits. In order to correct for this, the distribution of water bill rates is represented in intervals of £20 as a log-normal distribution around the average figure, as was demonstrated to be accurate to water company data in other analyses (CEPA, 2021). This representation of figures is given between £100 and £1200 annually for 2023-2024, which reflects essentially all consumer payments. This is expanded to between £100 and £1400 in 2029-30 as a result of water bill increases skewing this distribution. Figure 5 shows the distribution for the water bill values in 2023-24.

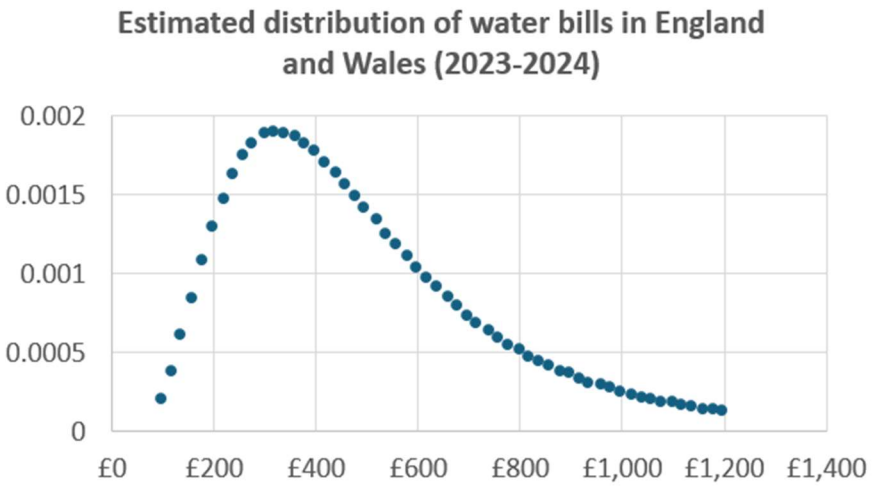

Figure 5: Estimated distribution of annual water bills in England and Wales (2023-2024)

Econometric forecasting will employ the data from Ofwat's (2024) price review (CCW, 2025), alongside projected increases in household income to allow for a calculation of water bills as a percentage of income for a representative sample of households, using a similar method employed by Castro & Bradshaw (2025) in their estimations for water poverty projections in England and Wales. Thousands of these iterations will be employed in order to achieve a representative value. Net household income data will be determined based on a representative sample extrapolated from the most recent year of the Department for Work and Pension's (DWP's) family resources survey

(DWP, 2025 & Figure 6) and projected into the future based on data from the Office for Budget Responsibility, OBR (OBR, 2025).

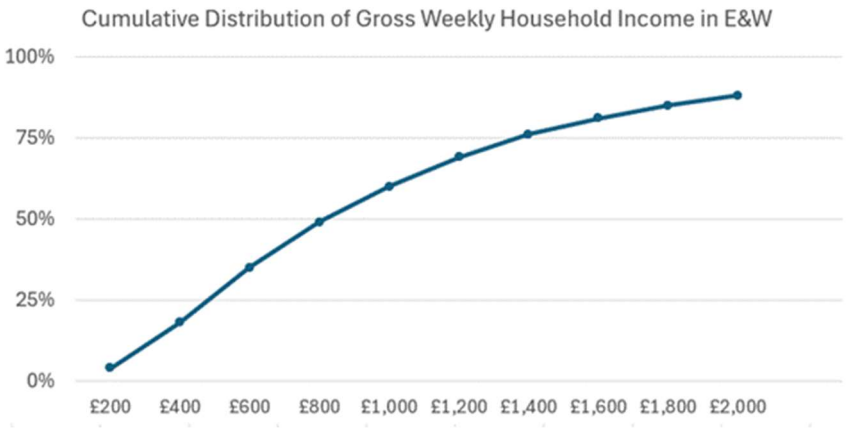

Figure 6: Cumulative distribution of gross weekly household income in England and Wales (2023-2024), based on data from the DWP Family Resources Survey

Finally, the core aspect of this work is the exploration of the dimension of ownership in water bill costs and water poverty through the inclusion of a public sector comparator. This comparator will provide an approach that can estimate the additional costs to consumers of water privatisation as a result of the projected increases mentioned earlier (Lobina, 2018).

To ensure the model in this research is accurate and maintains a conservative set of estimations to avoid straining predictive capability, the public sector comparator will be defined with minimal structural changes to the current English and Welsh water companies that might be expected under a longer-term transition to public ownership. Such structural similarities are also defined in reference to Scottish Water, a public sector company in operation within the UK which has similar scope to the companies in England and Wales (Hall & Gray, 2025). It can be assumed that the employment of a model based on international best practice could find additional redistributive savings in the form of green infrastructure or company restructuring that could further benefit consumers (Lobina et al., 2019).

Additionally, this research assumes that public ownership could be legislated immediately and without litigation (see UK legislative instruments, 2024). There are a number of scenarios for the achievement of this which would be up to the discretion of the UK Government. The procedure of special administration is considered in the most detailed projections in the next section, however under any scenario there would be over £3 bn in annual savings as a result of the transition to public ownership by any reasonable estimation (Hall & Gray, 2025).

The public companies will be defined as equivalent in operation to the current companies under the following specifications:

- Current estimations for increased infrastructure investment will be maintained to avoid distinction on the impact of investment on efficiency savings.
- Current estimations for operational and capital expenditure will be maintained.
- Water company dividend payments will be eliminated under the public comparator, resulting in savings to be applied as a reduction in customer bills.

- Water company financial costs on future expenditure will be cheaper under the public comparator, as a result of lower government interest rates (8% in Scotland compared to 35% in England and Wales), resulting in savings to be applied as a reduction in customer bills.

5. Findings

The following section outlines a critical realist model which seeks to represent the structures and mechanisms inherent to the water governance in England and Wales. These categories are grounded in historical data and qualitative behavioural understanding of the actors in the water governance system. This work seeks to accurately represent how these features relate to water pricing and result in socio-economic impacts to the wider population as a direct result of the motivations embedded into the system at the outset of privatisation.

Structures and mechanisms of water governance in England and Wales

The core mechanistic facet of English and Welsh water governance outlined in this research is that the water governance structure in England and Wales is one that promotes the realisation of short-term financialised gains over long-term social and economic sustainability until this becomes politically unsustainable (Lobina, 2019).

This is borne out of both data on water poverty, which will be explored subsequently, as well as a historical analysis of the actors in English and Welsh water governance. These will be outlined here in turn.

Water and sewerage companies

The 10 WASCs in England and Wales were brought into existence alongside a wave of subsequent privatisations in other sectors. The rationale for these privatisations is similar to that espoused by Austrian economists and others on grounds of private sector efficiency (Lobina, 2019). The profitability of these companies was seen as a major factor from the outset, with over £7bn of tax relief provided to them in the form of debt write-offs and a green dowry upon privatisation (Hall & Lobina, 2008).

Figures 7 and 8, as well as the disconnection increases in Figure 2, illustrate the reality of prioritisation under the private companies and the motivations they bring into their role. Prices increased at an unprecedented rate, the number of disconnections skyrocketed, until the practice was banned, and dividend payments totaled over £70bn in the 35 years since privatisation (Hall & Gray, 2025).

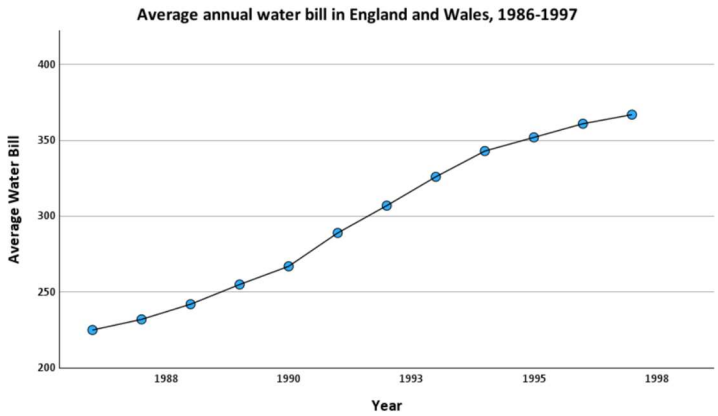

Figure 7: Increase in water prices 1985-1995 (Waterfacts, 1995; NIC, 2025)

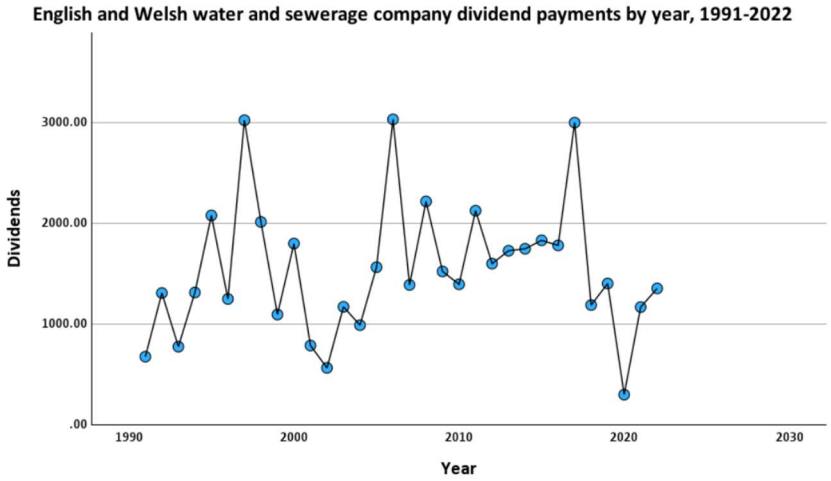

Figure 8: Historical dividend payouts from English and Welsh WASCs (figures in £m) (1990-2024)

The company role in this process comes through the submission of investment plans to Ofwat, which are subject to negotiation. This process has been described as being subject to company "gaming", where companies are able to over-estimate investment expenditure in their plans which are then realised as "efficiency savings (Lobina & Hall, 2024).

This data clearly outlines that the motivations of the water companies themselves share the short-term and self-destructive behaviours common to private sector water operators (Lobina, 2018). This supports the mechanism defined above that the water governance system values these factors over the social objectives that are valued and prioritised within well designed public water systems.

Ofwat

The data outlined above showcases that Ofwat is also complicit in the systemic failings in English and Welsh water governance through their agreement of the increases to water prices and dividends that have been experienced under the private system. Ofwat is nominally responsible for consumer protection in the agreement of these bills, however the historic increases in water bills alongside low investment expenditure in comparison to similar systems seem to preclude this (Yearwood, 2018; Figure 9).

Ofwat's aims to promote economic efficiency in the short term, and the perpetuation of privatisation, are valued over social objectives. A key argument perpetuated in this cycle is the promotion of the private sector to ensure efficiencies in the system (Hall & Lobina, 2008). This is seen as a motivating factor for the water companies and allows them to seek savings with a goal towards maximising the profit they can make from the service. However, this by definition precludes consumers from these benefits, and it is a feature which illustrates the ethical wedding of the regulator to short-term efficiencies, rather than social good.

UK Government

The UK Government's role, through the Department for Environment, Food and Rural Affairs, is slightly more complex. The government is the actor most strongly impacted by public pressure and has acted in that interest when no alternatives are available, although the perpetuation of this model of ownership suggests that the government has implicitly accepted a hands-off approach to water governance. Figure 9 illustrates this hypothesis.

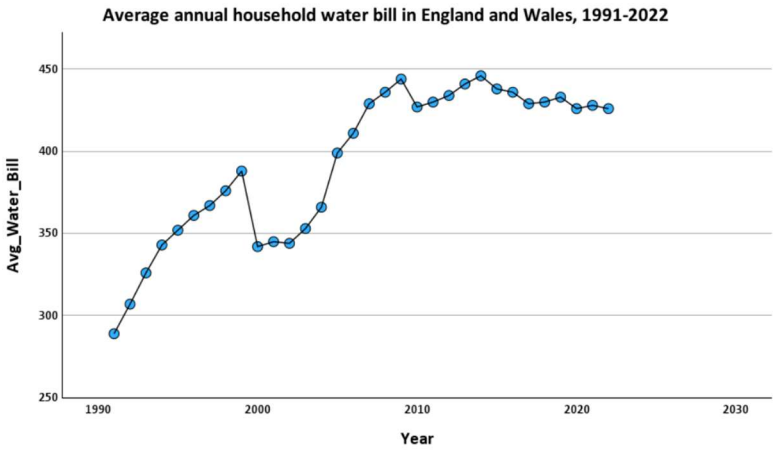

Figure 9: Average annual household water bill in England and Wales (1991-2022)

The drop in water prices in 1999 was achieved by the newly elected Labour government alongside the banning of water company disconnections (Hall & Lobina, 2008). This mandated drop in water prices was shown to have a real impact on water poverty, which decreased from 18% to 14.6% by 2006 (Fitch & Price, 2002; Snell & Bradshaw, 2006). However, water prices rose dramatically following this and no comparable action has been taken since, demonstrating a broadly hands-off approach on behalf of the UK government. Water prices have, however, held steady in the last decade, which came as a result of the Walker Review into the sector and subsequent discussion of affordability issues in England and Wales (Sylvester et al., 2023).

This demonstrates that the UK government can have the capability of enacting mechanisms which limit the short-termism present in the companies and Ofwat. When public pressure is also a factor, the examples in the late 1990s and early 2000s show that action can be taken at the national government level which promotes public good. However, this mechanism is historically an exception to the rule and only serves to mitigate the most unsustainable appetites of the other actors. Indeed, the current increase in water prices, despite public outcry, demonstrates that this mechanism is not always employed by the government.

Water Poverty

As noted above, the current price increases in water bills for England and Wales, shown in Figure 4, illustrate a lack of social prioritisation in the water governance system. Water poverty is a core mechanism of the current water governance system, although it certainly does not have to be. This is a result of prioritisation- as solutions to help alleviate this problem have been proposed repeatedly since privatisation (Fitch & Price, 2002; Castro & Bradshaw, 2025). It is presently still a core mechanism, with the announced price rises estimated to push a further 7.2% of households into water poverty by 2029-30 (Castro & Bradshaw, 2025) and minimal action on behalf of the water governance actors is being proposed to alleviate these impacts (Ofwat, 2024).

This next section constitutes a comparative analysis of the picture of water poverty in 2029-30 under the current system of governance, contrasted with a hypothetical public model which could make decisions and reinvestments to alleviate decision-making that is harmful, unethical and socially unsustainable.

This paper categorises changes to water poverty in England and Wales as primarily impacted by changes to water bill rates, although a number of other social factors contribute to this. Further, this research evidences that increases to water bills as borne out by dividend payments and other private sector pressures, as outlined by Yearwood (2018). This correlation is demonstrated in Figures 10 and 11, which outline the relationship between dividends and water bills, and water bills and water poverty respectively.

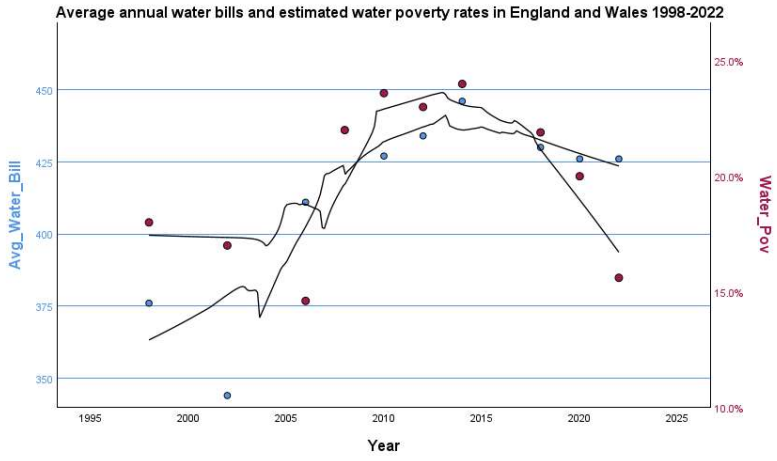

Figure 10: Average annual water bill vs. water poverty estimates in England and Wales (figures from Ofwat and the National Infrastructure Commission)

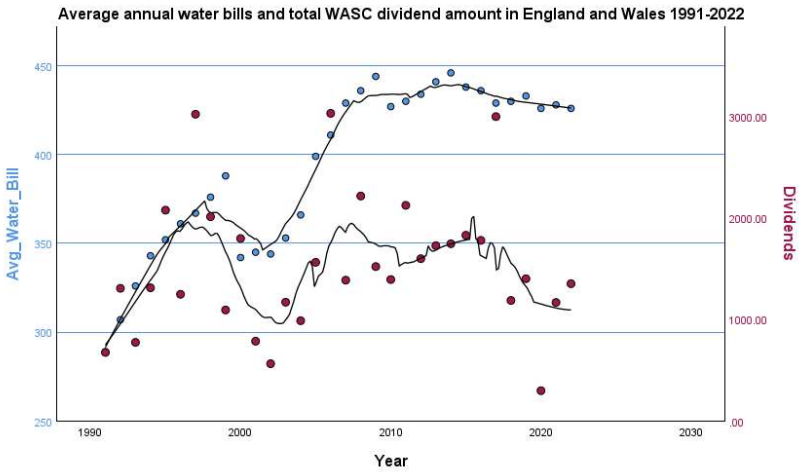

Figure 11: Average water bills in England and Wales vs. dividend payments by companies (Ofwat, 2024)

Importantly, the data in these figures is analysed using linear regression and other statistical methods to establish probable causation, while incorporating the impact other factors that contribute to water poverty. Namely, Figure 10's analysis incorporates changes in regular poverty and household income, allowing for a clear analysis of the impacts of the private sector mechanisms being explored. Historic increases in water bills are demonstrated to have a clear correlation with increased water poverty, with a t-test value expressing 80% confidence in this hypothesis. This provides a basis for exploring private ownership as a driver of higher water bills and consequently higher water poverty.

Additionally, Figure 11's analysis of the relationship between dividends and water bills explores the significance of operational expenditure, capital expenditure and changes to RPI on the changes to water bills that companies charge. This analysis shows that dividends are historically the strongest positive correlator in increases to water bills and t-test results express a 70% confidence in this hypothesis. The econometric analyses of these variables are present in more detail in the Appendix.

In summary, based on the historical pressures outlined above and the data shown here, we demonstrate the existence of the mechanism of privatisation which manifests through a pushing-up of water bills through dividends and other costs, that results in increases to water bills, and by extension water poverty rates (Yearwood, 2018; Hall & Gray, 2025). This mechanism is not considered by the actors in English and Welsh water governance due to their vested interest in the promotion of the privatisation model.

Comparative analysis and projection

The specifications for a public sector comparator outlined in the methodology result in savings of £5.8bn annually based on methodology outlined by Hall & Gray (2025). These savings can be employed to give an average annual reduction in water bill rates for consumers, relative to the price increases by 2029-30, specified in Table 1. It is worth emphasising that the estimations in this research are conservative and do not consider additional changes to the mode of operation under public ownership which could offer additional savings to the companies in the longer term, as has occurred in remunicipalised water utilities like Paris (Lobina et al., 2019)

Table 1: Projected changes to average water bills in 2029-30

Year and Mode of Operation	Average Annual Water Bill
2023-2024 (CCW 2025, private)	£443
2029-30 (projection, private)	£597
2029-30 (projection, public)	£447

The second set of findings in this work explore the future bill increases, their impact on water poverty and the potential of public ownership to mitigate this increase. By using data on household income and water bills, a series of over 4,000 income-bill data comparisons resulted in a baseline water poverty figure for 2023-2024 of 17.77% of households. These calculations are then extrapolated to 2029-30 with changes to income based on OBR (2025) projections, and the assumption of other economic factors not deviating. The data for these pairings is shown in Table 2, and the final results of the calculations are shown in Table 3.

Table 2: Results of bill-income comparisons

Year and Mode of Operation	Total number of iterations	Average bill-income ratio
2023-2024 (projection, private)	4,126	2.28%
2029-30 (projection, private)	4,126	2.89%
2029-30 (projection, public)	4,099	2.48%

Table 3: Water poverty projections for 2029-30

Year and Mode of Operation	Estimated water poverty rate
2023-2024 (projection, private)	17.77%
2029-30 (projection, private)	24.77%
2029-30 (projection, public)	17.93%

These projections assume other societal factors are equal and caution should be taken in assuming a direct predictive capability in these estimations. The core emphasis of these results is the relative distinction between the public and private figures of a 7.8% increase in the number of households experiencing water poverty based on these estimations by 2029-30.

Based on these projections, as was calculated by Castro & Bradshaw (2025) a theoretical figure for the water poverty gap can be calculated. This figure is a purely theoretical minimum cost to eliminate water poverty by lowering bills for all consumers below the 3% threshold for water poverty. This methodology has little real-world application and is based on perfect targeting, however it is a useful comparative exercise between the two ownership scenarios. Using the

projections above we calculate the theoretical cost to eliminate water poverty under the private and public comparator scenarios in Table 4.

Table 4: Water poverty threshold under two ownership scenarios in 2029-30

Year and Mode of Operation	Median gap per water poor household	Number of Households Impacted	Cost to eliminate water poverty for all households
2029-30 (projection, private)	£288.15	6,150,400	£1,772 m
2029-30 (projection, public)	£344.09	4,439,200	£1,527 m

These projections illustrate that the cost to eliminate water poverty in the year 2029-30 would be roughly £245m cheaper under the public sector comparator than the private sector comparator. The estimation for a median household water poverty gap for the private sector aligns with Castro and Bradshaw's (2025) median figure of £313. The estimation is much higher than CEPA's (2021) figure of a £720m water poverty threshold, which was given for 2020 data before the Ofwat (2024) price increases.

6. Implications (Practical)

This research uses a critical realist model to explain the motivations behind the actors in the English and Welsh water system and their impact on wider society. The model employs a grounding in historical data to illustrate that the perpetuation of the private system of ownership has resulted in a neglect of social sustainability in the advancement of short-term profitability. We argue that the social costs of privatisation have been exacerbated by historical practices of price rises, which have been sought in the promotion of private profit through dividend payments, as well as the additional costs to the private sector of investment and borrowing. These points are illustrated through the analysis of historical data, elaboration on the behavioural motivations of the actors in English and Welsh water governance and the projection of current trends onto the future trajectory of water poverty.

The mechanisms and structures which underpin these trends were further validated through a forecasting exercise that sought to establish the additional social cost that is burdened onto consumers through Ofwat's decision to increase prices for consumers at the highest level since privatisation (Ofwat, 2024). In the achievement of this modelling exercise, a clear distinction is established between the relative water poverty rates under the current private mode of operation, and a public sector comparator based on Scottish Water. We project that water poverty will affect an additional 7.8% of households by 2029-30 based on current agreed increases in water bills, in comparison to an alternative comparator scenario which reduces customer bills (while maintaining investment) through eliminating the inflated costs of privatisation. Further, these projections estimate that the cost to eliminate water poverty in the year 2029-30 would be roughly £245m cheaper under the public sector comparator than the private sector comparator. This proves the

significance of ownership reform on water in England and Wales and suggests that the prioritisation of the water system is currently not oriented towards consumer protection.

The estimates for water poverty produced by this methodology a define a water poverty baseline of 17.7% in 2023-2024, in line with estimates from 2022 (15.6%), 2021 (17.6%) and 2018 (21.9%) (15.6%), 2021 (17.6%) and 2020 (21%) (Castro & Bradshaw, 2023; CEPA, 2021; Bradshaw & Keung). However, the aim of this research is not to predict an absolute value for water poverty in England and Wales. It is, instead, to determine the relative impact of bill changes to water poverty figures, which can be accurately estimated by this method of analysis, as shown by the correlation with this research's estimate of the increase in water poverty (7.8%) with the estimate of Castro & Bradshaw (2025) of 7.2%.

The modelling in this paper, as previously noted, is a conservative estimation based on a controlled projection of bill data and the prevalence of a similar water company structure to present. There is the potential that the achievement of public ownership could lead to further improvements to the sector including the potential of saving from green infrastructure, additional efficiencies in operation, or the potential exploration of expanded social tariffs which have been neglected by the current water companies (Castro & Bradshaw, 2025). The potential of international best-practice in public water management to inform new public water companies in England and Wales could have stronger implications for such reform, as has been seen in Paris and other utilities which, following water remunicipalisation, have become some of the strongest examples of good public sector management (Lobina et al., 2019).

To summarise, the results of this modelling lend support to this paper's argument that privatisation has historically had a large impact on the level of water bill increase in England and Wales. Furthermore, it identifies that the impact of price rises could be mitigated by public ownership of water, and the employment of savings to reduce consumer bills by maintaining investment levels. This research demonstrates the importance of ethical considerations and historical grounding in the consideration of policy outcomes in the water sector. The clear conclusion is that water ownership reform should be considered by the UK government to ensure that consumers are prioritised into the future and allow for the promotion of eudaimonia, or social flourishing, with a public system that values the promotion of public good. This opens the door for further research to explore the water system's investment and sewage mitigation practices to explore the additional social costs which have been neglected under the private water system in England and Wales.

7. Implications (Theoretical)

This research attempts to expand upon the work of Fred Lee (2016) to argue for the recognition of the role of the onto-ethical nexus in the design of critical realist modelling. In this nexus we have defined social ontological inquiry that is there for the purposes of explanation, and in order to achieve this one has to employ historical grounding, supported by deep researcher engagement with a topic and an attempt at complete representation of the small world being modelled. In this nexus, ethics plays a double-role. The first of these is of an orientation of economic and social inquiry, applied to the alleviation of social ills, in this case represented by the social unsustainability of current water governance practices in England and Wales, defined in relation to water poverty. The second role is that of informing the design of the modeling exercise as a way of revealing the real-

world social costs of the policy that is being modeled. Here, illumination is not functional to explanation but rather to prescription. More precisely, this is a prescription oriented towards eudaimonia for individual and collective emancipation. For example, an ethical modeler will be more concerned about the social usefulness of the results revealed by the model, rather than allegiance to methodological imperialism or the display of the modeler's own prowess. The alleviation of water poverty, for example, is one of the preconditions of eudaimonia. This should never be sidelined by ulterior motives.

Once these preconditions are met, we believe that critical realist modeling becomes as legitimate an attempt to approximate the truth as any other methodological exercise: qualitative, quantitative or mixed. This, in the certainty, that all methods are imperfect and knowing represents the proverbial silver bullet. Indeed, the realisation of methodological limitations of all kinds helps us turn the gaze to the importance of the debate, rather than waiting for white knights that are unlikely to appear on the horizon.

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9. Appendix

Table 5: Water poverty estimation data, based on Sylvester et al. (2023)

Year	Estimated Water Poverty Rate	Source
1998	18.0%	DEFRA (1998)
2002	17.0%	Fitch & Price (2002)
2006	14.6%	Snell & Bradshaw (2006)
2008	22.0%	DEFRA (2013)
2010	23.6%	Bradshaw & Huby (2013)
2012	23.0%	DEFRA (2013)

2014	24.0%	NEA (2019)
2018	21.9%	Bradshaw & Keung (2020)
2019	17.9%	CEPA (2021)
2020	>20%	Water UK (2020)
2022	15.6%	Castro & Bradshaw (2023)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.760[a]	.578	.240	3.0071%

a. Predictors: (Constant), RPI, Relative_Low_Income_Households, Avg_Water_Bill, Avg_Income

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61.867	4	15.467	1.710	.283[b]
	Residual	45.214	5	9.043		
	Total	107.081	9			

a. Dependent Variable: Water_Pov

b. Predictors: (Constant), RPI, Relative_Low_Income_Households, Avg_Water_Bill, Avg_Income

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	12.083	51.224		.236	.823
	Avg_Water_Bill	.089	.043	.811	2.041	.097
	Relative_Low_Income_Households	-.630	1.599	-.196	-.394	.710
	Avg_Income	-.001	.001	-.379	-.664	.536
	RPI	-.503	.372	-.418	-1.350	.235

a. Dependent Variable: Water_Pov

Figure 12: Linear regression analysis of water poverty and water bills in England and Wales

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.607[a]	.368	.274	39.151

a. Predictors: (Constant), CapEx, OpEx, Dividends, RPI

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24090.497	4	6022.624	3.929	.012[b]
	Residual	41386.378	27	1532.829		
	Total	65476.875	31			

a. Dependent Variable: Avg_Water_Bill

b. Predictors: (Constant), CapEx, OpEx, Dividends, RPI

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	568.713	103.506		5.494	<.001
	RPI	-.431	3.915	-.019	-.110	.913
	Dividends	.016	.011	.226	1.445	.160
	OpEx	-.046	.014	-.505	-3.238	.003
	CapEx	.009	.010	.148	.879	.387

a. Dependent Variable: Avg_Water_Bill

Figure 13: Linear regression analysis of water bills and dividend payments in England and Wales bill rates.

Correlations

		Avg_Water_Bill	Water_Pov
Avg_Water_Bill	Pearson Correlation	1	.571
	Sig. (2-tailed)		.085
	N	32	10
Water_Pov	Pearson Correlation	.571	1
	Sig. (2-tailed)	.085	
	N	10	10

Figure 14: Pearson correlation of water bill and water poverty rates in England and Wales