Indexation of future price controls in the water sector

Water 2020 programme

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As part of the Water 2020 programme which considers the regulatory framework for wholesale markets for the PR19 price review in the water and sewerage sector, Ofwat, the industry regulator in England and Wales, is reviewing the appropriate inflation statistic to use in indexing future price controls.

Historically, most regulated sectors in the UK, including the water sector, have used the retail price index (RPI) to set the annual increase in allowed revenues or prices. In recent years, some regulators have started to move away from RPI in favour of the consumer price index (CPI) for the indexation of prices.

At this stage, Ofwat is the first regulator to consider changes to the indexation of both revenues (the 'inflation - X' price control mechanism) and the regulatory capital value (RCV).

The need for change has largely been prompted by the debate about the appropriateness of RPI as a measure of inflation. In particular, the Johnson review, published in early 2015 by the UK Statistics Authority (UKSA), urges regulators and other public bodies to aim to discontinue the use of RPI and to rely on more internationally accepted statistics.[1]

In place of RPI, the Johnson review recommends that the 'ONS should move towards making CPIH its main measure of inflation. In the meantime, the CPI should continue to be the main measure of inflation.'[2]

To support further work that Ofwat is undertaking in this area ahead of its publication in May 2016, Ofwat has commissioned Oxera to consider the potential benefits and costs of different options for change.

In this report, we consider several options, ranging from no change, a change to the indexation of revenues only, a change to the indexation of both revenues and RCV, and options which involve different proportions of the RCV continuing to be linked to RPI. Given the uncertainty around the final UKSA decision regarding the status of CPIH, we consider both CPI and CPIH as potential candidates to replace RPI.

All else being equal, changing the way revenues are indexed should have no impact on the forecast revenues (and hence forecast level of customer bills). However, options that involve a change to the indexation of the RCV will have an effect on the forecast profile of revenues (and bills), given the mechanics of the regulatory framework.

Options that involve a change to the indexation of the RCV to an inflation statistic that tends to have a lower value than RPI, such as CPI or CPIH, will, without any mitigating action, lead to an increase in bills in the short and medium term which will be offset—in net present value (NPV) terms—by lower bills in the longer term. The size of the short term bill increase will depend on how much of the RCV is indexed to CPI (or CPIH) versus RPI—the more of the RCV is switched to CPI (or CPIH), the bigger the bill impact. However, we note that Ofwat has suggested that companies may need to explore options for smoothing the bill impacts through other regulatory levers. These levers include the proportion of

[1] The UKSA has issued a further consultation on the issues with the final recommendations on the appropriate consumer inflation measures to be published in the first half of 2016.
[2] Johnson, P. (2015), 'UK Consumer Price Statistics: A Review', January, Executive Summary, p. 16.

expenditure that is reimbursed as pay-as-you-go (PAYG) and the speed of depreciation of the RCV (run-off rates).

We assess the options against a range of criteria. Our conclusions on each criterion are as follows.

Legitimacy of the inflation statistic

Overall, we find that RPI is calculated using a statistically flawed method, has been discontinued as a 'national statistic', and generally results in an 'upwardly biased' measure of consumer inflation. It is therefore appropriate to phase RPI out of the price control framework. Suitable alternatives include CPI and CPIH (pending the UKSA decision on CPIH).

Currently, CPI scores better as an alternative. If the government were to adopt CPIH as its primary measure of inflation (as per the Johnson review), CPIH might emerge as the preferred inflation statistic. However, at this stage this is uncertain.

Overall, all of the options that involve moving away from RPI could bring benefits to consumers, insofar as the legitimacy of the inflation metric is improved. Given the identified issues with RPI as an inflation statistic, options that involve faster transition of the RCV to CPI (or CPIH) indexation might be preferable.

'Fairness' of consumer bills

On the one hand, current levels of water and wastewater bills have been established as reasonable over time and therefore might be perceived to be fair. On the other hand, if some indexation options imply a change to the level and profile of bills that helps to improve the cost-reflectivity of tariffs, such change could bring bills closer to their fair level.

This suggests that some change in bills might be justifiable, if phased in gradually without prompting an undue adverse response from consumers. Overall, this would support options that involve changes to the indexation of the RCV, but a specific desirable speed of adjustment is difficult to establish.

Volatility of consumer bills

There is qualitative evidence that consumers prefer smooth bill profiles. To the extent that CPI (and CPIH) both tend to be less volatile than RPI, all of the options that involve a change to revenue indexation away from RPI to either CPI or CPIH are likely to benefit consumers in this regard.

Impact on operational risk

If one inflation statistic better reflects the underlying movements in companies' cash costs (OPEX and CAPEX), indexing revenues to that statistic might lower the operational risk faced by the companies.

Statistically, there has been limited (if any) correlation between historical movements in RPI, CPI, CPIH and water companies' costs. This does not imply that, in the long run, costs are not subject to inflationary pressure, but highlights the difficulty of unpicking the influence of other factors on year-to-year movements in costs. For example, we find that both RPI and CPI are positively correlated with long-term earnings in the economy, which are likely to influence water companies' labour costs (their biggest expenditure item).

Further, there might also be a circularity between the regulator's choice of inflation index and how costs move over time. For example, if a regulator switches to using CPI, this might give companies an incentive to transfer any existing RPI-linked cost contracts to CPI-linked ones. Additionally, RPI is continuing to fall out of use by government departments which may also affect the relationship between the industry costs and the underlying indices going forward. For example, it was announced in the 2016 Budget that business rates would be indexed to CPI rather than RPI from April 2020.[3]

Overall, there is no clear evidence that the industry's operational risk will materially change under any of the indexation options considered. Given that there is no stronger link between RPI and companies' cost movements compared with the other indices (CPI or CPIH), there is no clear cost or benefit to the industry/consumers from moving away from RPI.

Impact on financing costs

A useful measure of risk faced by all investors in a firm in aggregate is the volatility of the enterprise value. Changes in risk to the value of the firm could translate into changes in the rates of return required by investors. This could subsequently translate into a cost or benefit to consumers.

Based on a range of reasonable assumptions for the volatility and correlation of different inflation statistics, we consider volatility of the enterprise value of a water company experienced as a result of deviations in the outturn RPI and CPI relative to forecast. We do this on a forward-looking basis.

Our analysis suggests that, first, inflation uncertainty drives only a small proportion of the overall volatility of firm value.

Second, any option for change that involves some transition for the indexation of the RCV does not increase this volatility.

If anything, nominal volatility is reduced in almost all cases. CPI is less volatile than RPI, and therefore a switch to CPI reduces the volatility of firm value. This result holds for a range of notional capital structures considered, even including financing structures that include a substantial proportion of RPI-linked debt.[4]

There is also no assumption that existing RPI-linked debt needs to be refinanced as a result of any change. Since there is no material change in the volatility of firm value, there is unlikely to be any change to the firm's ability to service existing RPI-linked liabilities—hence, there is no obvious rationale for refinancing these liabilities early.

We therefore conclude that there is unlikely to be a material, robustly quantifiable impact on the industry's risk (and hence financing costs) under any of the options for change considered.

Our assessment is performed for the value of the firm in aggregate. We note that the impact may be felt differently by different groups of debt/equity investors.

In assessing the implications of change in the regulatory framework for risk and required returns, it is arguably the aggregate impact that is most relevant. Explicit recognition of a potential increase in risk for one specific investor group in allowed financing costs would need strong justification and evidence. Further, if consideration is given to one group of investors that may face higher risk, then

[3] HM Treasury (2016), 'Budget 2016', March.
[4] As high as 62.5% of the RCV.

similar considerations need to be given to other investor groups, some of which may face lower risk.

Given that, in aggregate, risk is not increasing and there is a market for equity and debt finance in the sector, it is unlikely to be in consumers' interests for the indexation choice to be unduly influenced by the needs of one specific investor group.

Further considerations on financing costs

In assessing the potential benefits and costs of different indexation options, it is not evident that there is a need for Ofwat to demonstrate that a sufficiently liquid CPI-linked debt market exists.

Inflation indexation of revenues and the RCV was not originally motivated by a desire to accommodate particular financing options. Further, Ofwat's existing framework for the assessment of the allowed cost of debt for the industry primarily relies on evidence from nominal debt markets.

Notwithstanding these observations, and the earlier conclusion that there is unlikely to be any change in risk and financing costs, we understand that the industry is concerned about the potential availability and cost of CPI-linked products.

We find that the CPI-linked debt market is currently in its infancy, with the absence of a government CPI-linked bond market being a key driver of this. Predicting the costs and speed of development of such markets is difficult.

On the one hand, it is conceivable that, at least initially, CPI-linked products will be more expensive than other debt instruments currently available to the industry. On the other hand, there are other drivers, such as growing pension fund demand for CPI-linked assets, that could help to unlock a competitive CPI-linked market more rapidly than has been observed historically for other nascent financial instruments.

Overall, these observations also do not suggest material changes to the financing costs of the industry under any of the indexation options considered.

Impact on financeability

All else being equal, any option for change that involves changes to the indexation of the RCV is likely to improve financial credit ratios in the short to medium term, since cash flows will be brought forward. This assumes that the NPV-neutrality of any proposed change is preserved and that no offsetting changes to the revenue profile are made. If offsetting changes are made (e.g. through the use of PAYG levers and run-off rates), at worst, there will be no change to the forecast credit metrics (assuming no material changes to the rating agencies' methodologies).

Assessing the longer-term impact of any proposed change on financeability is more uncertain. However, at this stage there is unlikely to be any obvious benefit or cost to consumers under any of the options considered.

Impact on perceptions of regulatory risk

RPI indexation of price controls and the RCV has been a long standing element of the regulatory framework. Many stakeholders have expressed concerns that a change to the indexation of the RCV may create downward pressure on Ofwat's assessment of allowed returns and/or allowed costs which may not be justified

or occur in the absence of any change. Also, while any changes to cash-flow profiles could be offset by use of financeability levers, there are concerns that adjustments to cash-flow profiles through the use of PAYG levers or run-off rates are less transparent and predictable than the well-established RCV indexation mechanism. Specifically, the final choices of PAYG/run-off rates are subject to greater discretion by Ofwat.

There seems to be general acceptance that some change to the indexation of price controls is warranted. However, the key concern is around the pace of change to the indexation of the RCV.

This suggests that, all else being equal, options that involve changes to the existing RCV are more likely to increase perceptions of regulatory risk than the other options considered.

However, the more clarity and transparency Ofwat can provide on how the NPV-neutrality commitment will be achieved in practice, the more these concerns are likely to be alleviated. Changes to the regulatory framework can affect the perceived risk of a regulated sector. However, Ofwat's track record of regulating the sector should provide reassurance that any change will be implemented and managed in a reasonable way.

Overall, it is not clear that the concerns raised should translate into a cost to companies (and therefore a cost that needs to be passed on to consumers) under any of the options considered.

Summary

Overall, on the basis of the various criteria considered, there is a clear case to change the basis of revenue indexation away from RPI. There are also good reasons to change the basis of the RCV indexation. This would reduce the reliance of regulation on an inflation statistic that is gradually falling out of use, is statistically flawed (leading to an upwardly biased measure of inflation) and inherently more volatile. In turn, this is likely to increase the legitimacy of the regulatory framework and reduce volatility of bills.

As regards the choice between CPI and CPIH, at this stage, CPI emerges as the preferred statistic of the two. However, if the UKSA decision favours the use of CPIH as the headline measure of inflation, this assessment may need to be revisited.

From a pure operational and financial risk perspective, for the industry on average, there is no strong rationale for taking a phased approach to transitioning the indexation of the RCV away from RPI to a different metric such as CPI. In other words, there is no evidence that financing costs would go up to the industry if a switch to a different inflation statistic is implemented in full for both revenues and the RCV, resulting in a cost to consumers.

However, we are mindful of the potential bill impact of a fast transition, and the impact that this appears to have on the perceived credibility of Ofwat's NPV-neutrality commitment. Therefore, on balance, there is a credible case for some form of transition of the RCV indexation.

The desirable speed of transition may depend on the extent to which Ofwat and the industry can work together to alleviate some of the existing concerns about the NPV-neutrality of the proposed changes, and on the emerging bill profiles (taking into account other factors affecting forecast revenues for the next regulatory period).

1 Introduction

As part of the Water 2020 programme which considers the regulatory framework for wholesale markets for the PR19 price review in the water and sewerage sector, Ofwat, the industry regulator in England and Wales, is reviewing the appropriate inflation statistic to use in indexing future price controls in the sector.

In January 2015, the UK Statistics Authority (UKSA) published an independent review of consumer price statistics, led by Paul Johnson, Director of the Institute for Fiscal Studies.[5] The review was commissioned to consider what changes are needed to the range of consumer price statistics. The review followed previous conclusions that the current approach to calculating the retail price index (RPI), the UK's longest-running measure of consumer price inflation, fails to meet international standards.[6] Specifically, the way in which prices are averaged to derive the RPI is statistically flawed and can result in an upward bias in recorded inflation.

The Johnson review urges regulators and other public bodies to discontinue the use of RPI and to rely on more internationally accepted statistics:[7]

> Government and regulators should work towards ending the use of the RPI as soon as practicable. Where they decide to keep using it the UK Statistics Authority should ask them to set out clearly and publicly their reasons for doing so.

In place of RPI, the Johnson review recommends that the 'ONS should move towards making CPIH its main measure of inflation. In the meantime, the CPI should continue to be the main measure of inflation.'[8]

The CPI (consumer price index) is currently the headline measure of inflation and one that is used by the Bank of England as the inflation target. The CPIH is a variant of CPI that includes housing costs. However, there remain concerns about the processing of private rents data, which feeds into the housing costs component of CPIH. These concerns need to be addressed before CPIH can be suitable as the headline measure of inflation.

The UKSA has issued a further consultation on the issues, with the final recommendations on the appropriate consumer inflation measures to be published in the first half of 2016.

On 9 March 2016, the National Statistician wrote to the UKSA, stating that they were 'inclined to consider that the CPIH should become the ONS preferred measure of consumer inflation and the focal point of ONS commentary in due course'.[9] The National Statistician noted the failings of the CPIH and also noted that a number of changes (such as including a measure for council tax) could be adopted this year. Whether these changes would address all the known issues with the CPIH is yet to be seen.

Historically, most regulated sectors in the UK, including the water sector, have used RPI to set the annual increase in allowed revenues or prices. In most sectors, the RPI statistic is used to index prices as well as the value of the regulated asset base (RAB). In recent years, some regulators have started to

[5] Johnson, P. (2015), 'UK Consumer Price Statistics: A Review', January.
[6] Office for National Statistics (2012), 'National Statistician's consultation on options for improving the Retail Prices Index', 14 November.
[7] Johnson, P. (2015), 'UK Consumer Price Statistics: A Review', January, Executive Summary, p. 23.
[8] Johnson, P. (2015), 'UK Consumer Price Statistics: A Review', January, Executive Summary, p. 16.
[9] Pullinger, J. (2016), 'Shaping the Future of Consumer Inflation Statistics in the UK', p. 1.

move away from RPI in favour of CPI, at least for the indexation of prices. Some of these changes relate to the recent debate about the appropriateness of RPI, whereas others have been driven by other external factors.[10] The issue of the appropriate inflation statistic for use in regulation is also currently being discussed by the UK Regulators Network (UKRN).[11]

In light of the recommendations of the Johnson review, in its latest Water 2020 consultation, Ofwat has proposed a range of options for change, as well as an initial indication of its preferred option.[12] Ofwat is the first regulator to propose changes to the indexation of both revenues and the regulatory capital value (RCV).

The proposed options for evaluation for the 2020–25 price control period include:

- no change from the current approach;
- changing the indexation of prices only to CPI (subject to final UKSA recommendations);
- changing the indexation of both prices and the RCV to CPI (subject to final UKSA recommendations);
- changing the indexation of prices to CPI (subject to final UKSA recommendations) and a transitional arrangement for the RCV indexation, whereby only a proportion of the RCV will indexed to CPI, and the remainder to RPI.

Ofwat's preferred option was the last one. Ofwat considers that '50% of the RCV should be indexed to RPI and 50% indexed to CPI'.[13] Based on the notional capital structure adopted by Ofwat at PR14 (the previous price review), 50% of the existing RCV represents the stock of existing debt held by the industry at the start of the 2015–20 price control period.[14] Based on our discussions with Ofwat, we understand that the exact interpretation of the proposed option over the 2020–25 price control period is to index 50% of the existing RCV to RPI, 50% of the existing RCV to CPI, and any new RCV additions to CPI.

To support further work that Ofwat is undertaking in this area ahead of its publication in May 2016, Ofwat has commissioned Oxera to consider the potential benefits and costs of different options for change.

The remainder of this report is structured as follows:

- section 2 reviews the original rationale for indexation of regulated prices and the regulated asset base, and introduces the key inflation statistics used in this report;
- section 3 examines how inflation affects forecast and actual revenues and value in a regulatory context, and develops an overall framework for the assessment of different options;

[10] The evidence on regulatory precedent is presented in Appendix A1.
[11] UKRN (2016), Inflation measures in economic regulation', Information paper, 8 February.
[12] Ofwat (2015), 'Water 2020: Regulatory framework for wholesale markets and the 2019 price review', December.
[13] Ofwat (2015), 'Water 2020: Regulatory framework for wholesale markets and the 2019 price review', December, p. 126.
[14] In PR14 Ofwat used a notional gearing assumption of 62.5%—i.e. debt represents 62.5% of the RCV. Furthermore, it assumed that new debt would comprise around 25% of all debt over the price control period; therefore, as an approximation, existing debt accounts for around 50% of the RCV.

- section 4 focuses on the underlying differences between the inflation statistics, and what they might mean for the legitimacy of using the different statistics in a price-setting process;
- section 5 discusses a couple of additional consumer considerations that might be relevant in evaluating the different options;
- section 6 analyses the extent to which water industry's operating and capital expenditure (OPEX and CAPEX, respectively) correlate with different inflation statistics, and what this might mean for the operational risk faced by the industry;
- section 7 evaluates the impact of the different options on financing costs and financeability;
- section 8 discusses any potential impact on regulatory risk and how it can be mitigated under the different options;
- section 9 concludes with an overall assessment of the benefits and costs of the different options.

2 Rationale for indexing price controls to inflation

Before we develop a framework for assessing the changes, it is useful to consider the key objectives of indexing price controls to inflation and the available inflation statistics. This section is structured as follows:

- section 2.1 discusses the rationale for the indexation of prices;
- section 2.2 considers the reasoning behind the indexation of the asset base;
- section 2.3 provides a brief overview of the key inflation statistics considered in this report (RPI, CPI and CPIH).

In summary, we find that, at the time of introducing RPI - X regulation, regulators generally judged that consumers were better placed to manage inflation risk than companies. Ultimately, providing protection to companies against inflation risk should minimise financing costs, thus delivering benefits to consumers through lower prices. RPI was universally chosen as the inflation statistic for indexing prices at the time as it was the primary measure of inflation in the economy.

The overall principle of the indexation of the RAB is to reflect changes in asset values over time. It recognises the fact that inflation can erode the value of any new investment made, given its long-lived nature in infrastructure, understating the true economic cost of providing the services. Most regulators have also adopted RPI for the indexation of the RAB, ensuring that investors are compensated for general price inflation.

Given the recent debate about the appropriateness of RPI as a measure of inflation in the economy, Ofwat is considering whether it remains appropriate to continue to use RPI in the regulatory framework. The potential candidates to replace RPI are CPI and CPIH.

2.1 Indexation of regulated prices

RPI - X regulation originally formed part of a discussion about an appropriate form of regulation of British Telecom (BT), the UK's incumbent telecoms provider.[15] At the time, five primary goals of regulation were set out as:

- the protection of consumers from monopoly behaviour;
- encouraging efficiency and innovation through the effective use of manpower, capital, and other resources;
- reducing the burden of regulation;
- promoting competition;
- ensuring the successful operation of BT as a commercial entity.[16]

Out of several options, RPI - X regulation was found to score highly in all five areas. This would allow BT to increase charges by no more than RPI - X each year, where RPI is a standard measure of general inflation in the UK. The discussion around BT price controls occurred in 1983, prior to the publication of

[15] Littlechild, S.C. (1983), 'Regulation of British Telecommunications' profitability', Report to The Secretary of State, February, Section 13.
[16] Littlechild, S.C. (1983), 'Regulation of British Telecommunications' profitability', Report to The Secretary of State, February, Section 5.

CPI in 1996.[17] The motivation for RPI - X was to assure consumers that there would be a mechanism to ensure that prices of monopoly services would not increase in real terms, and would in fact be reduced annually by an efficiency factor, X.[18]

Indexation of tariffs by RPI - X therefore protects consumers from the risk that monopolies will raise their prices in real terms over time, but also protects regulated companies from the risk that input costs, which may not be fully within management control, will rise in line with unexpected movements in inflation.[19]

The first price control review in the water sector discusses indexation with respect to RPI, but does not offer a discussion on choice of index.[20] This suggests that, similar to the decision to index BT price controls in telecoms, there was no clear alternative to RPI at the time price controls were being established.

2.2 Indexation of the regulated asset base

The concept of the RAB, or RCV as it is referred to in the water sector, was first introduced post-privatisation. Assets in infrastructure-heavy industries, including water, were sold at a significant discount to their replacement cost, and the RAB or RCV was typically established with reference to the price paid by investors for the assets, which reflected this significant discount.[21]

A decision has been made in the water industry to use a version of current-cost accounting, such that the RCV is updated to current prices using a general measure of inflation as a proxy for asset inflation. Using a general, rather than an asset-specific, inflation measure is usually consistent with the concept of financial capital maintenance.

In infrastructure-heavy industries, assets are long-lived, and current cost accounting is necessary to prevent inflation from rapidly eroding the value of assets which have a long economic life and for which investors expect a rate of return for a reasonable period.[22]

Ofwat has also stated that the indexation of the RCV was designed to protect the notional value of newly privatised companies at the point of privatisation, and any increases they have made to this capital base in terms of capital investments to date.[23]

Unlike the indexation of revenue, inflation indexation of the RCV and how new CAPEX is remunerated through additions to the RCV is not specified in the licence. Instead, the concept of the RCV and how it evolves over time has been established on the basis of regulatory commitment through the process of successive price controls since 1990.

In effect, the choice of the initial RCV and the decision about how it is updated over time has established a starting level of customer bills and how they evolve over time. This may have some implications for how different options for

[17] Office for National Statistics (2013), 'Consumer price indices: a brief guide', p. 4.
[18] Green, R. (2013), 'Has price cap regulation of U.K. utilities been a success?', *Public Policy for the Private Sector*, Note no. 132.
[19] Green, R. (2013), 'Has price cap regulation of U.K. utilities been a success?', *Public Policy for the Private Sector,* Note no. 132; and NAO (2015), 'The economic regulation of the water sector', HC 487 Session 2015-16, 14 October, para. 13.
[20] Ofwat (1994), 'Future charges for water and sewerage services: the outcome of the Periodic Review', July, p. 4.
[21] Stern, J. (2014), 'The regulatory asset base and regulatory commitment', *Agenda,* February.
[22] Oxera (2001), 'Regulatory Accounts', *The Utilities Journal.*
[23] Ofwat (2015), 'Towards Water 2020 – policy issues: regulating monopolies', July, section 5.3.

indexation change fare from the point of view of customer acceptability and inter-generational equity.

2.3 Available inflation statistics

In this report, we consider three main measures of UK inflation: RPI, CPI and CPIH. All three statistics are measures of price inflation in the UK reported by the ONS.

Most of the debate by regulators so far has focused on whether RPI should be replaced with CPI. However, following the recommendations of the Johnson review, there is a possibility that CPIH will become the headline measure of consumer inflation.

Specifically, the Johnson review recommended that the ONS move towards making CPIH its main measure of inflation (noting that there were shortcomings with the processing of private rents data, resulting in an understatement of owner-occupiers' housing costs).

Therefore, before we develop the potential options for change of indexation in the water sector and the overall assessment framework, we briefly set out some background on each of the three inflation statistics. A more detailed review of the differences between them and what this might mean in a price-setting context is provided in section 4.

2.3.1 RPI

RPI was initially developed as a compensation index to protect workers from price rises associated with the First World War.[24] The calculation of the index has undergone a number of significant changes, but essentially RPI was the primary measure of consumer inflation available in the economy until the late 1990s.

Some variants of RPI were developed in the mid-1990s, including RPIY (RPI excluding mortgage interest payments and indirect taxes) and RPIX (RPI excluding mortgage interest payments). In 1997, it was announced that the responsibility for setting interest rates would pass to the Bank of England, with the government setting the overall inflation target with reference to RPIX.

More recently, there have been a few further refinements to RPI, including the use of an average effective rate instead of the standard variable rate in the measurement of mortgage interest payments, and improving the measurement of prices of clothing and footwear (from 2010).

In 2013, RPI was discontinued as an official national statistic due to concerns regarding its calculation (namely, the use of the Carli approach to calculating averages—see section 4.2.2).[25]

2.3.2 CPI and CPIH

In 1995, a new inflation measure, the HICP, was created (a comparable measure of inflation across EU member states). In 2003 it was renamed CPI to reflect its new role as the main UK domestic measure of inflation for macroeconomic purposes.[26]

[24] Office for National Statistics (2010), 'Differences between the RPI and CPI Measures of Inflation'.
[25] Office for National Statistics (2013), 'National Statistician announces outcome of consultation on RPI'.
[26] Office for National Statistics (2014), 'Consumer Price Indices: Technical Manual, 2014 Edition'.

Beyond 2003, there were a few minor refinements to CPI, including the way in which seasonal items are measured.

Since 2011, CPI has been used as the principal deflator of consumer spending within the National Accounts and has been used to index tax credits and public service pensions.

In 2013, CPIH (a measure of CPI that includes owner occupiers' housing costs) was added to the suite of indices (with back series available from 2005).

In March 2015, the ONS made improvements to the rental equivalence measure of owner-occupiers' housing costs in CPIH. Weights are not usually revised in CPI statistics as this would lead to revisions to the published indices. However, as CPIH is a relatively new statistic and its use is still limited, the ONS made retrospective changes to it, and reverted the statistic to 'experimental' status.[27]

On 9 March 2016, the National Statistician wrote to the UK Statistics Authority, stating that they were 'inclined to consider that the CPIH should become the ONS preferred measure of consumer inflation and the focal point of ONS commentary in due course'.[28] The National Statistician noted the failings of the CPIH, and also noted that a number of changes (such as including a measure for council tax) could be adopted this year.

Whether these changes would address all the known issues with the CPIH is yet to be seen. An assessment report also published in March 2016 by the UKSA noted a number of significant issues with the current CPIH methodology, such as the quality assurance processes in place for private rents data sources; trends in the index that are not always easily explained; and some user disagreement and distrust about the concepts and methods that the ONS uses to measure Owner Occupiers' Housing costs.[29]

[27] Office for National Statistics (2015), 'Revising the weight of Owner Occupiers' Housing in CPIH'.
[28] Pullinger, J. (2016), 'Shaping the Future of Consumer Inflation Statistics in the UK', p. 1.
[29] UK Statistics Authority (2016), 'Assessment of compliance with the Code of Practice for Official Statistics', p. 6.

3 Assessment framework and options for change

This section provides a common understanding of how inflation affects the key elements of a price control and companies' cash flows. This is then used to develop a framework for assessing the options for change.

This section is structured as follows:

- section 3.1 discusses how the choice of the inflation statistic currently feeds into Ofwat's price-setting process;
- section 3.2 considers how inflation affects cash flows and the value of a regulated business;
- section 3.3 presents the options for change considered in this report;
- section 3.4 illustrates the differences in the potential revenue impact of different indexation options;
- section 3.5 presents the overall framework used to assess the options in the remainder of this report.

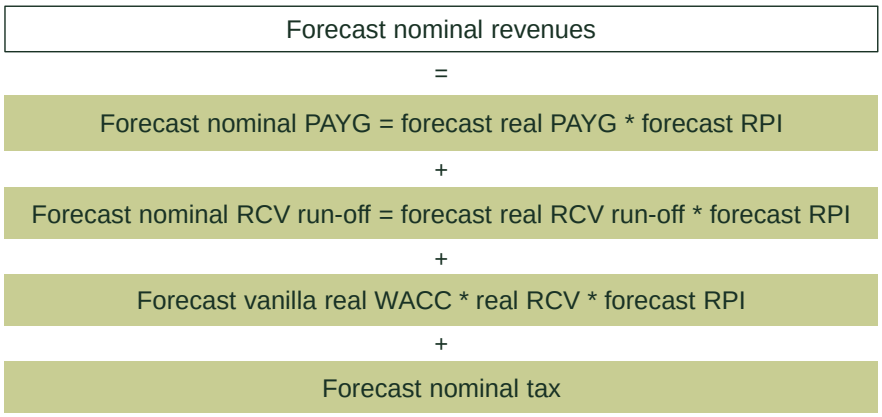
3.1 Ofwat's current approach

To understand what benefits and costs might be associated with a change in the inflation statistic, first, we briefly set out how inflation currently feeds into price controls.

3.1.1 Overview of regulatory building blocks

At PR14, Ofwat set separate wholesale and retail controls. The wholesale controls were indexed to RPI. Ofwat noted that this would 'retain the stability and certainty that ensure the water and sewerage sectors can continue to attract low-cost financing in these parts of the value chain, which are relatively asset intensive'.[30] The wholesale revenues are built up as follows.

Figure 3.1 Key components of allowed forecast nominal revenue



Note: The diagram shows only the key components of allowed revenues. In practice, there are other elements, such as true-up adjustments for certain incentives and costs from previous price control periods, but for simplicity, these are not shown. PAYG, pay-as-you-go; WACC, weighted average cost of capital.

Source: Oxera.

[30] Ofwat (2013), 'Setting price controls for 2015-20 – framework and approach: A consultation', p. 18.

Assessment of forecast total expenditure

In assessing efficient wholesale expenditure, a key part of Ofwat's toolkit included a set of TOTEX (total expenditure) models. These econometric models covered both OPEX and CAPEX. The data that fed into the models were expressed in real terms (2012–13 prices), adjusted using RPI.

Within some of the key TOTEX models, Ofwat made use of a time variable which picked up trends in costs over time (that are not related to the other variables specified in the models), and so to some extent reflected industry-wide trends in real price effects. The results of Ofwat's models along with other evidence, such as special factor claims put forward by companies, were used to determine an efficient level of forecast TOTEX.

Changing from RPI to another measure of inflation, in itself, would not require a fundamental change to Ofwat's cost assessment framework. Ofwat could undertake its cost assessment using a different price base. The historical nominal outturn costs of companies could be re-based (as could forecast costs) to use the alternative measure, which would change the values of the models' coefficients. However, this in itself should not affect the assessment of efficient levels of nominal costs.

Whether the TOTEX assessment needs to be adjusted in some way because of changes to the risks faced by the industry (e.g. changes to exposure to input price pressures) is examined in section 6.

Pay-as-you-go and RCV run-off

Unlike previous reviews, at PR14 Ofwat did not consider OPEX and CAPEX in isolation. Ofwat let companies propose how much of their TOTEX to recover in the year in which the costs are incurred (this is known as the 'PAYG ratio').

Similarly, rather than directly calculating depreciation based on an assessment of companies' assets, Ofwat allowed companies to propose 'run-off rates' (the rate at which the RCV is returned to investors through the depreciation charge) separately for the existing RCV and any new RCV additions.

In giving companies' this flexibility, Ofwat expected them to balance both affordability and financeability considerations.[31]

Allowed return and tax

Ofwat estimates the weighted average cost of capital (WACC) by assuming a combination of debt and equity financing. The WACC is estimated in real terms with reference to RPI-linked financial market data (e.g. yields on RPI-linked government bonds), which is then multiplied by the RCV (which is indexed to RPI). Ofwat's PR14 WACC methodology and any implications for it are discussed in more detail in section 8.2.2.

At PR14, tax was estimated separately on a nominal basis. The calculations should not be affected by Ofwat changing its measure of inflation.

3.1.2 Factoring in outturn inflation

To forecast allowed nominal revenues, Ofwat uses a forecast of financial year average RPI. To calculate actual allowed revenue increases during the price

[31] Ofwat (2013), 'Setting price controls for 2015-20 – framework and approach: A consultation', p. 73.

control period, Ofwat uses the outturn RPI between the two preceding Novembers.[32] This is due to the November RPI being the latest available measure of outturn inflation at the point when companies need to finalise their charges ahead of the next charging year. This means that the change in water bills due to inflation indexation always lags behind inflation experienced across the economy as a whole. However, in the long run, these timing differences should largely even out.

To forecast the evolution of the RCV in nominal terms, Ofwat also uses a forecast of financial year average RPI. At the end of a price control period, the nominal value of the RCV is adjusted to reflect outturn RPI.

3.2 Impact of inflation on cash flows and firm value

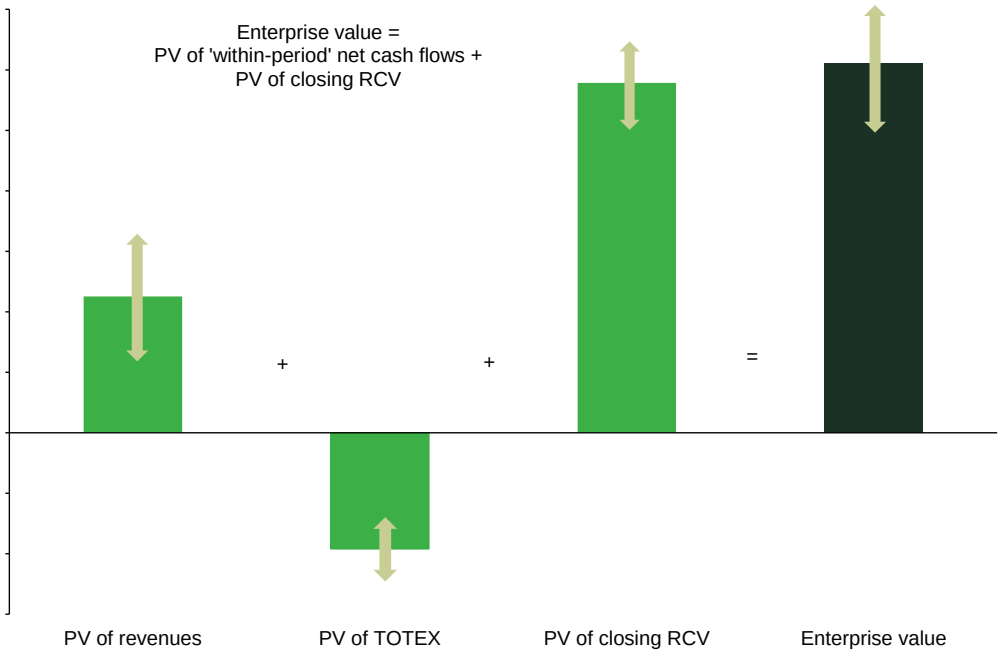
A key component of any framework for assessing the benefits and costs of a change to inflation indexation is understanding how inflation affects the risk profile of the industry.

A useful measure of risk faced by all investors in a firm in aggregate is the volatility of the enterprise value. Changes in risk to the value of the firm could translate into changes in the rates of return required by investors. This could subsequently translate into a cost or benefit to consumers.

The enterprise value of a regulated firm could be thought of as consisting of the following components (as illustrated in Figure 3.2):

- the present value (PV) of the net cash flows during the five-year price control period, which are equal to the difference between the PV of revenues and cash expenditure (TOTEX);
- the PV of the closing RCV at the end of the price control period.

Figure 3.2 Breakdown of the enterprise value of a water company



Source: Oxera.

[32] In other words, 2015–16 revenues would be inflated by the difference between RPI in 2014 and 2013.

It is useful to consider the effects of inflation on each separate component. The volatility of firm value attributable to inflation will depend on the volatility of the different components of value in response to deviations between forecast and outturn inflation.

- Outturn revenue will vary from forecast revenue depending on the difference between the regulator's forecast level of inflation and outturn inflation within period.
- Outturn cash costs (OPEX and CAPEX) may also vary from forecast depending on the difference between the regulator's forecast level of inflation and outturn inflation within period. However, the degree to which year-on-year changes in costs are affected by outturn inflation depends on the extent to which the chosen inflation statistic is an important driver of costs during the price control period. Unlike outturn revenue, there is no mechanistic link between outturn inflation and costs.
- The outturn RCV will vary from forecast depending on the difference between the regulator's forecast level of inflation and outturn inflation within period.

Given the way in which the industry has financed itself historically, there is another component of value that is affected by inflation. RPI-linked debt plays an important role in the financing mix of the industry.

Interest payments on RPI-linked debt are calculated on a principal that is indexed annually with outturn RPI. Deviations between forecast and outturn RPI will therefore affect the evolution of both the interest payments and the principal repayable at maturity on RPI-linked debt.

A change to the inflation statistic used to index revenues and/or the RCV will, therefore, affect the overall nominal volatility of the value of a regulated water company, by potentially affecting each of the components of firm value identified above. This understanding of the link between the volatility of firm value and inflation indexation directly feeds into our assessment framework presented at the end of this section. However, we first introduce the options for change considered in this report.

3.3 Potential options for change

In the Water 2020 December 2015 consultation, Ofwat has set out four options for change (see section 1). For the purposes of this report, we evaluate a slightly wider range of options, which are set out in Table 3.1.

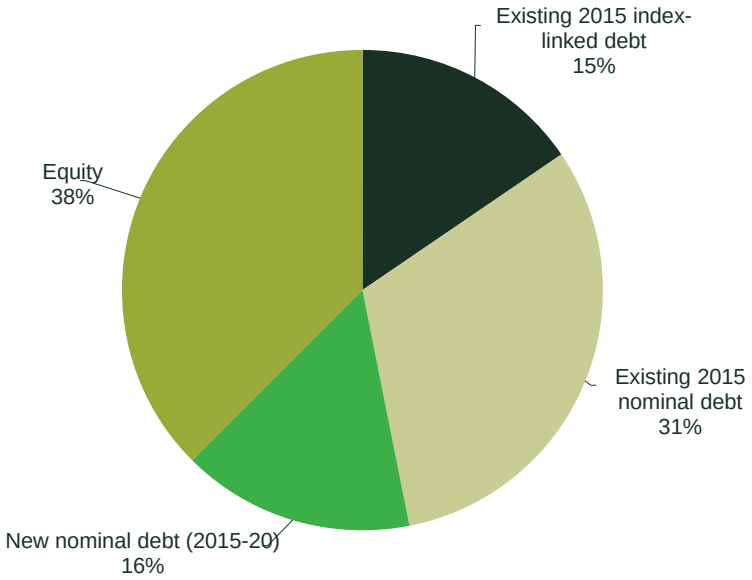
Table 3.1 Options for change

Option	Indexation of revenues	Indexation of the RCV	
Option 1: no change	RPI	RPI	No change in the forecast level of bills
Option 2: only revenue indexation is changed	CPI (or CPIH)	RPI	
Option 3: full switch	CPI (or CPIH)	All RCV indexed to CPI (CPIH)	Options imply a change in the forecast level of bills
Option 4: transition based on the notional proportion of RPI-linked debt	CPI (or CPIH)	15% of the RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 5: transition based on Water 2020 preferred option	CPI (or CPIH)	50% of the RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 6: transition based on notional equity	CPI (or CPIH)	62.5% of existing RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 7: transition based on new RCV only	CPI (or CPIH)	existing RCV indexed to RPI; new RCV additions post-2020 indexed to CPI (or CPIH)	

Source: Oxera.

Options 4–6 are linked to the historical assumptions made by Ofwat regarding the appropriate notional capital structure (Figure 3.3).

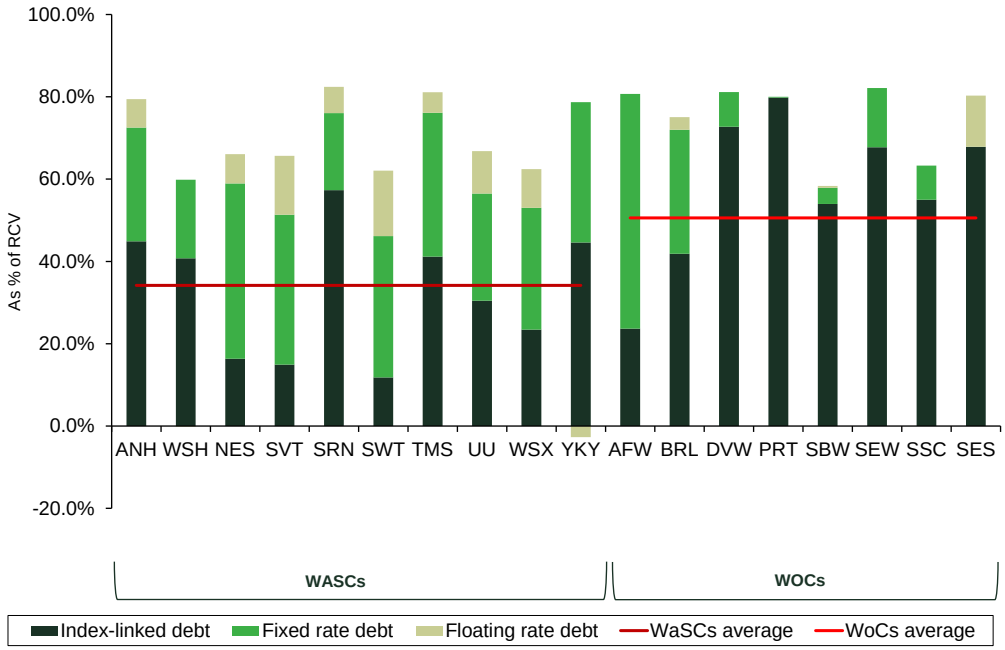
Figure 3.3 Ofwat's PR14 notional capital structure assumptions as at the end of the current 2015‑20 price control



Source: Oxera, based on Ofwat's PR14 final determinations assumptions.

These assumptions, at least in part, have been influenced by observed financing choices made by the industry (see Figure 3.4).

Figure 3.4 Industry debt composition, percentage of RCV



Note: Averages are weighted by the RCV.

Source: Oxera analysis, using Ofwat's financial monitoring data and updates provided by the companies in response to Ofwat's information request. Data is for financial year 2014/15.

The transitional options 4–6 for the indexation of the RCV are based on an industry-wide assessment of the notional and actual capital structure. Option 4 is based on the PR14 assumption on gearing and the proportion of index-linked debt in the notional capital structure, at the end of the 2015–20 price control period. Option 5 effectively assumes that all existing debt at the start of the current price control period was index-linked. Option 6 is based on providing protection to all debt on a notional balance sheet, with only the equity proportion of the RCV switched to CPI indexation.

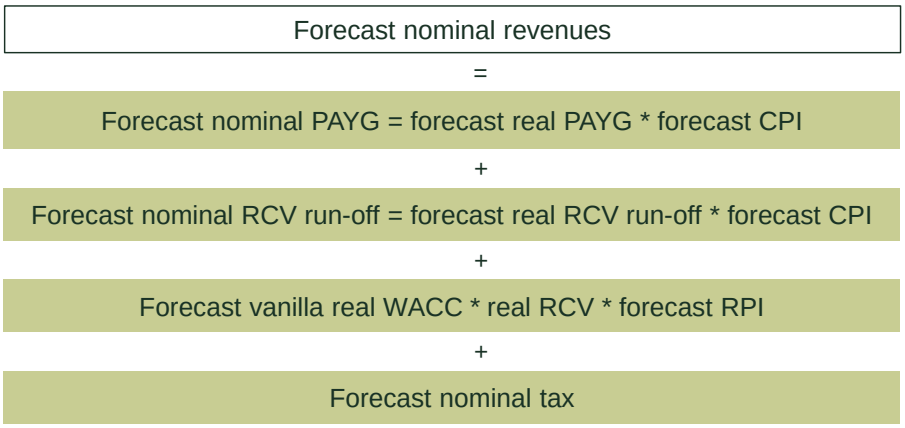
3.4 Impact on revenues under different indexation options

To ensure a common understanding of the issues and to develop a coherent framework for analysing the changes, we first outline the implications for the forecast level of nominal revenues, assuming that any change implemented would be net present value- (NPV-) neutral. In other words, the forecast level of nominal costs and the nominal rate of return would stay the same.

3.4.1 Changes to indexation of revenues only (option 2)

Assuming that the forecast level of the water industry TOTEX and the forecast nominal cost of capital stay the same, simply changing the way revenues are indexed should have no impact on the forecast revenues (and hence forecast level of customer bills).

Figure 3.5 Key components of allowed forecast nominal revenue under CPI indexation



Source: Oxera.

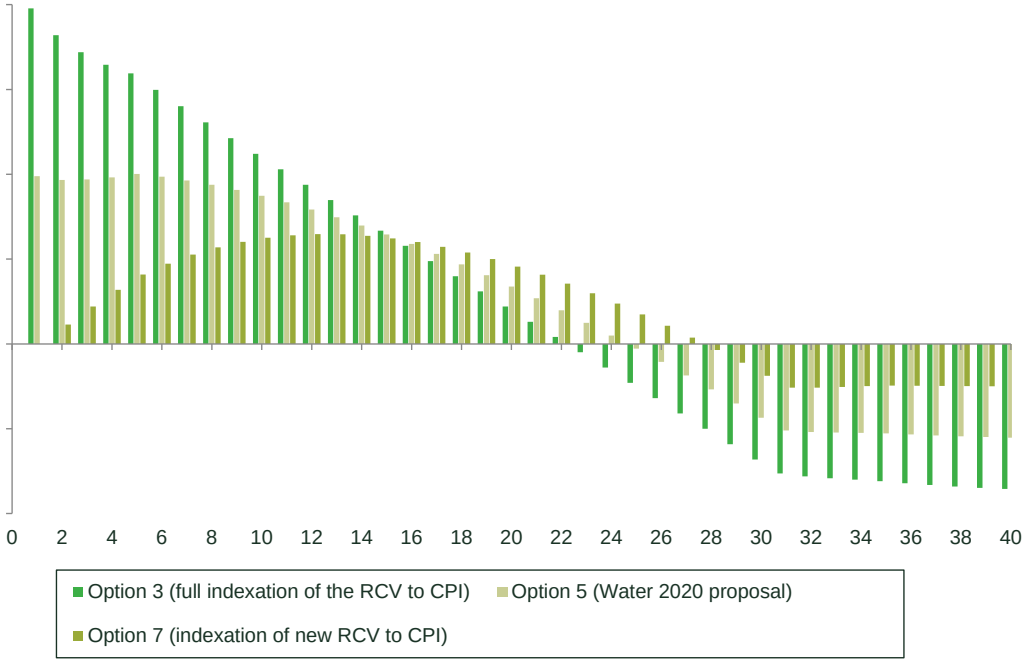
This approach will require a restatement of real TOTEX projections relative to CPI rather than RPI in order to derive forecast real PAYG and real RCV run-off. However, unless there is any evidence of why nominal TOTEX forecasts should change (discussed further in section 6), or why the risk exposure of the industry changes (discussed in sections 6 to 8), there is no clear reason why the forecast level of revenues will change.

The outturn profile of revenues, and hence customer bills, is likely to be different as it will depend on the outturn profile of both RPI and CPI, rather than just RPI.

3.4.2 Changes to the indexation of both revenues and the RCV (options 3–7)

A change to the indexation of both revenues and the RCV will have an effect on the forecast profile of revenues (and bills). This is because using an inflation statistic such as CPI, which tends to have a lower value than RPI, means that the allowed return component of allowed revenues needs to go up to reflect the relative increase in the real WACC. This effect is proportionately bigger than the effect of growing the RCV at a slower rate in the short to medium term. The illustrative effect on revenues under a selection of options—option 3 (full indexation of the RCV to CPI), option 5 (Water 2020 proposal), and option 7 (indexation of new RCV to CPI)—is shown in Figure 3.6.

Figure 3.6 Impact of changes to RCV indexation on forecast revenues



Note: Stylised representation of the water industry.

Source: Oxera.

Assuming the allowed WACC is estimated correctly, the change should be NPV-neutral in revenue terms.

3.4.3 Options involving CPIH

Directionally, any option involving CPIH will have a similar effect to the options involving CPI. As discussed in more detail in section 4, CPIH also tends to be lower than RPI and has generally tracked CPI relatively closely since its introduction.

3.5 Framework for assessing alternative options

The basis of the rationale for indexing price controls (discussed in section 2) and the underlying mechanics of how inflation indexation affects companies' cash flows provides useful context for developing a framework for assessing the potential indexation changes.

Importantly, any changes also need to be assessed in the context of Ofwat's primary duties, which include:[33]

- protecting the interests of current and future consumers;
- ensuring that the companies are able to finance their functions;
- ensuring that the functions of water and sewerage companies are properly carried out;
- securing the long-term resilience of the sector.

Taking these factors into account, there is a range of benefits and costs which may influence Ofwat's overall assessment of any potential change. We outline

[33] The Water Act 1991; the Water Act 2014.

some initial hypotheses in Table 3.2, and the subsequent sections of the report consider each of these issues in greater detail.

Table 3.2 Potential sources of benefits and costs

Dimension	Benefit or cost?	Evidence
Legitimacy of the inflation statistic	If RPI is gradually losing its status as an appropriate measure of inflation, a switch to CPI (or CPIH) could be a **potential benefit** to consumers insofar as it improves the overall legitimacy of the regulatory framework.	Section 4
'Fairness' of consumer bills	A change to CPI (or CPIH) indexation of the RCV would imply an increase in bills in the short to medium term, all else being equal. If RPI is no longer an appropriate measure of inflation, it is no longer an appropriate driver of the level and profile of bills. This suggests that options involving customers paying more in the short term (as a result of changes to the basis of RCV indexation) may be desirable insofar as they improve the cost-reflectivity of tariffs. However, this may need to be balanced with the perception that the current level of bills is 'acceptable' and that significant changes in bills may be undesirable from a consumer perspective.	Section 5
Volatility of consumer bills	If there is evidence that CPI (or CPIH) is likely to be less volatile going forward than RPI, and consumers value lower bill volatility, a switch to CPI (or CPIH) could be a **potential benefit** to consumers.	Section 5
Reflectivity of movements in companies' operating costs	Depending on which inflation statistic better reflects the underlying movements in companies' TOTEX costs, a switch to CPI (or CPIH) could be a **potential benefit or cost** to consumers. The benefits or costs could manifest themselves either in changes in the required cost allowances or in the required rate of return (by affecting the risk to which companies are exposed).	Section 6
Impact on financing costs	The choice of the inflation statistic affects firm value by affecting the value of net cash flows during a price control period, the value of the RCV, and the size of interest payments and principal on RPI-linked debt. Depending on the volatility of the different inflation statistics, a change of indexation approach could therefore affect the volatility of firm value. Changes in this volatility could translate into changes in financing costs. A change in the indexation approach may also affect the optimal future mix of financing (nominal versus CPI-linked versus RPI-linked), and may affect financeability. In principle, a switch to CPI (or CPIH) could be a **potential benefit or cost** to consumers, depending on the interaction of the all aforementioned factors.	Section 7
Impact on regulatory risk	A significant change to the regulatory contract, depending on how it is implemented, may affect perceptions of regulatory risk. If not appropriately mitigated, this in turn could manifest itself as a **potential cost** to consumers.	Section 8

Source: Oxera.

4 Legitimacy of different inflation indices

In this section, we assess the key differences between the three inflation statistics (RPI, CPI and CPIH) and consider what these might mean for selecting an appropriate index in the context of price setting.

Specifically, the section is structured as follows:

- section 4.1 discusses how the different indices have behaved in the past;
- section 4.2 reviews the methodology used to compile each index;
- section 4.3 focuses on the predictability and volatility of the different statistics;
- section 4.4 analyses the implications for selecting an index within a price-setting framework.

A summary of our conclusions and the implications for the overall assessment of benefits and costs of the different options is provided upfront.

Key findings

Overall, we find that RPI is calculated using a statistically flawed method, has been discontinued as a 'national statistic', and generally results in an 'upwardly biased' measure of consumer inflation.

CPIH is a relatively new measure, and has recently had its status changed to 'experimental' (although the verdict on the status of CPIH in the economy is still uncertain pending the UKSA's final decision).

CPI is currently the government's official inflation measure, is used widely throughout the economy, and has been developed to be comparable to international measures of inflation.

The cost of mortgage payments plays a prominent role in RPI. The significance of mortgage payments in RPI has led to it being more volatile historically compared with CPI and CPIH. While interest rate rises going forward may be more gradual than the sharp decrease observed in the aftermath of the financial crisis, overall, RPI is likely to be more susceptible to unpredictable swings than either CPI or CPIH.

Overall, we conclude that it is appropriate to phase RPI out of all elements of the price control framework. Suitable alternatives include CPI and CPIH (pending the UKSA decision on CPIH).

All options that involve moving away from RPI could bring benefits to consumers insofar as the legitimacy of the inflation metric is improved. However, it is not straightforward to quantify this benefit.

Given the identified issues with RPI as an inflation statistic, options that involve faster transition of the RCV to CPI (or CPIH) indexation might be preferable.

Evaluation of the options

Table 4.1 summarises the implications of the analysis in this section for the overall assessment of the benefits and costs of the different options for change.

Table 4.1 Options for change: legitimacy of the inflation statistic

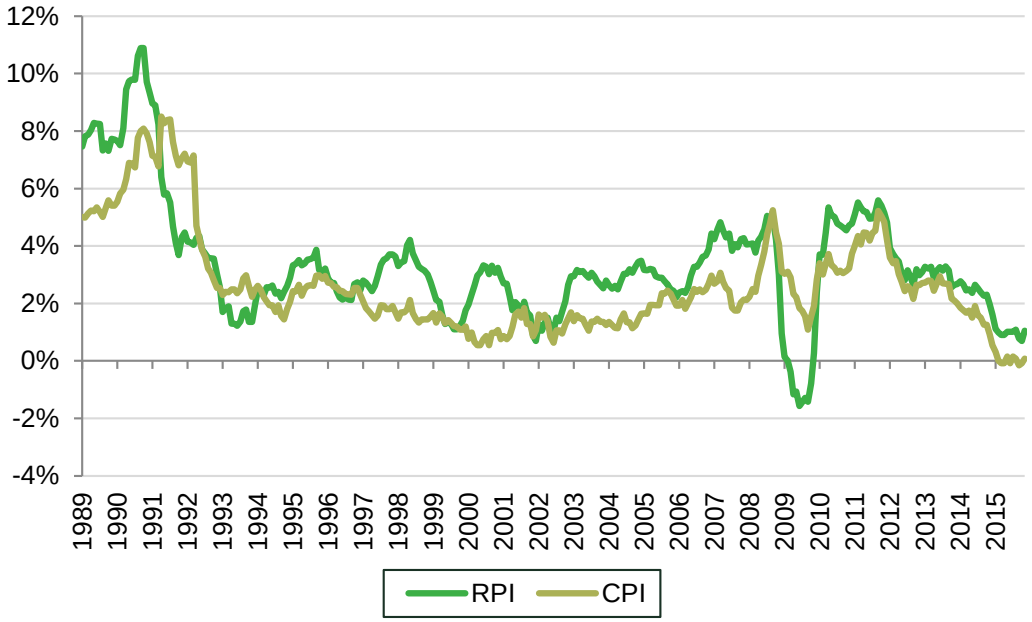
Option for change	Benefit or cost relative to Option 1 (no change)
Option 2: only revenue indexation is changed	
Option 3: full switch	
Option 4: transition based on the notional proportion of RPI-linked debt	Benefit, difficult to quantify.
Option 5: transition based on Water 2020 preferred option	Options that involve faster transition of the RCV to CPI (or CPIH) indexation might be preferable.
Option 6: transition based on notional equity	
Option 7: transition based on new RCV only	

Source: Oxera.

4.1 Historical movements of the indices

This sub-section focuses on recent trends in the movements of the three indices. Despite their notable differences (discussed further below), RPI and CPI have been relatively closely correlated over time (see Figure 4.1).

Figure 4.1 Long-term trends in RPI and CPI



Note: The ONS has retrospectively estimated historical CPI data prior to 1998.

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Table 4.2 RPI and CPI regression statistics

	Full time period	Since 2010
R^2	0.60	0.92
P-value	0.00	0.00
Coefficient (RPI as the dependent variable)	0.89	0.96

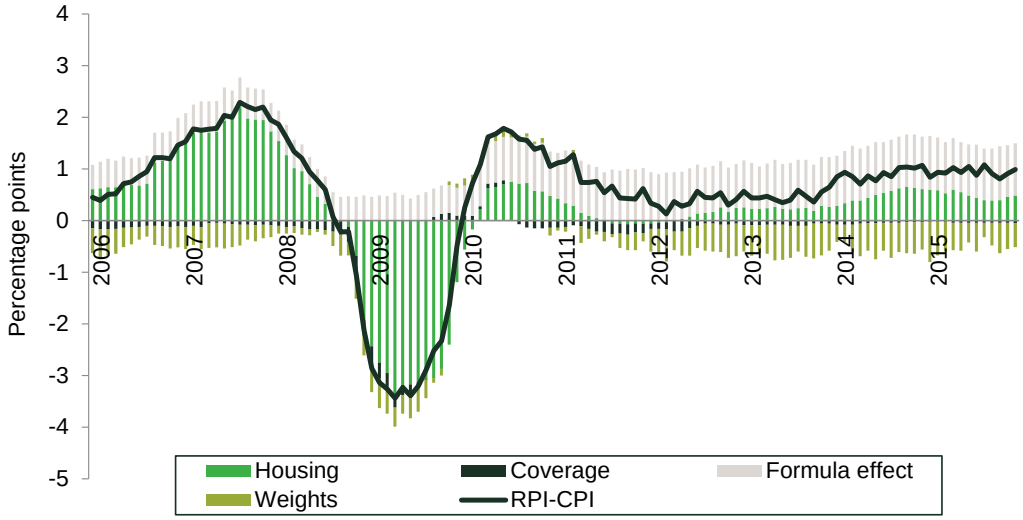
Note: A low p-value (for example, below 0.05) indicates a low probability that such a relationship between variables would have occurred at random (i.e. low values suggest a statistically significant relationship between variables).

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

As Figure 4.1 and Table 4.2 illustrate, RPI and CPI have moved more in line with each other since 2010 (we explore why this is the case in section 4.2.4).

Figure 4.2 shows what has historically made up the difference (the 'wedge') between RPI and CPI.

Figure 4.2 Components of the wedge (RPI–CPI)



Note: 'Coverage' relates to which items are considered; 'weights' relate to the weighting that different components are given within the overall indices.

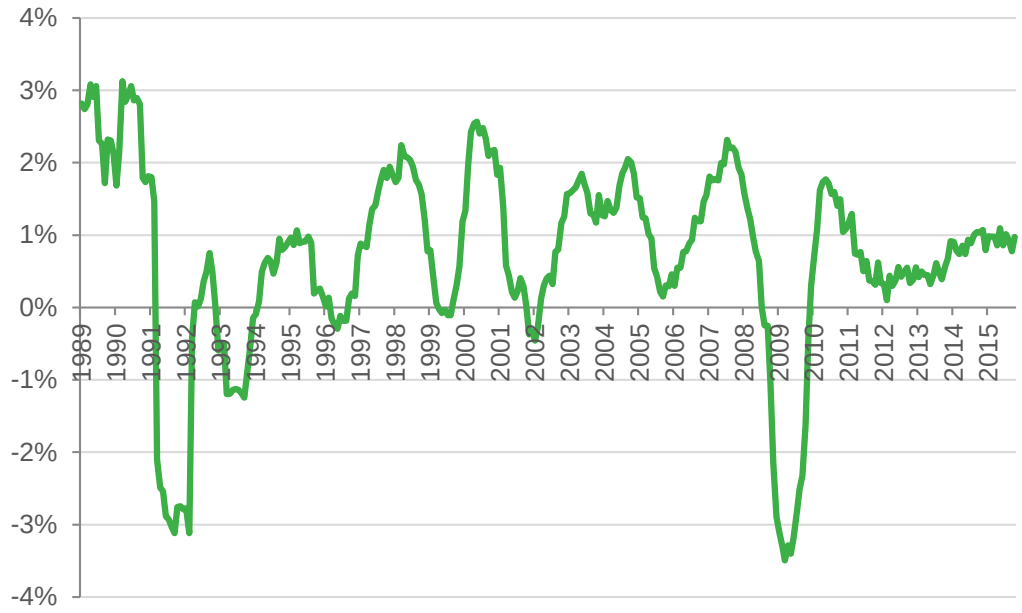
Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Office for National Statistics (2011), 'Consumer Price Indices'.

As can be seen from the above, from 2006:

- the housing components of the indices initially drove the majority of the difference between the two, although this has become less pronounced more recently (although this may change going forward);
- the formula effect used to be around 0.5%, but has increased to around 1% (RPI greater than CPI per annum); this has largely been driven by the change to the way clothing prices are measured (see section 4.2.2);
- differences in the weightings also explain some of the difference between the two metrics. The choice of the weightings alone has in recent years typically added 0.5% to CPI relative to RPI.

Figure 4.3 shows the wedge over the longest time period for which the ONS reports data. As discussed above, pre-1998 CPI data has been estimated by the ONS.

Figure 4.3 Long-term wedge (RPI–CPI)

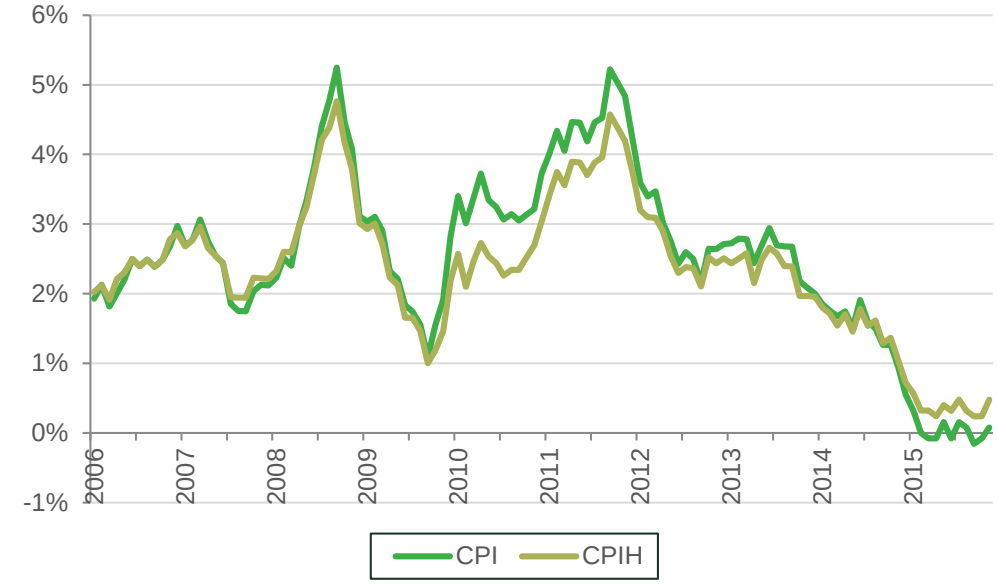


Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

As can be seen from the above, the size of the wedge has been more volatile historically than in recent years. Potential reasons for this are explored in section 4.2.

The only difference between CPI and CPIH is the inclusion of owner-occupiers' housing costs in CPIH. Figure 4.4 shows how these two measures compare over time.

Figure 4.4 Trends in CPI and CPIH



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

As the figure shows, over the period 2006–15 CPI and CPIH have been closely correlated.

Table 4.3 CPI and CPIH regression statistics

	Full time period (since 2006)
R^2	0.96
P-value	0.00
Coefficient (CPI as the dependent variable)	1.19

Note: A low p-value (for example, below 0.05) indicates a low probability that such a relationship between variables would have occurred at random (i.e. low values suggest a statistically significant relationship between variables).

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

For completeness, Table 4.4 shows the regression statistics for RPI and CPIH.

Table 4.4 RPI and CPIH regression statistics

	Full time period (since 2006)
R^2	0.55
P-value	0.00
Coefficient (RPI as the dependent variable)	1.20

Note: A low p-value (for example, below 0.05) indicates a low probability that such a relationship between variables would have occurred at random (i.e. low values suggest a statistically significant relationship between variables).

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Following from these high-level observations, the next sub-section reviews how the indices are produced, the formulae used to calculate them, their composition, and how their sub-components have changed over time.

4.2 Methodology and composition of the three indices

There are a number of technical differences between the indices which can result in notable divergences. Understanding these differences can help inform a view of which measure may be more appropriate within the context of price setting.

4.2.1 Production of indices

RPI, CPI, and CPIH are produced monthly by the ONS. The data collected for use within the indices refers to prices at a set point in time, which is usually the second or third Tuesday of each month. Publication takes place four or five weeks later and has never been delayed or missed.[34]

The regular publication of the indices may give a degree of confidence that any of the three measures could be used within a robust regulatory framework. However, it should be noted that currently only CPI has the status of an official national statistic. A national statistic is a measure that has been certified by the UKSA as compliant with its Code of Practice for Official Statistics.[35]

In 2015, the ONS reverted CPIH to 'experimental' status,[36] although this is not to say that it will not gain 'national statistic' status in the future (as noted above, the Johnson report recommended that the ONS should move towards making CPIH

[34] Office for National Statistics (2013), 'Information paper - Consumer Price Inflation - including CPI, CPIH, RPIJ & RPI', p. 3.
[35] Office for National Statistics (2015), 'Types of official statistics', https://www.statisticsauthority.gov.uk/national-statistician/types-of-official-statistics/.
[36] Office for National Statistics (2015), 'Revising the weight of Owner Occupiers' Housing in CPIH'.

its main measure of inflation). In 2013, RPI was discontinued as an official national statistic due to concerns regarding its calculation.[37]

The following describes the different formulae used in compiling inflation indices, and the associated statistical issues.

4.2.2 Formulae effects

The three commonly used approaches to calculating averages within an index are:

- the arithmetic mean of price relatives (Carli);
- the ratio of arithmetic mean prices (Dutot);
- the geometric mean (Jevons).

RPI uses a combination of Carli and Dutot, while CPI and CPIH predominantly use the Jevons formula, with some Dutot.[38]

The Jevons formula takes into account the possibility that consumers will substitute between goods in response to changes in the product prices. The Dutot and Carli formulae, on the other hand, imply that quantities purchased remain fixed regardless of any changes in relative prices. The Jevons formula will always give either the same or a lower price increase than the Carli.[39] It is not possible to establish a similar general result between the Carli and Dutot formulae.[40]

A key disadvantage of the Carli is that it fails the 'time reversal test'. That is, if prices return to their previous level, the calculated index does not (see Table 4.5).

Table 4.5 Example of time reversal

	Year 1	Year 2	Year 3
Product A	£10	£20	£10
Product B	£30	£20	£30
Product C	£50	£25	£50
Inflation indices			
Carli	1.00	1.06	1.41
Dutot	1.00	0.72	1.00
Jevons	1.00	0.87	1.00

Note: For further details on the calculations of the example, see Appendix A2.

Source: Oxera analysis.

In the above example, prices in year 3 have returned to their year 1 levels. However, unlike the Dutot and Jevons formulae, the Carli has not returned to an index of 1 (it has failed the time reversal test). This failing is widely recognised by statisticians. Very few countries use the Carli in calculating their official inflation measures.

[37] Office for National Statistics (2013), 'National Statistician announces outcome of consultation on RPI'.
[38] Further detail on the differences between the three averaging methods is provided in Appendix A2.
[39] This can be empirically observed by comparing RPI and RPIJ—a variant of RPI published by the ONS that uses the Jevons formula.
[40] Institute of Fiscal Studies (2012), 'A winning formula? Elementary indices in the Retail Prices Index', IFS Working Paper W12/22.

The difference in formulae effect has increased since 2010 (see Figure 4.2). This is largely driven by methodological improvements to the measurement of clothing, which started to be implemented in January 2010.[41] The improvements in measurement increased the dispersion of price relatives, meaning that there is now a greater opportunity for substitution effect within CPI than was previously the case. All things being equal, this should act as a downward driver on CPI relative to RPI (this could be described as RPI being 'upwardly biased').

In 2012, the ONS consulted on whether the methodological failings of RPI should be addressed (either partially or completely).[42] The ONS concluded that the basic formulation of RPI is accepted as currently defined and that any future changes should be limited to issues such as the annual update of the basket and weights, improvements to data validation and quality assurance, etc.[43] However, due to the statistical failings (such as the lack of substitution, and the time reversal test), RPI's status as a national statistic was removed.

4.2.3 Composition of indices

As well as the formulae effect, RPI, CPI, and CPIH differ in the composition of price data of which they are comprised.

Within each year, RPI, CPI, and CPIH measure the change in baskets of fixed composition. The baskets are made up of around 700 items. The overall indices are produced in stages, with sub-indices obtained at each stage and weighted together to give higher-level indices. The data used to produce the weights comes from a variety of sources.

CPI and CPIH weights are derived from the National Accounts' estimates of household final monetary consumption expenditure in the UK. They include the expenditure of all private households, residents of institutional households, and foreign visitors to the UK. The lower-level weights use estimates of household expenditure derived from a variety of sources, including the most recent Living Costs and Food Survey (LCF) and Annual Business Survey.[44]

Weights for RPI are mainly obtained from the LCF data. However, the top 4% of households by income, and pensioner households dependent on state benefits for at least 75% of their income, are excluded.

All three measures are representations of the general cost of living experienced in the UK. However, as each measure is based on average data, they do not perfectly reflect the cost of living experienced of any single consumer. Due to each measure comprising a specific mix of prices, they may be more (or less) reflective of the costs that different types of customer experience.

Table 4.6 shows the components of the indices and their 2015 weights.

[41] Office for National Statistics (2011), 'CPI and RPI: increased impact of the formula effect in 2010'.
[42] Office for National Statistics (2012), 'National Statistician's consultation on options for improving the Retail Prices Index'.
[43] Office for National Statistics (2012), 'National Statistician's Consumer Prices Advisory Committee: CPAC(13)01'.
[44] Office for National Statistics (2013), 'Information paper - Consumer Price Inflation - including CPI, CPIH, RPIJ & RPI', p. 5.

Table 4.6 Weightings used in 2015 RPI (per 1,000 parts)

	Weighting
Housing	263
Motoring expenditure	115
Food	109
Leisure services	78
Household services	65
Household goods	59
Alcoholic beverages	56
Catering	47
Fuel and light	45
Clothing and footwear	42
Personal goods and services	41
Leisure goods	28
Tobacco	27
Fares and other travel costs	25
Total	**1,000**

Source: Office for National Statistics (2015), 'Consumer Price Inflation'.

Table 4.7 Weightings used in 2015 CPI and CPIH (per 1,000 parts)

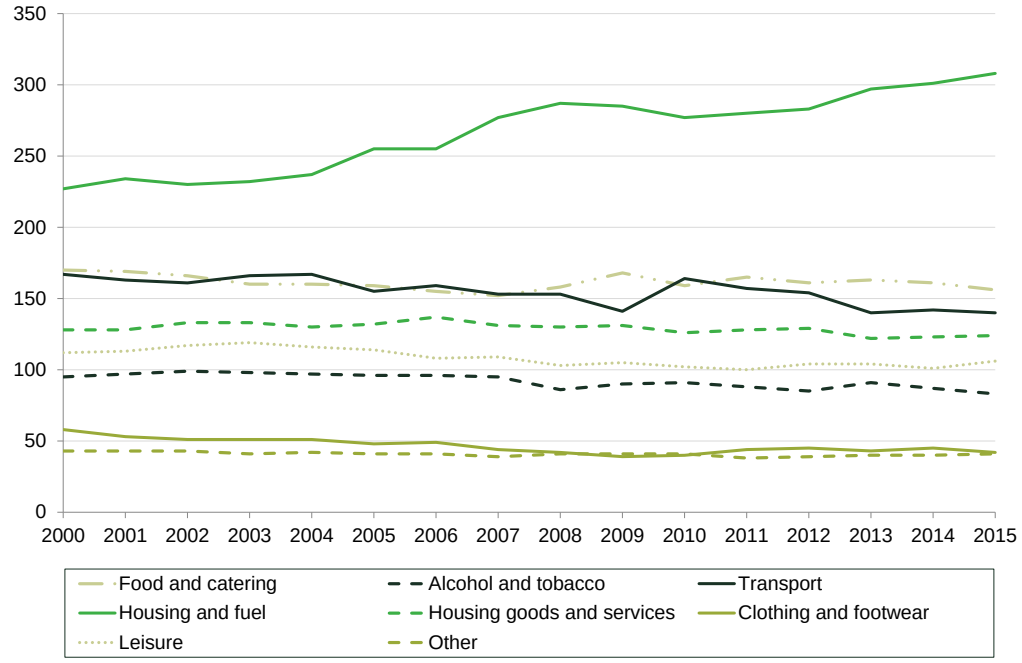
	Weighting CPI	Weighting CPIH
Transport	149	124
Recreation and culture	147	118
Housing, water, electricity, gas and other fuels	128	284
Restaurants and hotels	121	99
Food and non-alcoholic beverages	110	90
Miscellaneous goods and services	91	76
Clothing and footwear	70	58
Furniture, household equipment and maintenance	59	49
Alcoholic beverages and tobacco	43	35
Communication	31	25
Education	26	22
Health	25	20
Total	**1,000**	**1,000**

Source: Office for National Statistics (2015), 'Consumer Price Inflation'.

As can be seen in Tables 4.5 and 4.6, housing costs play a far more significant role in RPI and CPIH than in CPI.

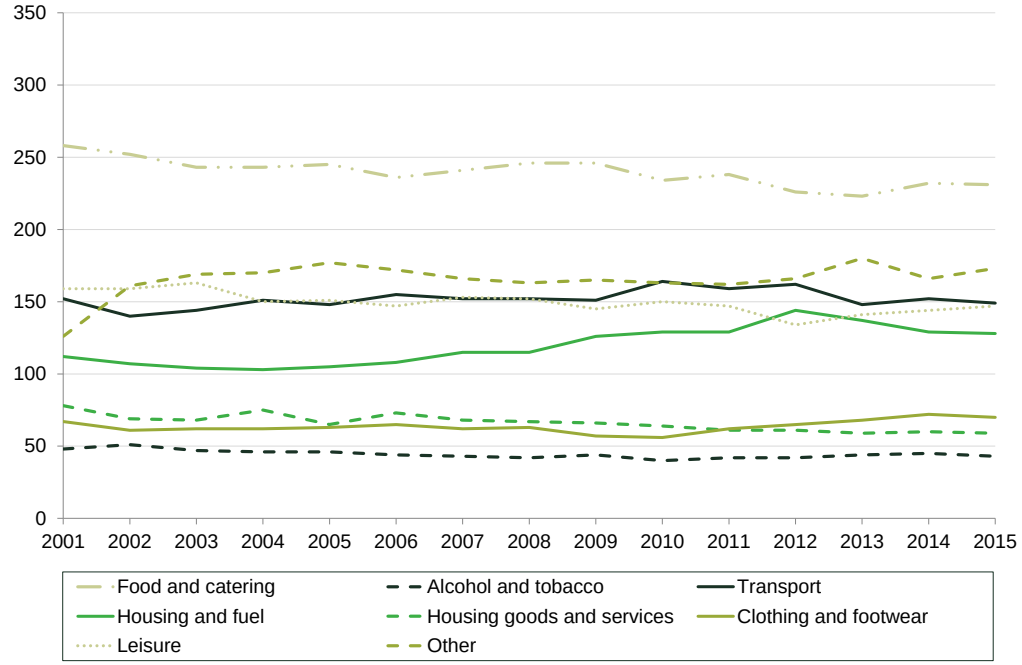
To illustrate how the weights have changed over time, some of the above categories have been combined. It should be noted that cost definitions vary across the metrics and so the summaries below are not perfectly comparable. They do, however, give an illustration of how the different parts of the measures have changed over time.

Figure 4.5 Changes in RPI weights over time



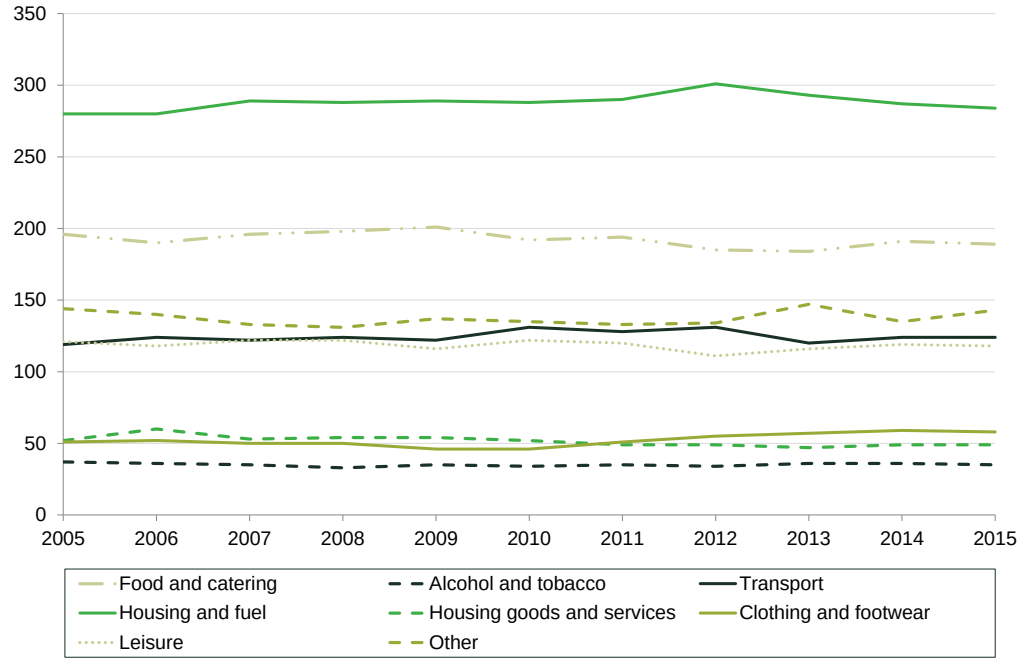
Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Figure 4.6 Changes in CPI weights over time



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Figure 4.7 Changes in CPIH weights over time



Note: Weightings reflect revised backcast ONS figures.

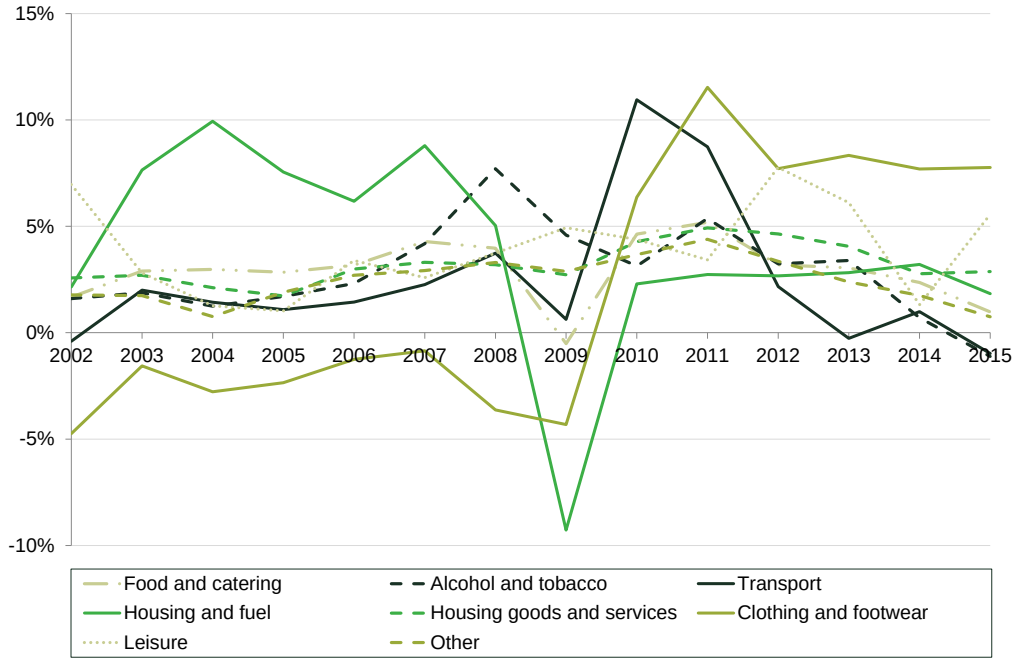
Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

As can be seen, the weightings of most measures have remained fairly stable over time with a few exceptions—the most notable of which is the housing and fuel price component of RPI, which has increased by nearly one-third over the last 15 years. This means that RPI is far more dependent on changes in housing and fuel prices than it was historically.

4.2.4 Price changes within the indices

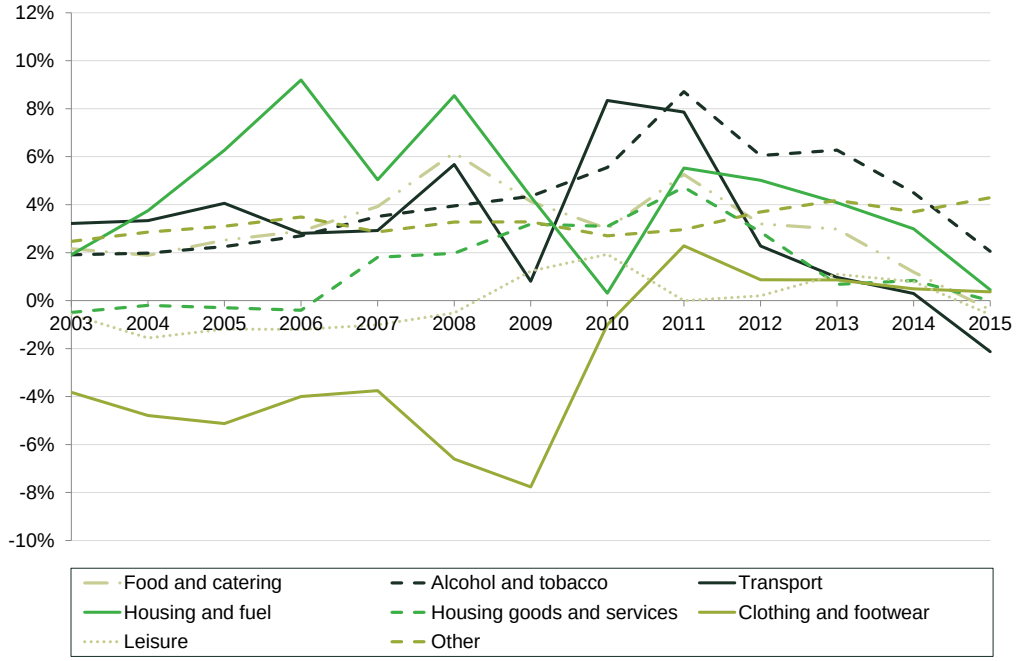
Using the same aggregations as above, Figures 4.8–4.10 show how the price of each component within the indices has changed over time.

Figure 4.8 Changes in RPI component prices over time



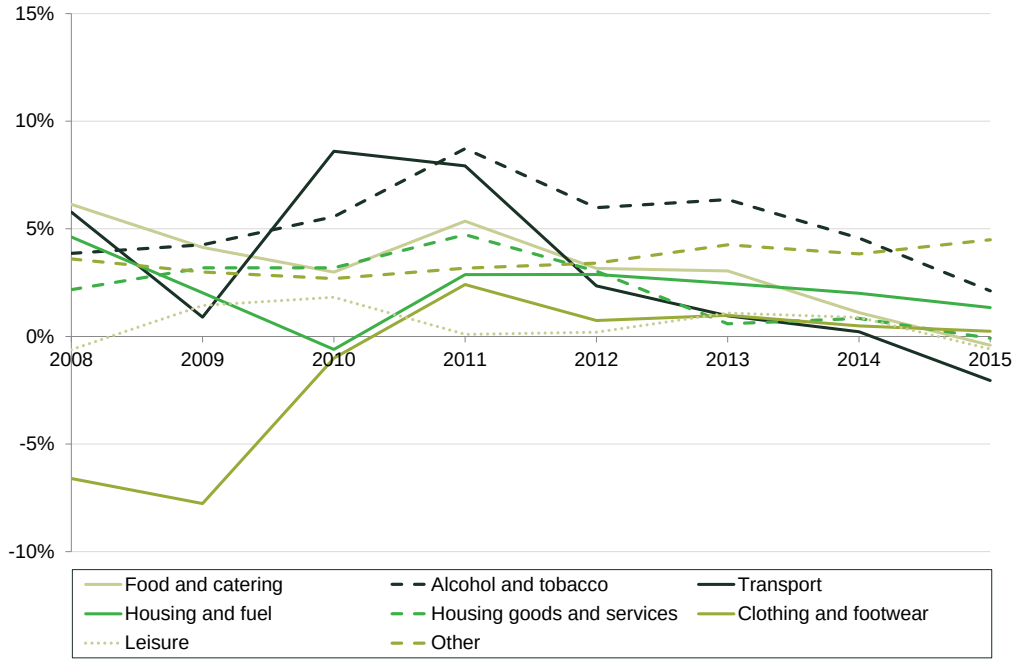
Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Figure 4.9 Changes in CPI component prices over time



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Figure 4.10 Changes in CPIH component prices over time



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

Certain components have seen notable volatility, such as housing and fuel, clothing and footwear, and transport prices.

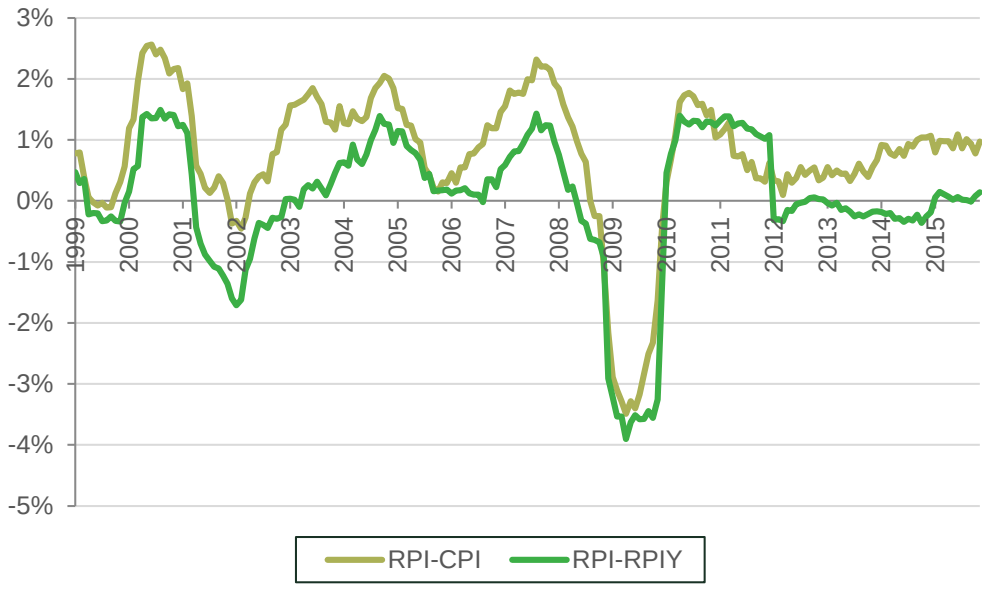
The volatility of housing prices is of particular note due to the relatively large weighting this component is given in RPI and CPIH.

It is also worth noting the large drop in housing prices in 2009 in RPI. This was predominantly due to a fall in the price of mortgage interest payments. Within RPI, mortgage interest payment sub-indices fell by over 30% between 2008 and 2009 (mortgage interest payments are included in RPI and, to a lesser degree, in CPIH, but not in CPI).

The fall in mortgage interest payment costs was driven by the Bank of England cutting its base rate from 4.5% in October 2008 to 0.5% by March 2009. Homeowners with tracker mortgages or re-mortgaging, and new buyers taking out mortgages, would have seen (all things being equal) a substantial drop in mortgage payments costs, and this was reflected in RPI.

Historically, mortgage interest payments have been the primary driver of the difference between changes in RPI and CPI. Figure 4.11 shows the RPI–CPI wedge compared with the difference between RPI and RPIY (a variant of RPI that excludes mortgage interest payments and indirect taxes). The figure illustrates the extent to which mortgage interest payments within RPI have affected the wedge.

Figure 4.11 Mortgage interest payment effect on the wedge

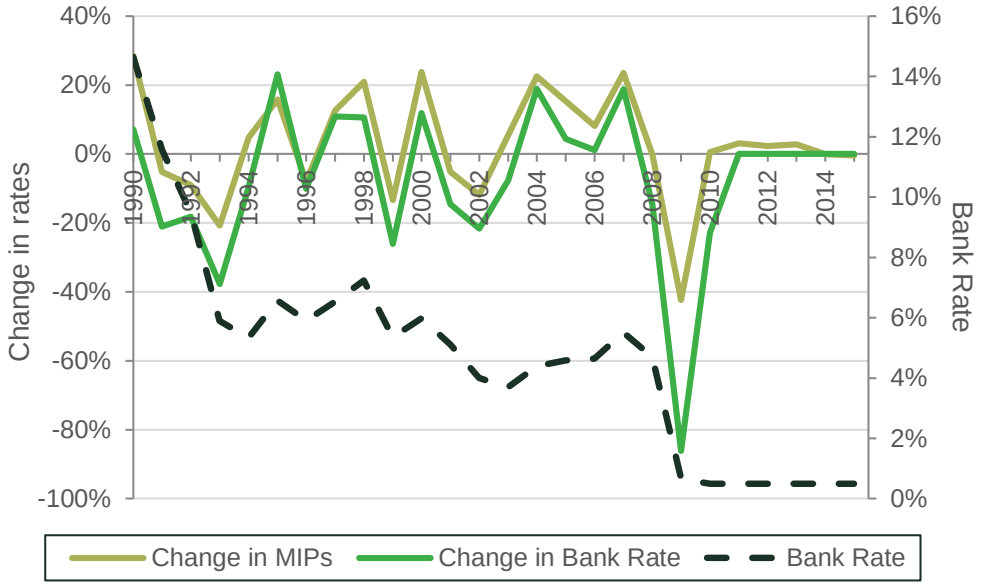


Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

The figures show that the effect has been less profound in recent years. This is likely to be due to the Bank of England maintaining interest rates at a constant level, and therefore the wedge being caused primarily by other factors (such as the formulae effect driven by the change in the methodology for capturing clothing data).

Figure 4.12 shows the relationship between changes in the Bank Rate and the mortgage interest payments used in RPI.

Figure 4.12 Bank Rate changes and mortgage interest payments



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Bank of England (2015), 'Statistical Interactive Database - official Bank Rate history'.

The figure highlights a strong relationship between changes in the Bank Rate and changes in mortgage interest payments.

4.3 Predictability and volatility of different statistics

As part of the price-setting process, some assumptions are required for the future level of inflation (as explained in section 3). Depending on how outturn inflation feeds into the price control framework, the extent to which a given measure of inflation can be accurately forecast may affect its suitability for use in the price-setting framework.

In particular, given the current financing arrangements of the water industry, if Ofwat were to switch to CPI indexation of revenues and/or RCV, the extent to which it can forecast the RPI–CPI wedge neutrally (i.e. not systematically over- or under-forecasting) may become more important.

4.3.1 Forecasts

Currently there are limited forecasts of CPIH. However, on a monthly basis, the Treasury collates and publishes a range of independent forecasts for RPI and CPI. Forecasts collated in 2012 compared with outturn inflation are presented in Table 4.8.

Table 4.8 Historical independent forecasts (annual average)

	2013	2014	2015
RPI average forecast	2.7%	2.5%	2.9%
CPI average forecast	2.3%	2.1%	2.2%
RPI outturn	3.0%	2.4%	1.0%
CPI outturn	2.6%	1.5%	0.0%
Difference forecast to actual (RPI)	-0.3%	0.1%	1.9%
Difference forecast to actual (CPI)	-0.3%	0.6%	2.2%

Source: Oxera analysis of HM Treasury (2012), 'Forecasts for the UK economy'.

The independent forecast averages underestimated both RPI and CPI for 2013, and overestimated both measures in 2014 and 2015. The average forecast for RPI was slightly closer to the outturn values than for CPI, particularly for 2014. This suggests that forecasting either measure can prove difficult. However, this is a relatively short time period to draw any firm conclusions whether RPI or CPI is more difficult to forecast on an annual basis.

The most recent collation by the Treasury of independent inflation forecasts is presented in Table 4.9.

Table 4.9 Recent independent forecasts (annual average)

	2016	2017	2018	2019
RPI average forecast	2.2%	3.1%	3.3%	3.3%
CPI average forecast	1.3%	1.9%	2.0%	2.0%
Implied wedge (RPI–CPI)	0.9%	1.2%	1.3%	1.3%

Source: Oxera analysis of HM Treasury (2015), 'Forecasts for the UK economy'.

The independent forecast averages suggest that the wedge between RPI and CPI may slightly increase over the next few years. This may be due to an expectation that interest rates will increase, thus placing an upward pressure on RPI that will not be reflected to the same extent in CPI.

Table 4.10 shows the range of inflation forecasts from the Treasury report.

Table 4.10 Recent independent forecasts (annual average)

	2016	2017	2018	2019
RPI highest forecast	2.8%	3.7%	4.2%	4.4%
RPI lowest forecast	0.8%	2.0%	2.3%	2.2%
CPI highest forecast	1.7%	3.0%	2.9%	2.5%
CPI lowest forecast	0.8%	1.3%	1.6%	1.6%
RPI interquartile range	0.4%	0.6%	0.4%	0.5%
CPI interquartile range	0.4%	0.3%	0.3%	0.0%
Wedge interquartile range	0.3%	0.6%	0.6%	0.7%

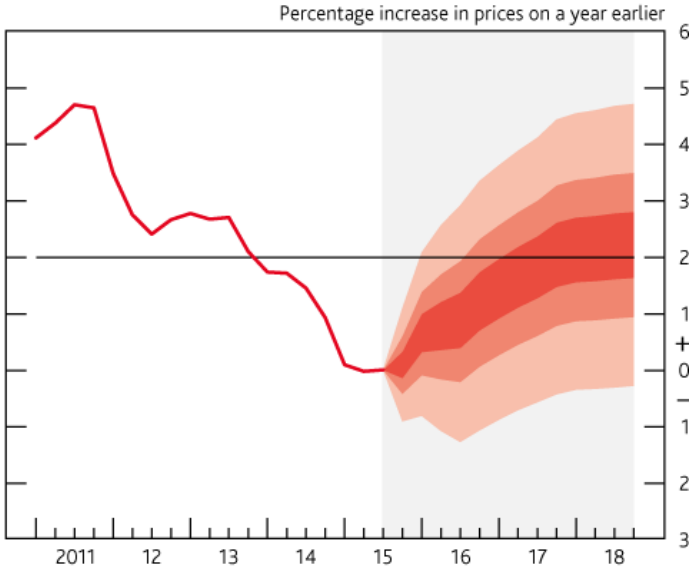
Note: An interquartile range is the range between the 25th and 75th percentiles—it indicates how spread out the different forecasts are once some of the more extreme forecasts have been removed.

Source: Oxera analysis of HM Treasury (2015), 'Forecasts for the UK economy'.

As can be seen, there is a greater range in RPI forecasts than in CPI forecasts. This may imply that CPI is easier to forecast.

The Bank of England also regularly publishes forecasts for CPI covering three-year periods with different bands of certainty.[45] It does not currently publish such forecasts for either RPI or CPIH.

Figure 4.13 Bank of England CPI forecast



Note: The shading corresponds to a probabilistic assessment of inflation given fixed assumptions on interest rates and asset purchases.

Source: Bank of England (2015), 'Inflation Report, November 2015'.

4.3.2 Volatility

The extent to which one measure of inflation is more volatile than the others may affect forecasting accuracy. It may also affect the desirability of using such a metric within a price control framework from a customer's perspective due to customer preference for price stability (discussed in section 5). There may be some benefits of volatility to the extent that it reflects the movements in the

[45] See Bank of England (2015), 'Inflation Report'.

underlying costs of the regulated company (see section 6). The volatility of each index is considered below.

The data collected for use in the indices refers to prices at a set point in time (typically the second or third Tuesday of each month). Two exceptions in CPI and CPIH are the collection of petrol and diesel prices and the collection of premiums for car and house contents insurance, both of which reflect average prices over the month. These measures use more than one day's worth of data as they are known to be volatile. Such averaging does not occur within RPI.

The ONS is currently considering whether a similar approach should be extended to fresh fruit and vegetables.[46]

Table 4.11 compares measures of historical volatility for each index.

Table 4.11 Historical volatility of inflation measures 2006–15

	RPI	CPI	CPIH
All measures since 2006 (the point at which all measures had been reported for one year)			
Standard deviation	1.7%	1.2%	1.0%
Standard deviation/mean	0.57	0.49	0.43
Range	7.2%	5.4%	4.5%
Range/mean	2.33	2.14	1.92

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'.

RPI has had greater single-year volatility since 2006 than the other two metrics, with CPIH being the most stable.

Going forward, it is not possible to be certain which metric will exhibit greater or lesser volatility. However, the following should be noted.

- If the Bank of England increases its base rate back towards the long-run average, this will place an upward pressure on RPI, and to a lesser degree CPIH. While this could affect volatility, it is currently expected that the Bank of England will progressively phase in any rate rises. That said, with such a significant component of RPI being driven by mortgage interest payments (see section 4.2.3), RPI will continue to be exposed to changes in the housing market.
- The Bank of England has an explicit objective to target CPI inflation at 2% per year. No such target currently exists for either RPI or CPIH. However, if CPIH becomes the headline measure of inflation in future, it may replace CPI as the Bank of England's inflation target. For example, in its response to the UKSA 2015 consultation[47] on appropriate measures of consumer inflation, the Bank of England states that 'once the issues surrounding the measurement of owner-occupied housing costs are judged to have been resolved, the CPIH measure regains its status as a National Statistic, and has a proven track record, there is a strong case for its becoming the main measure of inflation'.[48]

[46] Johnson, P. (2015), 'UK Consumer Price Statistics: A Review', p. 36.
[47] UKSA (2015), 'Measuring Consumer Prices: the options for change', June.
[48] UKSA (2015), 'Summary of Responses: Measuring Consumer Prices: the options for change', November, p. 9.

- As noted above, CPI and CPIH contain some monthly averages for components which are known to be volatile, as opposed to relying on a single day's data.

4.4 Implications for selecting an index going forward

Based on the evidence reviewed, we consider the suitability of each index in a price-control setting against the following criteria.

- Availability—to be used within a price control framework, it is beneficial for an inflation metric to be regularly published by a respected source.
- Consistent with government—this aids consistent reporting across the economy, and reduces the scope for confusion for customers and other stakeholders. For example, if prices are reported to be flat in real terms by a regulator, it may create confusion if a government department were to report prices as increasing due to using a different measure of inflation.
- Statistical robustness—a non-statistically robust measure can lead to counterintuitive and/or erroneous results.
- Predictability—the extent to which a given measure of inflation can be accurately forecast may affect its suitability for use within the price-setting framework.
- Volatility—evidence suggests that consumers prefer low volatility in prices (see section 5). Therefore, it may be beneficial to use a stable measure in a price-setting framework.
- Likely future use.

Table 4.12 provides a qualitative summary assessment of how each measure of inflation fares against these criteria.

Table 4.12 Assessment of inflation measures

	RPI	CPI	CPIH	Comments
Availability	✓	✓	✓	All measures are regularly produced by the ONS.
Consistent with government	×	✓	×	CPI is the government's official statistic, and is comparable to measures of other countries.
Statistical robustness	×	✓	✓	RPI uses the Carli technique, which has recognised statistical failings.
Predictability	–	✓	×	While difficult to forecast, a range of independent forecasts are available for RPI and CPI. The fact that the Bank of England has an explicit target for CPI may suggest that CPI's uncertainty is currently more bounded than that of the other measures.
Volatility	×	–	✓	Over the last ten years, CPIH has been the least volatile measure, followed by CPI. RPI may be affected going forward by the Bank of England raising the base rate.
Likely future use	×	✓	✓	The Johnson report recommended that the government move to CPIH as its primary measure of inflation. Whether the government will adopt this recommendation, or continue to use CPI, is not currently known.

Source: Oxera.

At present, CPI generally scores better than the other two indices against the criteria considered. However, if the government were to adopt CPIH as its primary measure of inflation (as per the Johnson review recommendation), CPIH might emerge as the preferred inflation statistic.

5 Further consumer considerations

First, from the consumer perspective, if RPI is no longer an appropriate measure of inflation, it is no longer an appropriate driver of the level and profile of bills. As concluded in the previous section, this would point towards phasing RPI out of all elements of the price control framework, regardless of how aware consumers are of how inflation feeds into the price control.

In this section, we consider two additional issues that might be relevant from a consumer perspective: the impact of the proposed changes on the perceived 'fairness' of consumer bills (section 5.1), and on the volatility of consumer bills (section 5.2).

Key findings

When it comes to the perceived fairness of bills, we conclude that two conflicting objectives potentially come into play. On the one hand, current levels of bills have been established as the norm over time and therefore might be perceived to be fair and reasonable. On the other hand, if some indexation options imply a change to the level and profile of bills that helps to improve the cost-reflectivity of tariffs, such change could bring bills closer to their fair level.

It is difficult to assert clearly whether the change in bills implied under the different indexation options considered improves the fairness of consumer bills. Insofar as RPI is no longer a legitimate driver of bill profiles over time, some change in bills is potentially justifiable, if it can be phased in gradually without undue adverse customer response.

When it comes to the volatility of consumer bills, there is some qualitative evidence that consumers prefer smooth bill profiles. ***To the extent that CPI (and CPIH) both tend to be less volatile than RPI, indexation options that involve a switch of revenue indexation away from RPI to either CPI or CPIH are likely to benefit consumers.***

Evaluation of the options

Table 5.1 summarises the implications of the analysis in this section for the overall assessment of the benefits and costs of the different options for change.

Table 5.1 Options for change: further consumer considerations

Option for change	Benefit or cost relative to Option 1 (no change)
Option 2: only revenue indexation is changed	
Option 3: full switch	
Option 4: transition based on the notional proportion of RPI-linked debt	Benefit, difficult to quantify.
Option 5: transition based on Water 2020 preferred option	Difficult to distinguish between the options.
Option 6: transition based on notional equity	
Option 7: transition based on new RCV only	

Source: Oxera.

5.1 'Fairness' of consumer bills

As explained in section 2, the initial RCV was set at a substantial discount to the replacement cost of industry assets. There was a recognition at the time that charging consumers prices on the basis of replacement cost would have been

difficult in part because customers had become accustomed, ahead of privatisation, to tariffs at the prevailing level. In essence, a reasonable starting level of consumer bills was established at privatisation.

This suggests that significant changes and, in particular, increases in consumer bills are unlikely to be perceived as fair or acceptable. However, it is also likely to be the case that customer bills do not fully reflect the underlying economic cost of providing the services. The depreciation component of allowed revenues, up until 2015, has been calculated with reference to the replacement value of assets (measured by the modern equivalent asset value, MEAV), rather than the value of the RCV. However, the allowed return component of allowed revenue has been based on the RCV (which remains materially below MEAV).[49]

This means that it is difficult to establish precisely what a fair or acceptable bill profile looks like. There are likely to be robust arguments for maintaining a relatively smooth bill profile but, on the other hand, certain one-off increases in consumer bills might be also justified, in particular if they help to improve the cost-reflectivity of tariffs.

If RPI is now considered to be an upwardly biased inflation statistic, while a statistic such as CPI is considered to be a more suitable measure of general inflation, then changing the basis of indexation of the RCV is appropriate. All else being equal, such a change will have the effect of increasing bills to consumers in the short to medium term, with offsetting changes in the longer term. However, if this helps to improve the cost-reflectivity of tariffs, then this could be a reasonable outcome from an economic efficiency perspective.

In conclusion, against these conflicting objectives of acceptability of the legacy levels of bills versus cost-reflectivity, it is difficult to establish precisely whether the change in bills implied under the different indexation options considered improves fairness. Some change in bills is potentially justifiable, if phased in gradually and without undue adverse customer response.

5.2 Volatility of consumer bills

There is some evidence that CPI is likely to be less volatile going forward. If there is evidence that consumers value lower bill volatility then a switch to CPI could be a potential benefit to consumers.

An in-depth review of this evidence base is outside the scope of this report. However, the following should be noted.

- Various pieces of customer research undertaken by water companies at PR14 identified that water customers have a stated preference for bill changes to be smooth, rather than volatile. For example, Southern Water's research at PR14 shows that the vast majority of customers expressed a preference for gradual changes in bills over time, rather than more volatile changes over time.[50] Ofwat advised us that some other pieces of customer research by the companies show similar results.
- Similarly, research undertaken in other jurisdictions or sectors also indicates that customers have the same preference for smooth bill profiles (for

[49] According to industry estimates cited by Ofwat, the RCV represents only 12% of net MEAV. Ofwat (2015), 'Water 2020: Regulatory framework for wholesale markets and the 2019 price review', December, p. 19.
[50] Southern Water (2014), 'Response to Draft Determination: household bill profile', https://www.southernwater.co.uk/media/default/pdfs/16%20household%20bill%20profile.pdf.

example, research by the Water Industry Commission for Scotland (WICS) and by Ofgem).[51]

- These findings are consistent with previous research undertaken for Ofwat, Defra, the Welsh Assembly Government, the Consumer Council for Water, the Environment Agency, the Drinking Water Inspectorate, Natural England, and Water UK at PR09. This research suggested that 'over eight in ten customers stated that they would prefer to see bills change steadily every year throughout the period, so that customers do not see big changes from year to year.'[52]
- Defra has recently issued charging guidance to Ofwat which sets out key objectives, including 'stability and predictability'. Defra notes that 'customers strongly value stable and predictable bills'.[53]

[51] Water Industry Commission for Scotland (2015), 'The Role of Customers in the Strategic Review of Charges Process in the Water Industry in Scotland'. Ofgem (2015), 'Ofgem Consumer Panel Year 6, Wave 3. Smart Billing', March.
[52] BMG Research and MVA Consultancy (2009), 'Understanding customers' views', para. 7.2.1.
[53] Defra (2016), 'Charging guidance to Ofwat', p. 10.

6 Water industry TOTEX costs

This section reviews how water companies' expenditure has historically moved with the different inflation measures. Depending on which inflation statistic better reflects the underlying movements in companies' TOTEX costs, a switch to CPI (or CPIH) could be a potential benefit or cost to consumers. As discussed in section 2, one of the rationales of indexing price controls to inflation is to protect companies against general inflation risk to their cost base. This should ultimately benefit consumers, as companies can finance themselves at lower cost.

If one inflation statistic better reflects the underlying movements in companies' cash costs, indexing revenues to that statistic might lower the operational risk faced by the companies. Operational risk is affected by the underlying business risks and not by financing decisions.

Specifically, this section is structured as follows:

- section 6.1 considers the relationship between water company costs and inflation on a top-down basis;
- section 6.2 analyses the key components that make up water company costs and how these vary with inflation;
- section 6.3 discusses the implications for selecting an inflation statistic.

A summary of our conclusions and the implications for the overall assessment of benefits and costs of the different options is provided upfront.

Key findings

Based on the evidence considered, statistically, there has been limited (if any) correlation between annual changes in RPI, CPI and CPIH and water companies' costs.

This does not imply that, in the long run, costs are not subject to inflationary pressure, but is likely to highlight the difficulty of unpicking the influence of other factors on year-to-year movements in costs. These factors could include a range of exogenous factors such as changes in efficiency, significant weather (or failure) events, changes in service levels/demand/outputs delivered, and other cost movements that are not directly reflected in the three measures of inflation considered.

The largest single type of costs that a water company incurs is labour costs. We find that both RPI and CPI are positively correlated with long-term earnings. Historically, RPI has had a slightly stronger correlation. However, in more recent years the relationship has broken down for all three measures of inflation.

Given the above, there is little to choose between the three measures of inflation in terms of which one would more suitably reflect companies' costs within a price control framework. Based on the composition of the underlying indices (reviewed in section 4), intuitively using an index that is not dominated by mortgage interest payments—i.e. using an index such as CPI rather than RPI—may be more reflective of cost trends going forward.

It is also worth noting that there might be a circularity between the regulator's choice of the inflation index and how costs move over time. For example, if a regulator switches to using CPI, this might give companies an incentive to transfer any existing RPI-linked cost contracts to CPI-linked ones. Therefore,

going forward the relationship between the industry costs and the underlying indices may change relative to observed historical trends.

In conclusion, we find that there is no clear, robust evidence to suggest that the industry's operational risk will materially change under any of the indexation options considered. In other words, there is unlikely to be any clear benefit or cost to consumers as a result of any of the changes.

Evaluation of the options

Table 6.1 summarises the implications of the analysis in this section for the overall assessment of the benefits and costs of the different options for change.

Table 6.1 Options for change: reflectivity of movements in companies' operating costs

Option for change	Benefit or cost relative to Option 1 (no change)
Option 2: only revenue indexation is changed	No material benefit or cost.
Option 3: full switch	No material benefit or cost.
Option 4: transition based on the notional proportion of RPI-linked debt	No material benefit or cost.
Option 5: transition based on Water 2020 preferred option	No material benefit or cost.
Option 6: transition based on notional equity	No material benefit or cost.
Option 7: transition based on new RCV only	No material benefit or cost.

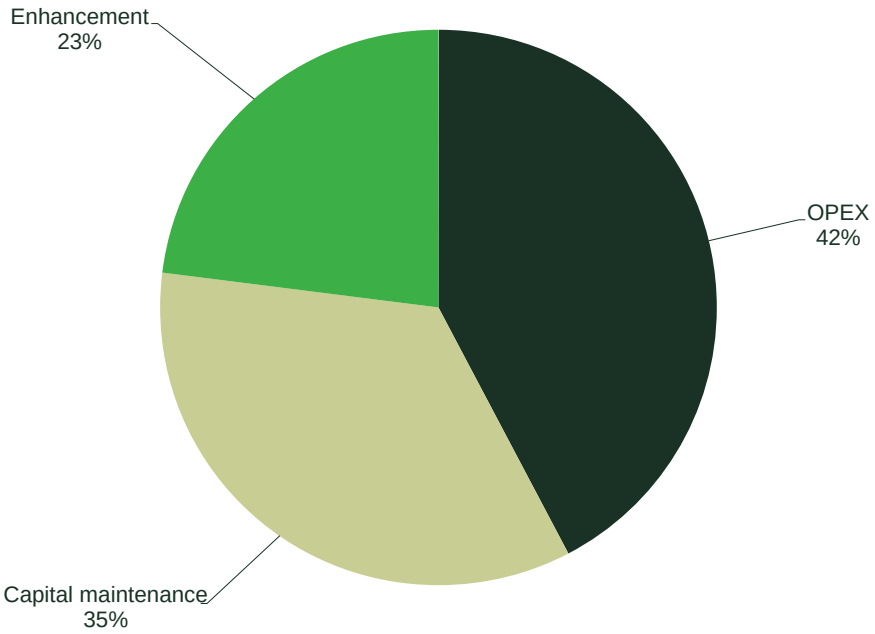
Source: Oxera.

6.1 Top-down analysis

In considering the correlation between water companies' costs and inflation, we first assessed companies' outturn expenditure (on a 'top-down' basis).

Figure 6.1 and Figure 6.2 show the different components of TOTEX as forecast at PR14 over the 2015–20 period.

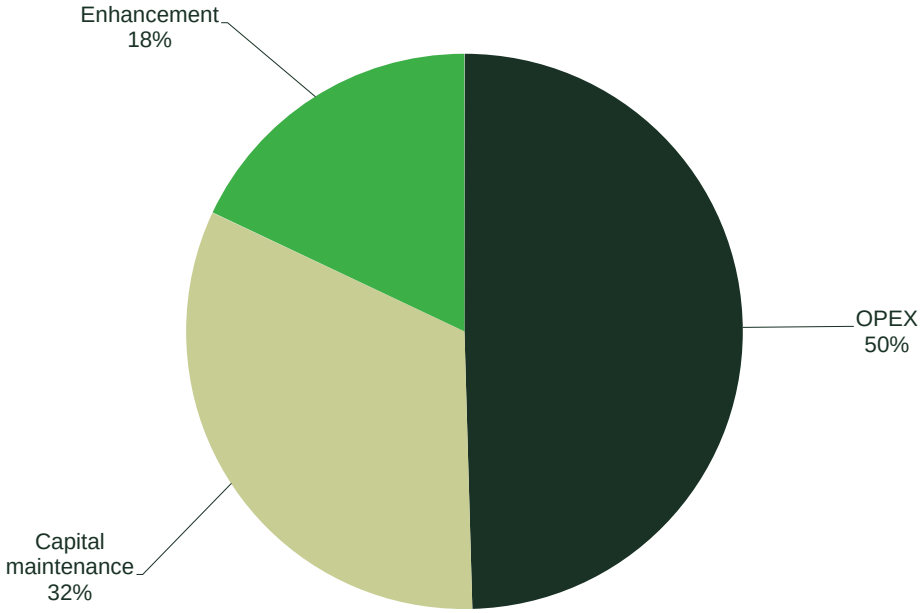
Figure 6.1 Composition of water and sewerage companies' TOTEX for 2015–20



Note: Enhancement includes infrastructure enhancement and 'new CAPEX'.

Source: Oxera analysis of Ofwat (2014), 'Financial models'.

Figure 6.2 Composition of water-only companies' TOTEX for 2015–20



Source: Oxera analysis of Ofwat (2014), 'Financial models'.

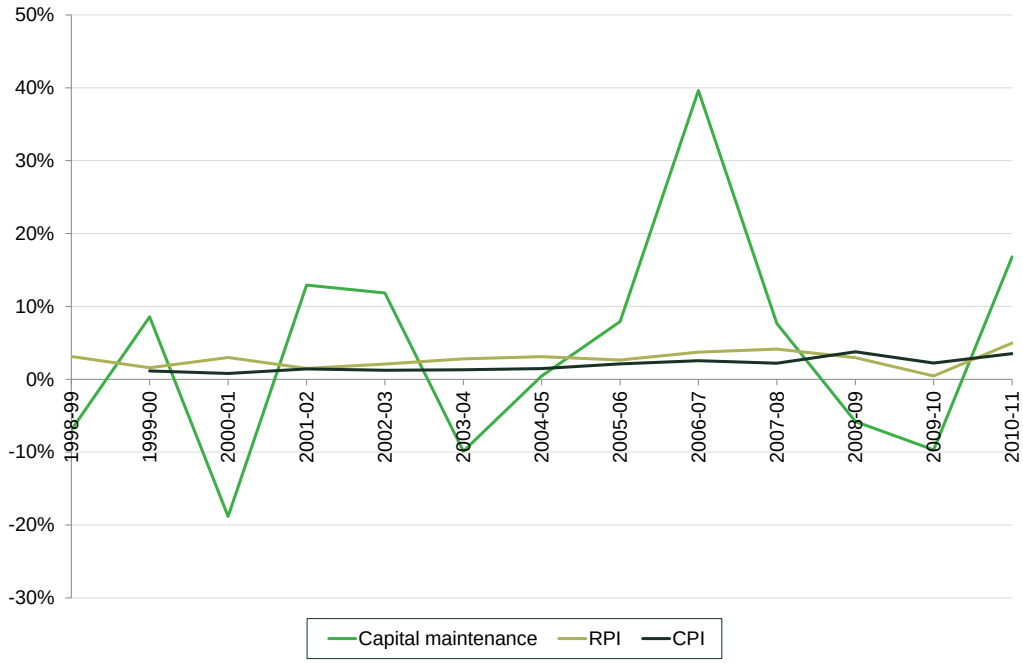
Historically, CAPEX has been somewhat volatile in the water sector.[54] Enhancement expenditure (investment in new service levels) is largely driven by decisions on scope and when to invest.

[54] See Ofwat (2009), 'Future water and sewerage charges 2010-15: final determinations', figure 9.

Capital maintenance expenditure might be expected to be more stable over time, which may enable a relationship with inflation to be observed. However, as shown below, this is not the case.

Figure 6.3 and Figure 6.4 show changes in water and sewerage capital maintenance expenditure compared with RPI and CPI over the years for which data was widely reported in the 'June Return' submissions to Ofwat.

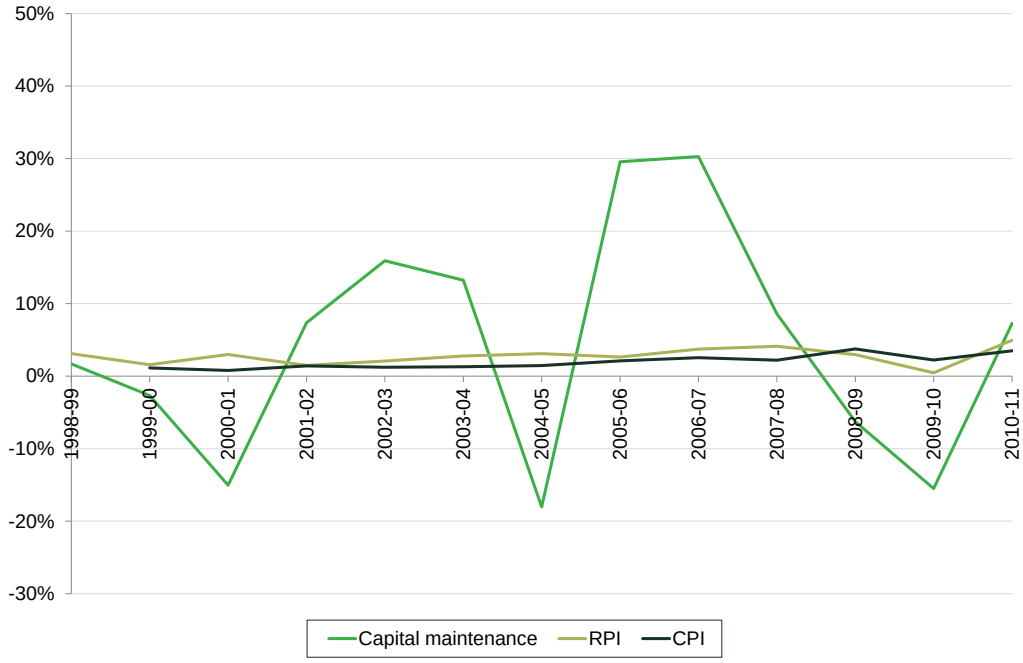
Figure 6.3 Capital maintenance growth rates—water service



Note: Expenditure consists of infrastructure renewal expenditure and non-infrastructure expenditure net of grants and contributions

Source: Oxera analysis of Ofwat's June Return dataset and Office for National Statistics (2015), 'Consumer Price Inflation'.

Figure 6.4 Capital maintenance growth rates—sewerage service



Note: Expenditure consists of infrastructure renewal expenditure and non-infrastructure expenditure net of grants and contributions.

Source: Oxera analysis of Ofwat's June Return dataset and Office for National Statistics (2015), 'Consumer Price Inflation'.

The figures above show that, historically, capital maintenance expenditure has peaked and troughed in five-year cycles, and has exhibited no clear relationship with either RPI or CPI.[55]

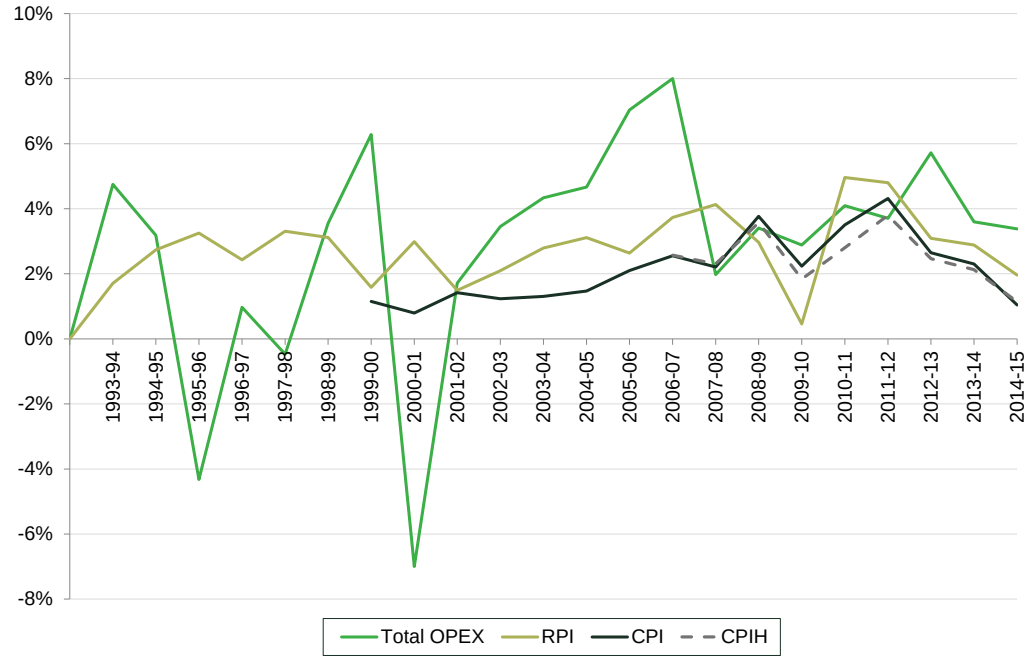
Determining whether this cyclical expenditure has been driven by the regulatory cycle, maintenance cycles, or changes in construction prices[56] is outside the scope of this report. However, relative to the apparent presence of other drivers, it is clear that RPI and CPI are not primary determinants of within-period changes in levels of CAPEX.

Oxera has therefore focused its analysis on exploring potential relationships between RPI, CPI, and CPIH, and the remaining 40–50% of companies' TOTEX: their operating costs.

Figure 6.5 shows how changes in total operating costs have compared with changes in RPI, CPI, and CPIH.

[55] As CPIH has been reported only since 2005, it has been omitted from the above analysis. Arguably it may be assumed that, historically, it may have moved broadly in line with CPI (see section 4.1).
[56] At PR14 Ofwat abandoned the use of the Construction Output Price Index (COPI) for indexing CAPEX. This suggests that the industry did not consider RPI to be a significantly weaker measure of capital inflation than the COPI—a more construction-focused index.

Figure 6.5 OPEX growth rates



Source: Oxera analysis of Ofwat's June Return dataset and Office for National Statistics (2015), 'Consumer Price Inflation'.

Thus, even with operating costs there has been notable volatility from one year to the next.

We have tested the correlations statistically and found no significant relationship between the changes in operating costs and the three measures of inflation. We have also undertaken the analysis separately for the water and sewerage services for years where comparable data is available. The separate service analysis also shows no significant relationship.

Oxera has also considered a number of scenarios and found no significant relationships. These included:

- normalising costs by headcount;
- normalising power costs by average pumping head multiplied by distribution input;
- comparing cost allowances at the price review with outturn expenditure; and
- using November–November changes in inflation rather than financial year average.

Oxera has assessed cost movements over different time periods in case a correlation were to be observed for a limited time only. We found that there may have been a relationship between changes in OPEX and RPI over the period 2001–07. However, the statistical indicators significantly deteriorate when the time period is moved a single year in either direction, suggesting that the observed correlation may be more driven by chance than a strong causality.

Oxera has therefore concluded that, at a headline level, the effect of inflation (as measured by RPI, CPI, and CPIH) on water companies' expenditure cannot be readily observed. Companies' expenditure is likely to be predominantly driven by a range of other factors, such as changes in efficiency, significant weather (or

failure) events, changes in service levels/demand/outputs delivered, and other exogenous factors.

This does not necessarily mean that no relationship exists; it may simply be masked by all the above factors. Therefore, section 6.2 considers some of the underlying inputs into water companies' cost bases to assess the extent to which they may be correlated with the measures of inflation.

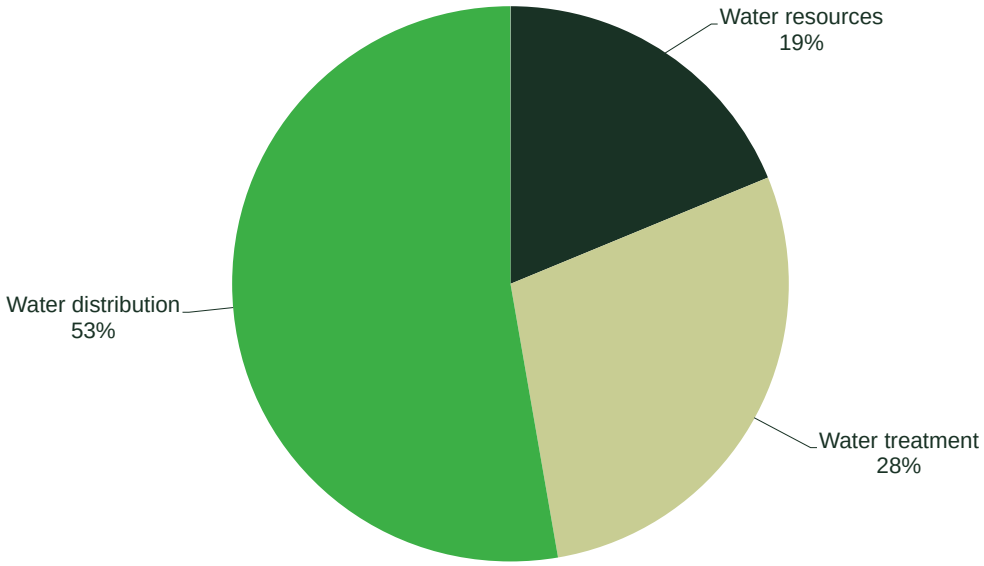
6.2 Understanding the make-up of water company costs

The different cost types that companies incur are first assessed, and the extent that the inflation measures may correlate with some of the key underlying drivers of water companies' costs is then considered.

6.2.1 Analysis of the costs that companies incur

The figures below present a breakdown of the component cost types across the value chain and on an aggregated basis.[57]

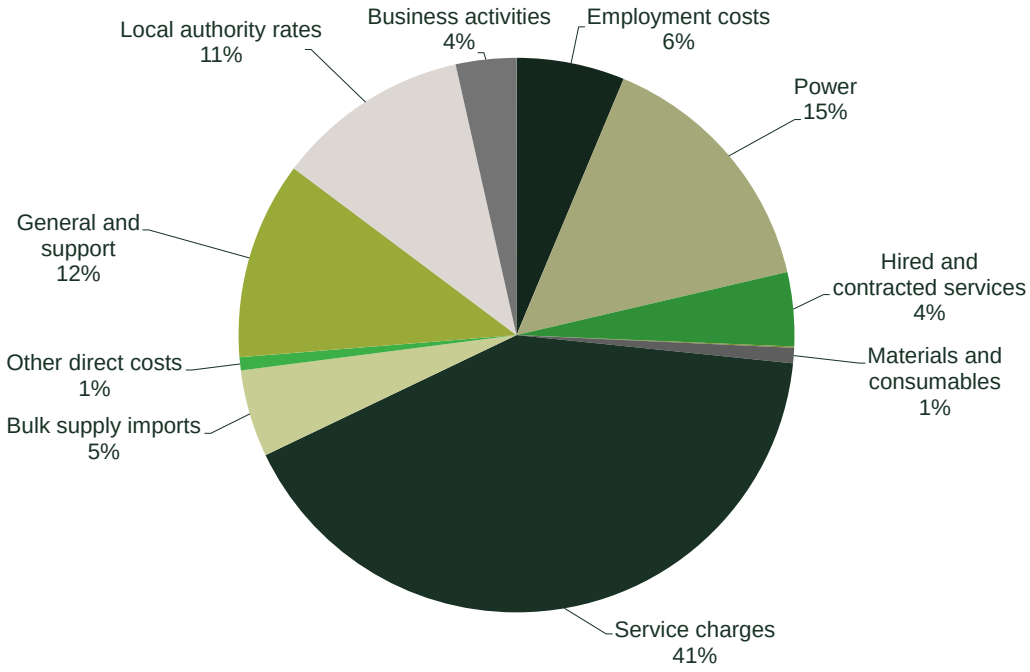
Figure 6.6 Water service OPEX by value chain component



Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

[57] Retail has been excluded from this analysis due to it not receiving inflation indexation.

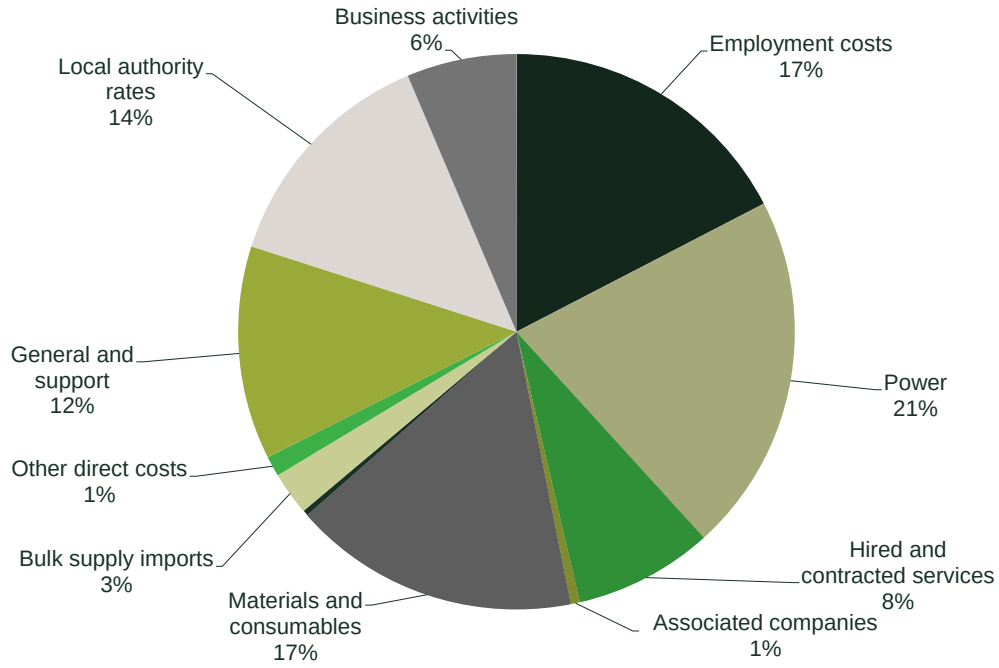
Figure 6.7 Water resources OPEX by cost type



Note: Service charges are made by the Environment Agency. Bulk supply imports are payments for importing water from a neighbouring undertaker. Business activities relate to scientific services and other miscellaneous activities.

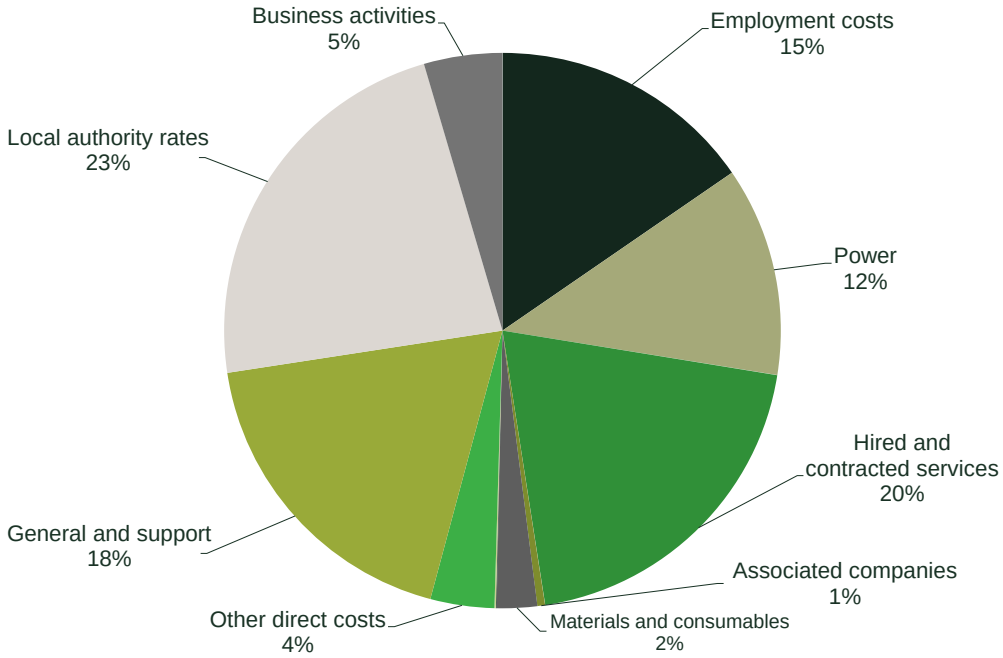
Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.8 Water treatment OPEX by cost type



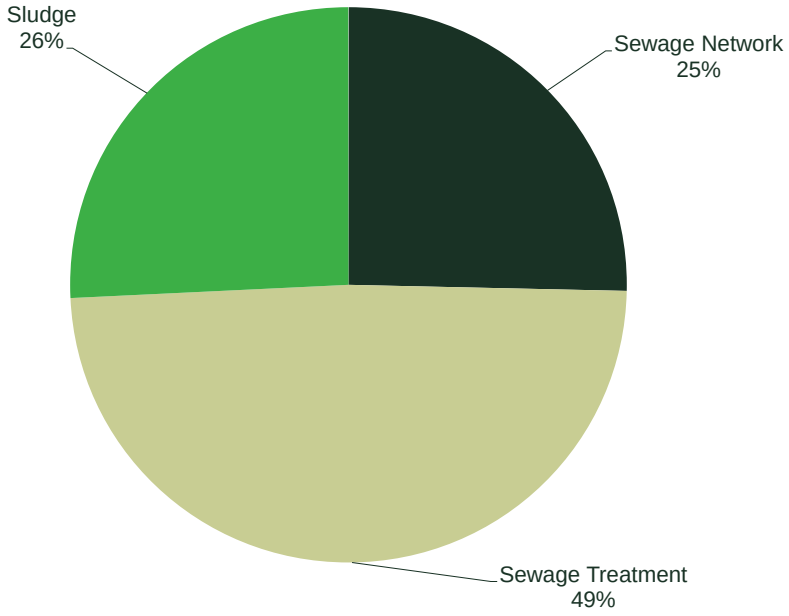
Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.9 Water distribution OPEX by cost type



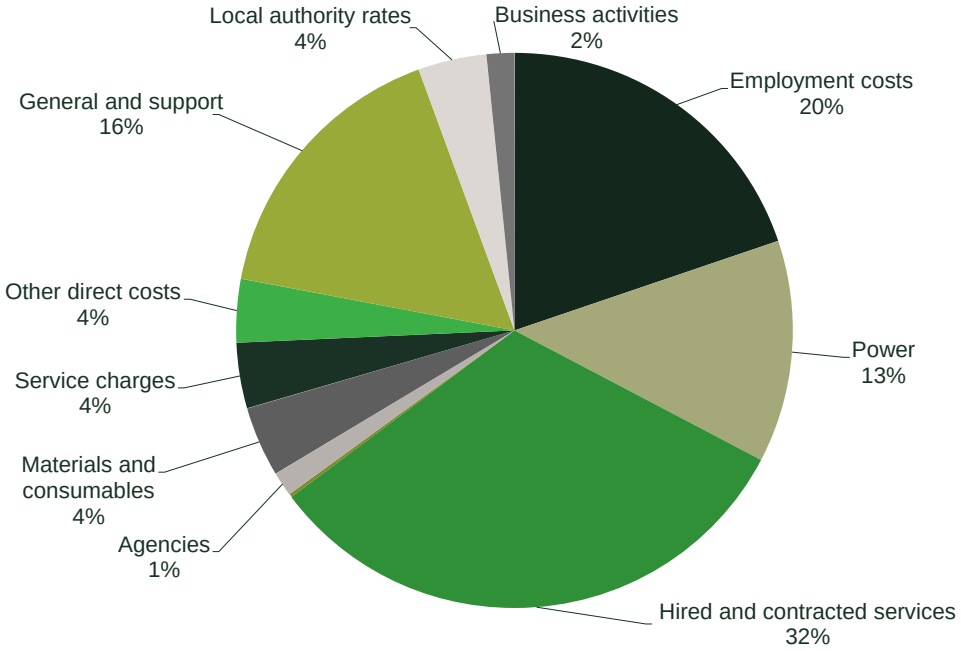
Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.10 Sewerage service OPEX by value chain component



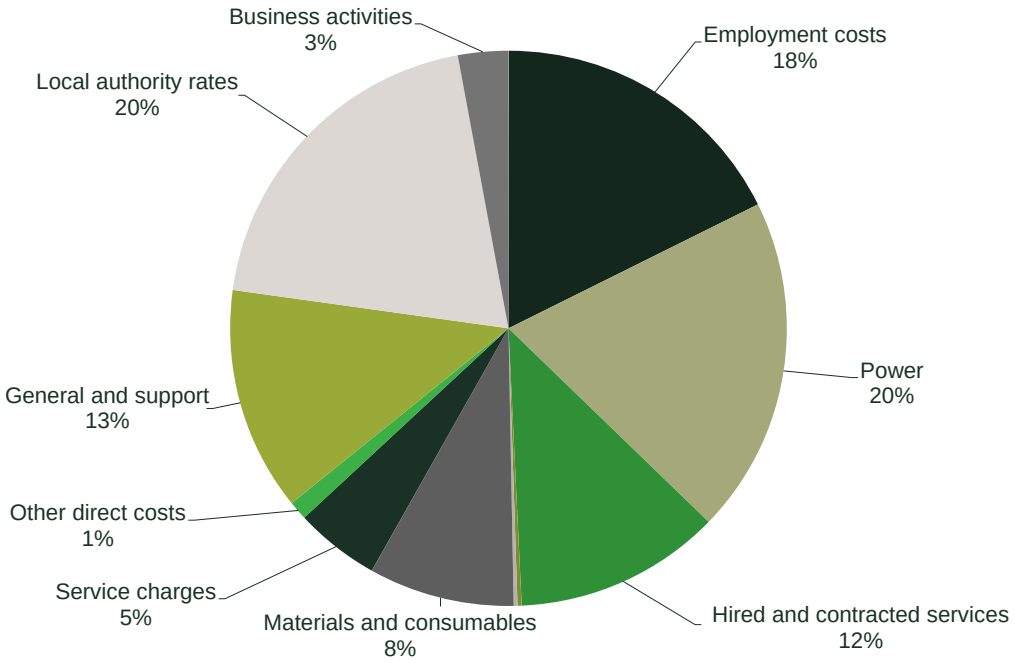
Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.11 Sewerage network OPEX by cost type



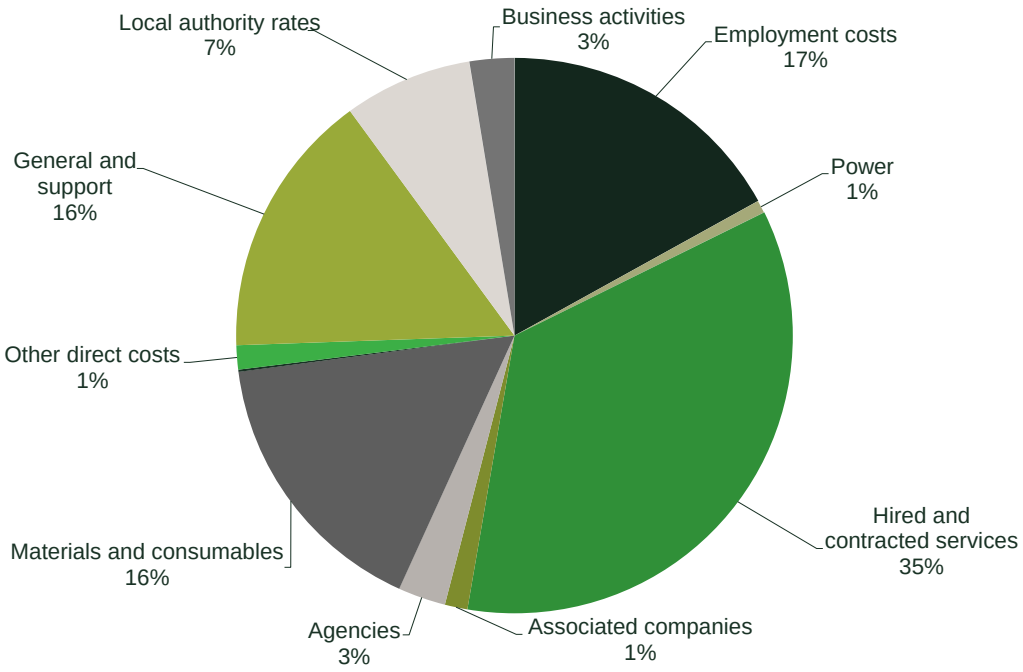
Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.12 Sewerage treatment OPEX by cost type



Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figure 6.13 Sludge OPEX by cost type



Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Figures 6.6–6.13 are summarised in the Tables 6.2 and 6.3.

Table 6.2 Composition of water service OPEX

	Water resources	Water treatment	Water distribution	Total
Employment costs	6%	17%	15%	14%
Power	15%	21%	12%	15%
Hired and contracted services	4%	8%	20%	14%
Associated companies	0%	1%	0%	0%
Materials and consumables	1%	17%	2%	6%
Service charges	41%	0%	0%	8%
Bulk supply imports	5%	3%	0%	2%
Other direct costs	1%	1%	4%	2%
General and support	12%	12%	18%	15%
Local authority rates	11%	14%	23%	18%
Business activities	4%	6%	5%	5%
Total	**19%**	**29%**	**53%**	**100%**

Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

Table 6.3 Composition of sewerage service OPEX

	Sewage network	Sewage treatment	Sludge	Total
Employment costs	20%	18%	17%	18%
Power	13%	20%	1%	13%
Hired and contracted services	32%	12%	35%	23%
Associated companies	0%	0%	1%	1%
Agencies	1%	0%	3%	1%
Materials and consumables	4%	8%	16%	9%
Service charges	4%	5%	0%	3%
Bulk supply imports	0%	0%	0%	0%
Other direct costs	4%	1%	1%	2%
General and support	16%	13%	15%	15%
Local authority rates	4%	20%	7%	13%
Business activities	2%	3%	3%	3%
Total	**25%**	**49%**	**26%**	**100%**

Source: Oxera analysis of Ofwat's June Return dataset, 2011–12 data.

As the tables illustrate, the parts of the value chain have different mixes of cost types. For example, nearly half of water resource OPEX is incurred on service charges (charges made by the Environment Agency), and the treatment parts of the value chain are (comparatively) power-intensive. However, there are some components that are common across the value chain. In particular, labour costs constitute a significant proportion of costs.

How the major common components of costs may be affected by underlying drivers of inflation is assessed below.

6.2.2 Underlying drivers of water company costs

Ofwat has previously considered around 50% of OPEX to be labour-related.[58] As well as the 'employment costs' category, labour costs are also major components of the 'hired and contracted services', and 'general and support' categories. Based on Oxera's analysis of the underlying data, labour, power, and local authority rates costs combined comprise approximately 80% of water companies' OPEX. The Competition Commission (now the Competition and Markets Authority) considered labour costs to be the single biggest component in the input mix for CAPEX.[59]

Therefore, we have assessed how underlying labour and power prices and local authority rates are correlated with the measures of inflation. While such input cost pressures may not be observed in companies' costs for any single year (due to companies' specific remuneration and power-hedging policies), they may have a medium- to long-term effect on companies' costs.

Labour costs

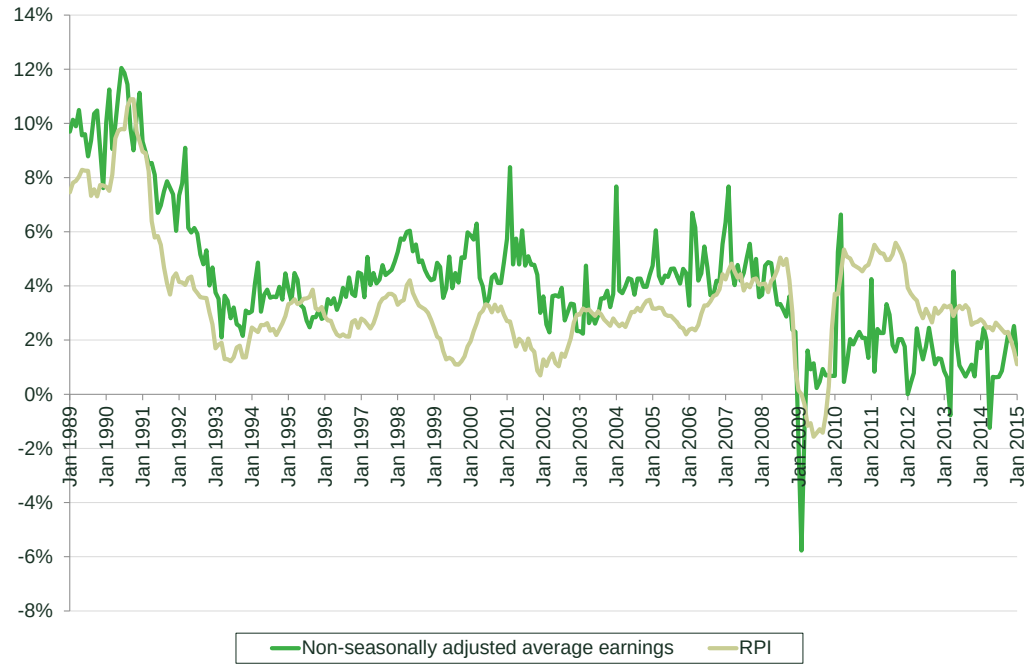
In the long run, a relationship between labour costs and inflation can be expected. Labour costs are a key input which affects prices of most goods in the economy, and ultimately feed into inflation statistics.

[58] Competition Commission (2010), 'Bristol Water Plc price determination – Appendix K', paras 114–5. The figure was 59% but the assessment included bad debt and excluded power. Adjusting for these gives a figure around 50%.
[59] Competition Commission (2010), 'Bristol Water Plc price determination', para. 4.10.

There are different measures of labour cost inflation. The ONS reports labour costs per hour (both seasonally and non-seasonally adjusted), and average earnings data (both seasonally and non-seasonally adjusted). Each dataset is reported from 2000. More historical earnings data is available (on a non-seasonally adjusted basis); however, this does not come with the same methodological assurances.

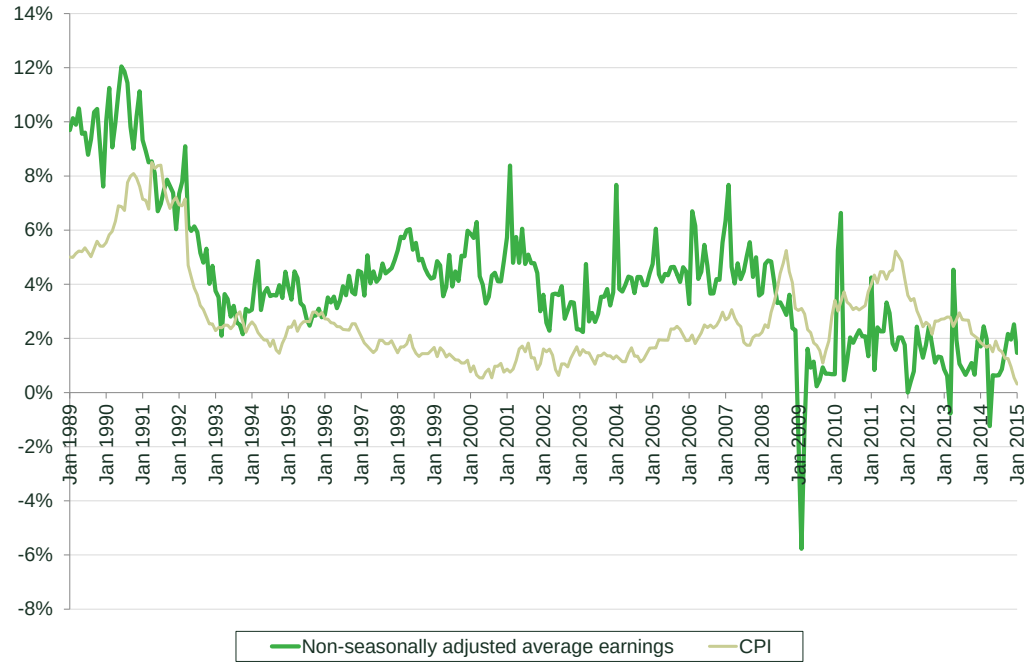
In the first instance, Oxera has considered relationships between earnings and the inflation measures using the longer dataset. This is set out in Figure 6.14 and Figure 6.15.

Figure 6.14 Earnings and RPI annual growth



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Office for National Statistics (2015), 'Average Weekly Earnings' (monthly data).

Figure 6.15 Earnings and CPI annual growth



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Office for National Statistics (2015), 'Average Weekly Earnings' (monthly data).

Both measures of inflation exhibit a positive relationship with average earnings. Regression statistics are set out below.

Table 6.4 Average earnings, RPI and CPI regression statistics

	RPI	CPI
R^2	0.45	0.27
P-value	0.00	0.00
Coefficient (earnings as the dependent variable)	0.82	0.74

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation' (monthly seasonally adjusted data from January 1989 to October 2015).

The regression statistics suggest that, over the time period considered, there is a positive relationship between both measures of inflation and average earnings, the correlation with RPI being slightly stronger than with CPI.

However, running regressions from 2000 produced far less pronounced relationships.[60] Oxera found that the relationships completely broke down in the period after the financial crisis.[61] This could either be a medium-term effect due to the idiosyncratic nature of the financial crisis, or could potentially be a more fundamental divergence between labour rates and the measures of inflation.

Historically, labour unions have played a greater role in negotiating salary increases than observed in more recent years. Labour unions may have used the main measure of inflation at the time as the starting point in salary negotiations.

[60] Various datasets listed above were used.
[61] For nearly all scenarios run Oxera found insignificant regression statistics. In some cases we found variables significant at the 10% threshold, but these apparent relationships were not robust to minor changes in the time period.

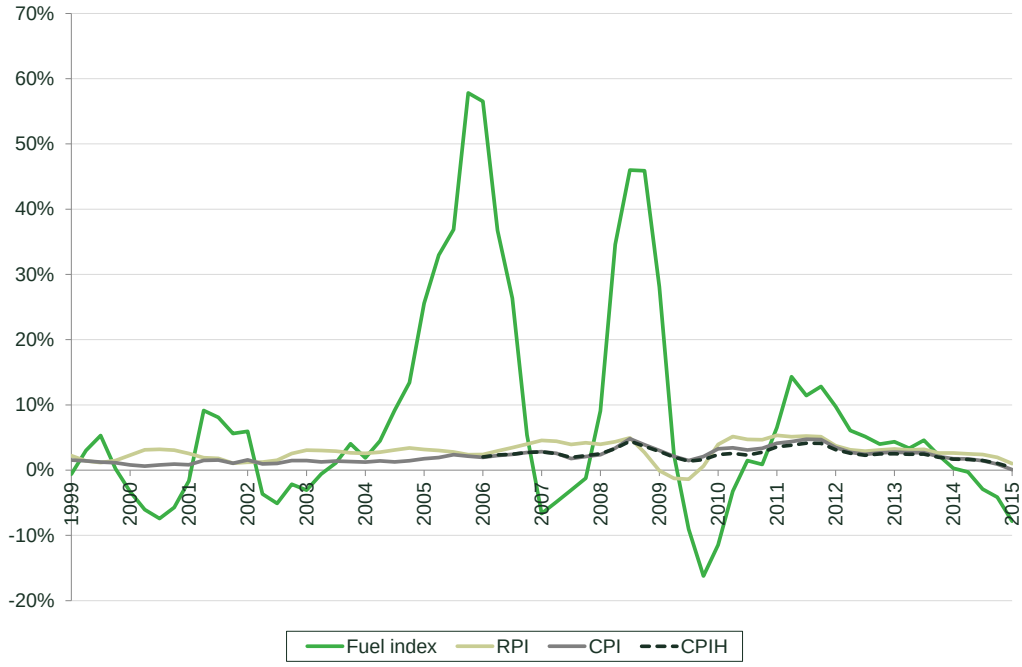
As stated above, CPIH has been reported only since 2005. Oxera did not find a significant correlation with labour prices during this period.

Power costs

There are different measures of power price inflation. We have used a total fuel index, including climate change levies, reported by the Department of Energy & Climate Change (DECC, both seasonally and non-seasonally adjusted).

Changes in the fuel price index and the three measures of inflation are presented in Figure 6.16.

Figure 6.16 Fuel inflation and RPI, CPI, and CPIH



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and DECC (2015), 'Fuel price indices for the industrial sector' (quarterly non-seasonally adjusted data).

As can be seen, over the time period considered there have been two large peaks in fuel price growth. Regression statistics are presented in Table 6.5.

Table 6.5 Fuel index, RPI, and CPI regression statistics

	RPI	CPI
R^2	0.02	0.14
P-value	0.31	0.00
Coefficient (fuel as the dependent variable)	1.44	5.60

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and DECC (2015), 'Fuel price indices for the industrial sector' (quarterly non-seasonally adjusted data from quarter 1, 1999 to quarter 1, 2015).

Table 6.6 Fuel index, RPI, CPI, and CPIH regression statistics since 2010

	RPI	CPI	CPIH
R^2	0.27	0.46	0.63
P-value	0.02	0.00	0.00
Coefficient (fuel as the dependent variable)	2.71	3.68	5.44

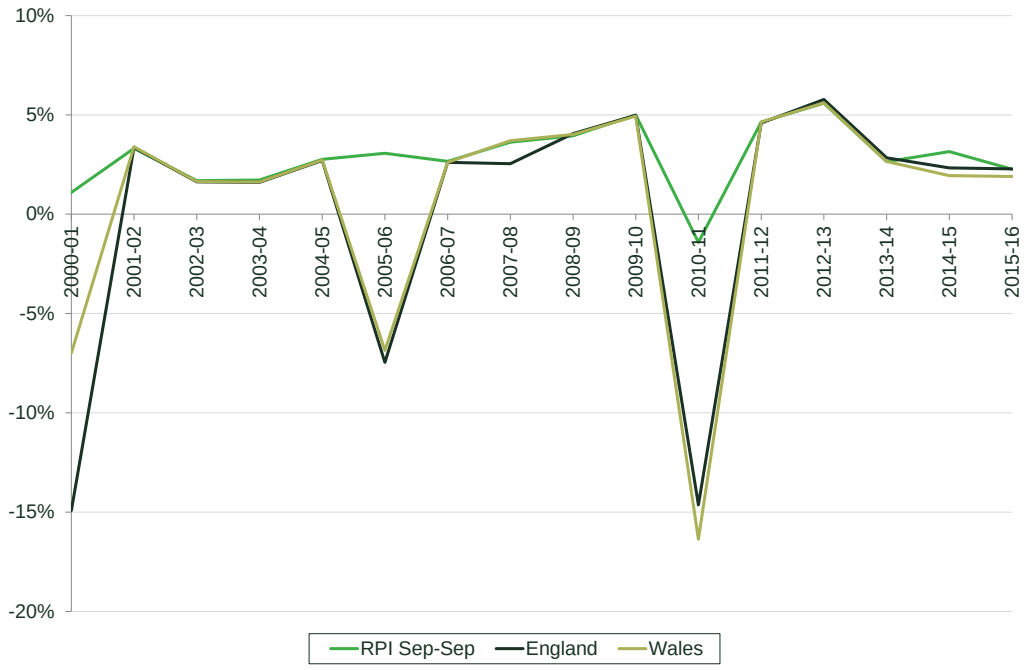
Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and DECC (2015), 'Fuel price indices for the industrial sector' (quarterly non-seasonally adjusted data from quarter 1, 2010 to quarter 1, 2015).

Over both the longer and shorter time periods, the CPI has a stronger relationship with fuel price movements than RPI. Since 2010 the relationship has strengthened, with the CPIH exhibiting some comparatively strong regression statistics.

Local authority rates

Increases in business rates (which comprise around 16% of water companies' OPEX) are currently[62] capped at changes in the September-to-September RPI.[63] However, the full cap is not always taken up, and there have been a number of significant revaluations over time. This is shown in Figure 6.17.

Figure 6.17 RPI and business rates



Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Valuation Office Agency (2015), 'What are the current multipliers?'.

The figure shows that there is a strong relationship in most years, with the significant exception of when revaluations take place. Regression statistics are shown in Table 6.7.

[62] As noted later in this sub-section, the Government is planning changes to this regime from April 2020.
[63] Local Government Finance Act 1988, schedule 7.

Table 6.7 Business rates, RPI, CPI, and CPIH regression statistics (England)

	RPI	CPI	CPIH
R^2	0.57	0.23	0.33
P-value	0.00	0.06	0.11
Coefficient (rates as the dependent variable)	2.96	2.27	2.73

Source: Oxera analysis of Office for National Statistics (2015), 'Consumer Price Inflation'; and Valuation Office Agency (2015), 'What are the current multipliers?'. Annual changes in business rates for the period from 2000/01 to 2015/16 when regressing on RPI and CPI, and the period from 2007/08 to 2015/16 when regressing on CPIH.

As would be expected, business rates have had a stronger relationship with RPI than with CPI or CPIH. However, both CPI and CPIH give similar coefficient values. It should also be noted that the Valuation Office Agency assesses water and sewerage service rateable values using different methods. This may reduce the importance of having a measure of inflation within the price control framework that closely tracks changes in business rates.

Finally, HM Treasury has announced in the 2016 Budget that, from April 2020, business rates will be indexed to CPI rather than RPI.[64] This further reduces the significance of the historical relationship with RPI for selecting an inflation index going forward.

6.2.3 Pension costs

Some of the cash costs that water companies incur relate to pension deficit repair payments. However, these were excluded from the cost modelling at PR14, and have historically been reported separately from the expenditure totals in the June Returns.

A significant proportion of water company defined benefit pension scheme liabilities is likely to be linked to RPI, rather than CPI, due to historical arrangements. Therefore, these costs are more likely to be correlated with RPI. However, companies may be in the process of changing these arrangements. For example, in 2011, Thames Water (the largest water and sewerage company) changed the terms of its pension scheme so that all benefits beyond that point would be CPI-linked. Oxera understands that Northumbrian Water has also made some of its pension liabilities CPI-linked.

The actual allowance for pension deficit recovery costs included in PR14 price limits and for cash pension contribution costs is relatively small as a proportion of total allowed costs (around 2.5% of TOTEX in total).[65]

Furthermore, it is debatable whether pension deficit recovery costs are a relevant consideration for selecting an inflation index going forward, given Ofwat's stated policy position on remunerating pension deficit costs. In 2013, it stated that it would reflect part of companies' pension deficits in the revenue limits over 2015–20, but would make no further allowances after that period.[66]

This, however, does not remove the underlying volatility in pension liabilities and costs to which companies are exposed.

[64] HM Treasury (2016), 'Budget 2016', March.
[65] Based on analysis of PR14 financial models.
[66] Ofwat (2013), 'IN 13/17 - Treatment of companies' pension deficit repair costs at the 2014 price review'.

6.3 Implications for selecting an index going forward

Statistically, there has been limited (if any) correlation between annual changes in RPI, CPI, and CPIH and water companies' costs.

This does not imply that costs are not subject to inflationary pressure in the long term, but highlights the difficulty of unpicking the influence of other factors on year-to-year movements in costs. These factors could include a range of exogenous factors such as changes in efficiency, significant weather (or failure) events, changes in service levels/demand/outputs delivered, and other cost movements that are not directly reflected in the three measures of inflation considered.

The largest single type of cost that a water company faces is labour costs. Both RPI and CPI are positively correlated with long-term earnings. Historically, RPI has had a slightly stronger correlation, although in recent years the relationship has broken down for all three measures of inflation.

There is some positive correlation between the inflation measures and power price inflation, particularly in recent years, with CPI and CPIH having a stronger correlation than RPI. On the other hand, RPI has historically been more correlated with changes in business rates than the other two measures of inflation. However, the government has announced a planned change to the indexation of business rates from RPI to CPI from April 2020.

In summary, the analysis is inconclusive. None of the measures of inflation is a strong indicator of water company costs. Equally, none of the measures appears to be obviously superior to the other two.

Theoretically, CPI and CPIH may have some advantages in that their calculation methods allow for time-reversibility (as discussed in section 4.2.2). Moreover, based on the composition of the underlying indices (reviewed in section 4), intuitively using an index that is not dominated by mortgage interest payments—i.e. using an index such as CPI rather than RPI—may be more reflective of the cost trends of a water business.

It is worth noting that there might be a circularity between the regulator's choice of inflation index and how costs move over time. Historically, companies may have been minded to enter into RPI-linked contracts with suppliers due to their revenues being RPI-linked, rather than any non-regulatory reason for RPI being a more appropriate measure than an alternative index (such as CPI).

For example, if a regulator switches to CPI indexation, this might give companies an incentive to transfer any existing RPI-linked cost contracts to CPI-linked ones. Therefore, going forward the relationship between the industry costs and the underlying indices may change relative to observed historical trends.

All in all, based on the evidence reviewed in this section it is not clear that CPI (or CPIH) is any less correlated with the underlying water company costs than RPI. Therefore, we conclude that there is no clear and robust evidence to suggest that the operational risk faced by the industry will materially change following a change in the indexation measure.

7 Financing costs and financeability

This section considers how a change in the indexation approach might affect the financing costs and financeability of the industry.

In order to evaluate some of these effects, in addition to desktop research, Oxera has conducted structured interviews with a range of stakeholders, including credit-rating agencies, debt investors, equity investors, pension insurers, banks and equity analysts.

Specifically, this section is structured as follows:

- section 7.1analyses how different indexation options affect the risk to the value of the firm, and hence, financing costs;
- section 7.2 reviews evidence on the availability and cost of CPI-linked debt products, and discusses whether this has any further implications for the industry's financing costs;
- section 7.3 considers the potential impact on financeability.

Our conclusions and the implications for the overall assessment of benefits and costs of the options are summarised upfront.

Key findings

Risk to the value of the firm

A useful measure of risk faced by all investors in a firm in aggregate is the volatility of the enterprise value. Changes in risk to the value of the firm could translate into changes in the rates of return required by investors. This could subsequently translate into a cost or benefit to consumers.

Based on a range of reasonable assumptions for the volatility and correlation of different inflation statistics, we consider the volatility of the enterprise value of a water company experienced as a result of deviations in the outturn RPI and CPI relative to forecast. We do this on a forward-looking basis.

Our analysis suggests that, first, inflation uncertainty drives only a small proportion of the overall volatility of firm value.

Second, any option for change that involves some transition for the indexation of the RCV does not increase this volatility.

If anything, nominal volatility is reduced in almost all cases. CPI is less volatile than RPI, and this reduces the volatility of a significant proportion of firm value. This result holds for a range of notional capital structures considered, including financing structures that include a substantial proportion of RPI-linked debt.[67]

There is also no assumption that existing RPI-linked debt needs to be refinanced as a result of any change. Since there is no material change in the volatility of firm value, there is unlikely to be any change to the firm's ability to service existing RPI-linked liabilities—hence, there is no obvious rationale for refinancing these liabilities early.

[67] As high as 62.5% of the RCV.

We therefore conclude that there is unlikely to be a material, robustly quantifiable impact on the industry's risk (and hence financing costs) under any of the options for change considered.

Our assessment is performed for the value of the firm in aggregate. We note that the impact may be felt differently by different groups of debt/equity investors.

For the purposes of assessing the implications of a change in the regulatory framework for risk and required returns, it is arguably the aggregate impact that is most relevant. Explicit recognition of a potential increase in risk for one specific investor group in allowed financing costs would need strong justification and evidence. Further, if consideration is given to one group of investors that may face higher risk, then similar considerations need to be given to other investor groups, some of which may face lower risk.

Given that, in aggregate, risk is not increasing and there is a market for equity and debt investment in the sector, it is unlikely to be in consumers' interests for the indexation choice to be unduly influenced by the needs of one specific investor group.

We have not performed the same analysis using CPIH, given the more limited dataset available for this measure. However, given that CPI and CPIH have historically moved closely together (see section 4), the same conclusions would be expected to hold under options that involve CPIH rather than CPI.

Availability and cost of CPI-linked debt products

In assessing the potential benefits and costs of different indexation options, it is not evident that there is a need for Ofwat to demonstrate that a sufficiently liquid CPI-linked debt market exists.

Although there was an RPI-linked government debt market when RPI - X price controls were introduced, the RPI-linked corporate debt market was insignificant. Inflation indexation of revenues and the RCV, as discussed in section 2, was not motivated by a desire to accommodate particular financing options.

Further, Ofwat's existing framework for the assessment of the allowed cost of debt for the industry primarily relies on evidence from nominal debt markets.

The benefits of existing RPI-linked debt are currently taken into account by Ofwat (on a notional basis) in its financeability assessment. However, suitable adjustments to financeability testing in PR19 can be made to ensure that the tests remain faithful to Ofwat's updated view of the appropriate efficient notional capital structure and financing mix.

Notwithstanding these observations, and the earlier conclusion that there is unlikely to be any change in risk and financing costs that is relevant for assessing the benefits and costs of change, we understand that the industry is concerned about the potential availability and cost of CPI-linked products.

We find that a CPI-linked debt market is currently in its infancy, with the absence of a government CPI-linked bond market a key driver of this. Predicting the costs and speed of development of such markets is difficult.

On the one hand, it is conceivable that, at least initially, CPI-linked products will be more expensive than other debt instruments currently available to the industry.

On the other hand, there are other drivers, such as growing pension fund demand for CPI-linked assets, which could help to unlock a competitive CPI-linked market more rapidly than observed historically for other nascent financial instruments.

Given the uncertainty around the cost and availability of CPI-linked products, it might be reasonable for Ofwat to assume no CPI-linked debt issuance for the next price control period, unless robust evidence emerges to the contrary.

In practice, companies' financing choices are driven by a range of factors, not just the indexation metric used by the regulator in the price control. It may well be the case that companies continue to use a mix of nominal and RPI-linked debt, as well as explore opportunities for CPI-linked issuances. ***Overall, these observations also do not suggest material changes to the financing costs of the industry under any of the indexation options considered.***

Impact on financeability

All else being equal, any development that involves changes to the indexation of the RCV is likely to improve financial credit ratios in the short to medium term.

This assumes that the NPV-neutrality of any proposed change is preserved and that no offsetting changes through the use of PAYG levers and/or RCV run-off rates are made. If such levers are used, at worst, credit metrics will remain at the same level as under the current regime (assuming no material changes to rating agencies' methodologies).

Assessing the longer-term impact of any proposed change on financeability is more uncertain.

It is reasonable to assume that some changes in the financing mix and debt levels would occur; however, the extent to which such changes go beyond 'normal' cash-flow and risk-management requirements of a regulated business is unclear. Long-term impacts on financeability will also depend on whether the rating agencies adjust their methodologies in response to the change in the indexation approach (e.g. regarding the treatment of index-linked debt and potential changes in PAYG and run-off rates). To date, the agencies have not explicitly committed to any changes in their methodology. Therefore, at this stage, there is no obvious benefit or cost to consumers under any of the alternative indexation options considered.

Evaluation of the options

Table 7.1 summarises the implications of the analysis in this section for the overall assessment of the benefits and costs of the different options for change.

Table 7.1 Options for change: impact on financing costs

Option for change	Benefit or cost relative to Option 1 (no change)
Option 2: only revenue indexation is changed	No material benefit or cost.
Option 3: full switch	No material benefit or cost.
Option 4: transition based on the notional proportion of RPI-linked debt	No material benefit or cost.
Option 5: transition based on Water 2020 preferred option	No material benefit or cost.
Option 6: transition based on notional equity	No material benefit or cost.
Option 7: transition based on new RCV only	No material benefit or cost.

Source: Oxera.

7.1 Risk to the value of the firm

As introduced in section 3, a useful measure of risk faced by all investors in a typical firm in aggregate is the volatility of the nominal enterprise value. If this volatility is driven by the regulator's choice of the inflation statistic, then a change to this statistic within the regulatory framework could affect the risk profile of the business. Changes in risk to the value of the firm could then translate into changes in financing costs, if material.

Specifically, for a typical water company, it is helpful to consider the following separate effects that deviations in outturn inflation from forecast have on the value of the business, and hence its volatility.

- ***'Within-price-control-period' volatility of net operating cash flows***. Net operating cash flows are defined here as revenues minus cash costs (i.e. TOTEX). Revenues are either linked to RPI or CPI, and hence, their volatility depends on the outturn volatility of RPI or CPI. The impact of revenue inflation indexation on the volatility of the net cash flows then in turn depends on whether TOTEX varies with outturn inflation. Given our finding in section 6 that there is no strong relationship between year-on-year fluctuations in water industry TOTEX and any of the chosen inflation statistics, a reasonable simplifying assumption is that TOTEX within the price control period does not vary with outturn inflation.
- ***Impact of inflation on the RCV***. There is a linear relationship between RCV and the inflation statistic used to index the RCV.
- ***Impact of inflation on debt costs***. For companies with RPI-linked debt, there is a linear relationship between coupon payments and debt principal on this debt and movements in RPI.

Another component of a water company's financing costs are interest payments on nominal debt. These can be treated as fixed throughout the price control period, and will not depend on the level of outturn inflation.[68]

It should be noted that changes in the volatility of the nominal value of the firm indicate how risk changes for all investors in the firm on aggregate. The impact for different types of investors may be different to this aggregate effect. To what

[68] Some companies may also have floating rate debt, but this tends to form a much smaller part of financing and so is not considered explicitly. Furthermore, in practice, if new debt is raised during the period, the exact interest payments will depend on the debt rate at which companies are able to issue new debt. However, for the purposes of the modelling, it is assumed that all debt is raised at the regulator's allowed cost of debt.

extent this needs to be explicitly considered in analysing the options is discussed later in this section.

First, we outline the modelling assumptions used to analyse the change in the volatility of firm value (sub-section 7.1.1). Second, we examine the contribution of inflation risk to the total volatility of firm value for a company with no RPI-linked debt, and consider how it varies under different indexation options (sub-section 7.1.2). Third, we assess how the introduction of RPI-linked debt changes this relationship and what implications this has for the evaluation of the options (sub-section 7.1.3).

7.1.1 Modelling approach

To assess the potential impact of the different indexation options considered on risk, we have modelled the volatility of the enterprise value of a water company experienced as a result of deviations in the outturn RPI and CPI relative to forecast. We have defined the enterprise value of a regulated business in section 3.2 as the sum of the PV of net cash flows during a five-year price control period and the PV of the closing RCV at the end of the price control period.

The volatility of the enterprise value is a useful measure of risk. It captures annual cash-flow volatility during a price control period as well as the impact on long-term value. Focusing on the enterprise value also allows an assessment of changes in risk for the business as a whole, which is what is most relevant for understanding any implications for the required rate of return. Finally, there is data on the overall volatility of the enterprise value of the listed water companies. This can provide a reference point for understanding the implications of any changes in volatility observed under different indexation options.

We analyse the volatility of the enterprise value using Monte Carlo simulation modelling, as well as a simple stylised model. The analysis is performed in all cases for a stylised water company in nominal terms using the following methodology and assumptions:

- TOTEX projections, allowed WACC, opening RCV, PAYG rates and depreciation run-off rates match the industry assumptions used at PR14;
- no out- or underperformance on any of the regulatory assumptions: the only metrics that vary from forecast are the assumed outturn levels of RPI and CPI used to index revenues, RPI-linked debt costs and the RCV;
- CAPEX is funded at the notional level of gearing of 62.5%, with dividends adjusting to maintain static gearing;[69]
- any new debt issuance during the period is in the form of nominal debt, and there is no refinancing of existing RPI-linked debt.

In sub-section 7.1.2we first assume no RPI-linked debt in the capital structure. In sub-section 7.1.3, the proportion of existing RPI-linked debt is set at either 50% or 100%. On a notional capital structure of 62.5% gearing, this is equivalent to either 31.25% or 62.5% of the RCV at the start of the modelling period being funded with RPI-linked debt. When comparing this with the actual levels of RPI-linked debt held by the industry, on average, RPI-linked debt represents 35% of

[69] This assumption is not critical to the results.

the industry RCV.[70] The averages are 34% and 51% for water and sewerage companies and water-only companies, respectively.[71]

Therefore, the assumption that existing RPI-linked debt is either 50% or 100% of the existing debt on a notional capital structure appears to encompass a reasonable range of actual financing structures observed in the industry. It should be noted that these proportions are also materially higher than the assumption used by Ofwat at PR14, where 33% of existing debt at the start of 2015 was assumed to be RPI-linked.

In calibrating the potential shocks to RPI and CPI, we have relied on historical data on the volatility and correlation between RPI and CPI. Specifically, standard deviation of RPI and CPI is assumed to be 1.5% and 1.2% respectively, based on observed historical volatility of the two indices over the 2000–15 period. This captures the full period since CPI has been officially published and includes the period of significant volatility in RPI during the financing crisis, including a period of negative RPI. Over the same historical period of 2000–15, the correlation coefficient between RPI and CPI has been 0.6.

7.1.2 Risk to value with no RPI-linked debt

First, it should be noted that, historically, the annual volatility of equity returns of the listed water companies has been in the range of 20–25%.[72] Average gearing of the three listed water companies is below the 62.5% notional level. Combined with the simplifying assumption that the market value of debt has negligible volatility, this translates into annual volatility of the enterprise value at or just below 10%, rounding for ease of presentation. Any observation about the contribution of inflation risk to this overall volatility, and how this contribution changes, should be considered in this context.

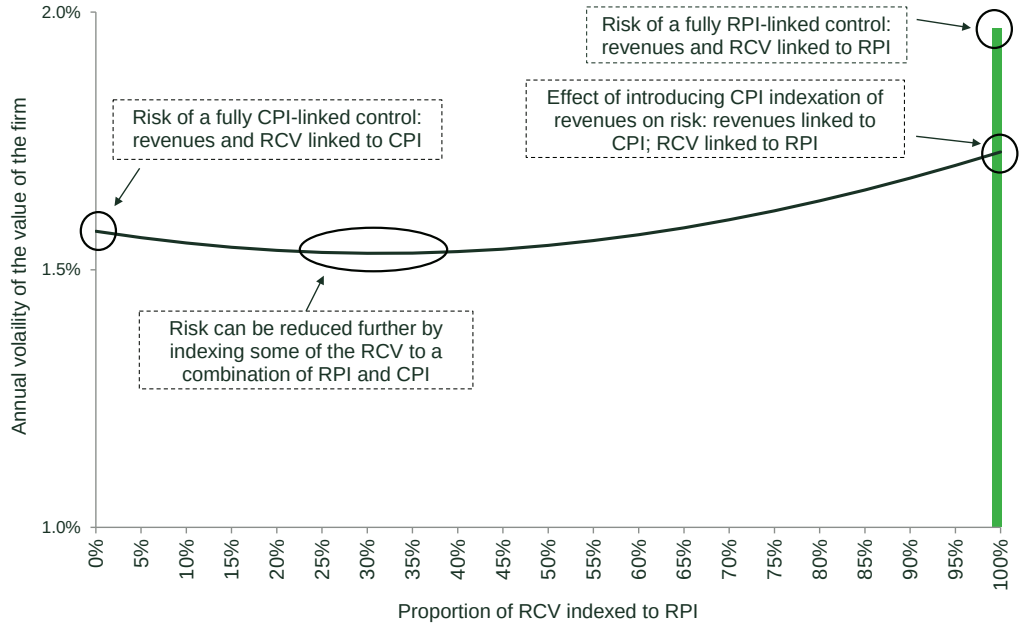
Based on our modelling, we observe the following.

- Under the current regulatory framework where both revenues and the RCV are indexed to RPI, for a company with no RPI-linked debt, the annualised volatility of firm value driven by deviations in outturn RPI from forecast during a five-year price control period is less than 2%.
- Changing the indexation of revenues only from RPI to CPI reduces this volatility. This is because a part of firm value is now driven by a less volatile measure of inflation.
- Changing the indexation of the RCV from RPI to CPI further reduces this volatility, for the same reason.
- The total reduction in risk achieved by the indexation of both revenues and the RCV to CPI compared to a fully RPI-linked control, however, is small—less than 0.5%.
- If the objective were to reduce inflation risk further, this could be achieved by choosing a combination of RPI and CPI to index the RCV. This can be thought of as a ‘portfolio’ diversification effect.[73]

[70] Using data for 2014–15, weighted average. This includes RPI-linked swaps.
[71] Using data for 2014–15, weighted average. This includes RPI-linked swaps.
[72] Based on historical share price data for Pennon, United Utilities and Northumbrian from Datastream over the 2000–15 period.
[73] Since RPI and CPI are not perfectly correlated, a combination of both statistics can result in a lower volatility of firm value compared with a scenario where only one statistic is used.

These effects are illustrated in Figure 7.1.

Figure 7.1 Linkage between inflation and risk, no RPI-linked debt



Source: Oxera.

For the avoidance of doubt, this analysis is presented in order to understand the link between inflation and risk; not to identify an indexation approach that results in lowest risk.

What the analysis shows is that, in principle, CPI indexation of both revenues and some (or all) of the RCV reduces the contribution of inflation risk to the overall risk of firm value. However, the potential risk reduction is small (less than 0.5%), when considered against the overall volatility of firm value of about 10%.

7.1.3 Risk to value with RPI-linked debt

Table 7.2 presents the results of the modelling, using the assumption that either 50% or 100% of existing debt is RPI-linked on a notional capital structure.

Table 7.2 Annual volatility of the enterprise value

Volatility, measured as standard deviation (%)	Option 1: no change	Option 2: CPI indexation of revenues only	Option 3: full switch to CPI	Option 5: Water 2020 proposal	Option 7: transition based on new RCV only
50% existing debt is RPI-linked	1.3%	1.0%	1.1%	1.0%	1.0%
100% existing debt is RPI-linked	0.9%	0.7%	1.0%	0.8%	0.7%

Note: The impact for five rather than all seven options is presented for conciseness.

Source: Oxera.

Table 7.2 shows that, as in the previous example, CPI indexation of revenues only (option 2) also reduces the volatility of firm value attributable to inflation.

For the notional company with 50% of existing debt that is RPI-linked, volatility also reduces under all other options that involve changing the basis of RCV indexation. As before, the reductions are small (0.3% at most).

The only case where volatility increases is for the notional company with 100% of existing debt that is RPI-linked under option 3 (where all of the RCV is indexed by CPI). However, the increase in volatility relative to option 1 is 0.1%. Again, in the context of the overall volatility of firm value of around 10%, this increase is small.

The volatility of the major components of firm value—the PV of net operating cash flows and the PV of closing RCV—is reduced if CPI is used to index revenues and some of the RCV. For companies with RPI-linked debt, there is a mismatch between how these components of value move and the value of RPI-linked liabilities if RPI and CPI do not move in exactly the same way. This will act to offset some of the reduction in volatility introduced by CPI indexation. However, unless the proportion of RPI-linked liabilities is very material (e.g. as high as 62.5% of the RCV) and all of the RCV indexation is switched to CPI, the net impact is still a reduction in risk, even accounting for the mismatch.

Ofwat has always used a notional capital structure to set allowed revenues, and has stated that the actual financial structure is a matter for the companies. As discussed earlier, the assumptions that either 50% or 100% of existing debt is RPI-linked (with 62.5% notional gearing) are higher than Ofwat's PR14 assumption and broadly reflect the average proportions of RPI-linked debt observed in the industry.

All in all, the analysis suggests that any option for change that involves some transition for the indexation of the RCV does not increase the volatility of firm value. In fact, under most options the volatility is reduced, albeit the reduction is small.

We therefore conclude that there is unlikely to be a material, robustly quantifiable impact on the industry's risk (and hence financing costs) under any of the options for change considered.

This assessment is performed for the value of the firm in aggregate. We noted earlier that the impact may vary by the type of debt/equity investor. Broadly, investors might be categorised as belonging to one of three groups.

- Investors primarily focused on nominal returns with no unusual desire for a link between returns and a specific type of inflation. These investors might experience some 'market average' exposure to inflation, as typically offered by 'average' stocks and bonds in the market.
- Investors seeking returns correlated with general inflation. These investors might be interested in assets that deliver returns that are linked to a measure of inflation which best reflects the underlying inflation in the economy (in the UK, for reasons outlined earlier in the report, CPI is currently a better measure of general inflation than RPI).
- Investors seeking returns correlated with a specific inflation statistic (e.g. RPI). These investors might have a desire to match specific RPI-linked liabilities with RPI-linked assets (e.g. UK defined benefit pension schemes).

Out of these three broad groups of investors, options involving some form of CPI indexation within the price control framework might increase risk only for the last group of investors—i.e. investors that specifically seek exposure to RPI in their investments. For the first two groups of investors, risk is reduced.

It is reasonable to assume that many holders of RPI-linked water bonds might belong to the RPI-seeking investor category, although the data to check this is

not publicly available. In principle, these investors could also belong to the second group: there are few assets in the market that offer explicit linkages to other measures of inflation, such as CPI (see section 7.2). Investing in RPI-linked bonds, therefore, might be one of the few options to gain explicit inflation linkage in the first place.

On the equity side, based on the available information, it is not clear that a substantial portion of equity investors in the water sector would fall into the RPI-seeking category. A large proportion of shareholders in the sector come from non-UK private equity funds. It is not obvious why exposure to UK RPI specifically would be strongly favoured by these investors. If anything, it might be reasonable to expect international investors to be more familiar with CPI as a measure of inflation as it is more comparable to inflation statistics used in other countries.

For the purposes of assessing the implications of a change in the regulatory framework for risk and required returns, it is arguably the aggregate impact that is most relevant. Explicit recognition of a potential increase in risk for one specific investor group in allowed financing costs would need strong justification and evidence. Further, if consideration is given to one group of investors that may face higher risk, then similar considerations need to be given to other investor groups, some of which may face lower risk.

Given that, in aggregate, risk is not increasing and there is a market for debt and equity investment in the sector, it is unlikely to be in consumers' interests for the indexation choice to be unduly influenced by the needs of one specific investor group.

Finally, it is also worth reiterating the point that any changes in risk are likely to be small in the context of the overall volatility experienced by these investors.

7.2 Availability and cost of CPI-linked debt products

Notwithstanding the conclusion that there is unlikely to be any aggregate change in risk and financing costs, we understand that the industry is concerned about the potential availability and cost of CPI-linked products. In particular, the ability to access CPI-linked products to hedge the potential increase in risk to RPI-seeking investors is seen as important by the industry.

Therefore, in this sub-section we review the available evidence and consider whether there are any implications for Ofwat's assessment of the different options.

Before considering the availability and cost of CPI-linked debt products, it is relevant to ask the question whether, as a regulator, Ofwat needs to demonstrate that companies can raise CPI-linked debt at reasonable cost.

It is not evident that this is in fact the case. RPI - X price controls, coupled with RPI linkage of the asset base, were introduced some time before a fully functioning RPI-linked corporate debt market existed. The primary rationale for RPI-linkage of the asset base was not motivated by an intention to promote a particular financing mix, as discussed in section 2.

It is the case that an RPI-linked government debt market did exist, and this has clearly played a role in how the corporate RPI-linked debt market has developed. However, it is arguable whether the scale and potential benefits of RPI-linked debt could have been precisely assessed and foreseen at the time of privatisation of the sector. Other sources of financing, namely nominal debt and

equity, have also played a major role in how the sector has evolved since privatisation.

The main benefit of RPI-linked debt to companies is that it improves the match between real cash returns allowed in price limits (the real allowed WACC component of allowed revenues) and interest payments. In a regulatory model that remunerates investors for inflation via indexation of the asset base, rather than the real cash return component of allowed revenues, cash flows are typically lower in the short to medium term than in a model that remunerates investors with a nominal WACC. Lower cash interest payments therefore have the effect of increasing the headroom in companies' cash flows. In return for lower cash payments, companies are liable for larger principal repayments at maturity. However, the fact that the RCV grows at the same rate as the principal repayments on RPI-linked debt helps to mitigate repayment risk at maturity.

The use of RPI-linked debt, therefore, has potentially increased the capacity of the sector to finance investment with debt, rather than equity.

The use of RPI-linked debt might also have had some positive impact on credit ratings, all else being equal. For example, Moody's takes into account only the cash interest payments due on RPI-linked debt in calculating interest coverage ratios[74] and excludes the inflation accretion of the principal. The main rationale is that the liabilities are underpinned by an asset base that grows at the same rate as the liabilities, and the cash return received by the companies within a price control period is based on a real cost of capital derived with reference to RPI. However, this is not the case with all metrics and agencies. Standard & Poor's does not make a similar adjustment to its ratios.

However, the way these factors have affected Ofwat's price-setting process is difficult to isolate precisely, since Ofwat has always relied on a notional capital structure and financing mix to estimate the WACC and assess financeability.

Some of these effects have probably been taken into account to some extent. First, the notional gearing assumption has steadily increased from one price control to the next. Second, Ofwat's notional financeability testing assumes the presence of some RPI-linked debt on the notional balance sheet. Furthermore, to the extent that the ability of the industry to finance itself with a mix of both nominal and RPI-linked debt has helped keep financing costs lower than they would otherwise be, this may have affected Ofwat's assessment of the WACC (e.g. in PR14 Ofwat placed some weight on the actual observed bond yields of water companies relative to the notional benchmark corporate bond index in deriving the cost of debt).

That said, there is no mechanistic link between the price-setting process and the availability/cost of RPI-linked debt. For example, in PR09, given the uncertain market conditions at the time, Ofwat assumed that no new RPI-linked debt would be available to the industry during the next regulatory period.

In estimating the WACC and assessing financeability in PR19 and beyond, Ofwat can consider whether any modifications to the methodology are required on the basis of available evidence at the time. For example, if rating agencies update their methodology in light of the change of the indexation approach, this can be taken into account when assessing forecast credit metrics. Similarly, if there is no clear evidence that companies can issue CPI-linked debt, Ofwat could assume no CPI-linked issuance for the foreseeable future. In future

[74] For example, see Moody's (2016), 'Transition to CPI creates risks for water and energy networks', 13 January.

periods, if CPI-linked debt becomes available, relevant assumptions can be updated accordingly.

Notwithstanding these points, we review the evidence on the potential availability and cost of CPI-linked products.

7.2.1 Stakeholder views on the costs of CPI-linked products

As mentioned above, we have conducted structured interviews with a range of stakeholders, including credit-rating agencies, debt investors, equity investors, pension insurers, banks and equity analysts, to gauge views on the different indexation options considered. We specifically put forward questions on the availability and cost of CPI-linked debt products, in particular, to those stakeholders that are likely to be active on either the demand or the supply side of such a market.

The main barrier cited by stakeholders to the development of a CPI-linked market was the fact that there was no CPI-linked government bond market which could provide reliable pricing benchmarks. It remains unclear if and when a government CPI-linked market might emerge.

Overall, most stakeholders we interviewed felt that 'first movers' in the CPI-linked market were likely to incur higher costs, both in the form of higher coupons as well as higher transaction costs and new issue premia.

This view was not shared by everyone. Some stakeholders noted that, given the growing demand for CPI-linked assets (discussed further below), 'first movers' could actually obtain attractive pricing. Whether this attractive pricing would prevail once more players enter the market is difficult to determine.

The uncertainty around the UKSA decision as to whether CPI or CPIH would emerge as the headline inflation statistic further complicates matters. At present, it reduces the prospect of the Debt Management Office (DMO) issuing CPI- (or CPIH-) linked securities in the near future.

7.2.2 Market evidence on CPI-linked bond issuances

The CPI-linked corporate bond market remains in its infancy. The past year has seen a small number of sub-sovereign issuers entering the market, but CPI-linked issuances remain rare (see Table 7.3).

Table 7.3 Recent CPI-linked bond issuances in 2015

Issuer	Amount	Tenor	Coupon
Greater London Authority (GLA)	£200m	25 years	0.34%
Warrington Borough Council	£150m	40 years	0.85%, CPI cap/floor of 3% and 0%
Church of England Pensions Board	£100m	33 years	Initial coupon of 3.13%, CPI cap/floor of 4% and 0% (principal not indexed to CPI)

Source: Press releases, Bloomberg.

In principle, the pricing of some of these bonds looks competitive, although it should be noted that this is a very small sample size.

For example, if we consider the GLA bond, the real interest charged is lower than one might expect. At the time of issuance, the debt spread for AA rated corporates over RPI was around 1.6%, while the expected long-run RPI–CPI wedge amounted to 1%. The spread over CPI (the real interest rate with respect

to CPI) implied by these figures is 0.6%, while the GLA issued the bond at a CPI-linked coupon of 0.34%.

The only investor in this bond was Rothesay Life, a specialist pension insurer. Discussions with Rothesay Life confirmed that the pricing (from the perspective of the issuer) was indeed attractive. As an insurer, Rothesay Life has a number of CPI-linked pension liabilities and it placed a relatively high value on the match provided by income from a CPI-linked bond to these liabilities—i.e. it was prepared to effectively pay a premium to obtain CPI linkage.

However, we understand from our stakeholder interviews that this is not an approach likely to be adopted by all pension insurers and pension trustees more widely. In particular, we understand that many pension fund trustees continue to rely primarily on RPI-linked products to hedge inflation exposure, regardless of whether their liabilities are RPI- or CPI-linked. However, if more CPI-linked products become available in the future, this may change.

The evidence on the costs of hedging the difference in the RPI–CPI wedge is also limited. Most stakeholders interviewed noted that it would be difficult to hedge. In principle it should be possible to obtain a bespoke quotation from a bank, but assessing the competitiveness of the offered pricing would be difficult in the absence of suitable traded benchmarks.

This suggests that the evidence on the feasibility and cost of CPI-linked products is relatively limited and, therefore, cannot be relied on for making any direct inferences about the potential use of such products by water companies during the next price control period.

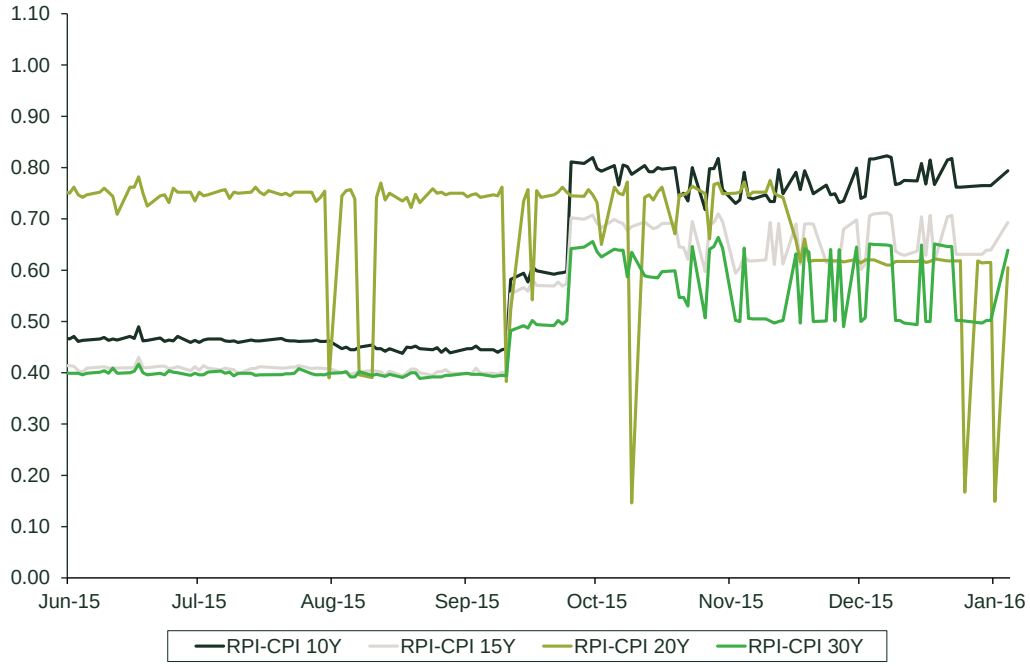
7.2.3 Other potential indicators of the cost of CPI-linked issuance

As an indicator of potential illiquidity of a CPI-linked bond market, we consider evidence on the bid–ask spreads of RPI and CPI swaps. In general, the bid–ask spreads on CPI swaps are found to be higher by around 20–30 basis points (bp) compared with RPI swaps.[75] Some of the difference could be due to higher illiquidity of the CPI swap market.

Using data from the inflation swap market, it is possible to derive the market-implied RPI–CPI wedge. This implied wedge for long-maturity inflation swaps has recently been around 50-80bp but it is quite unstable over time (see Figure 7.2).

[75] Based on data from Bloomberg and Datastream. The spreads on long-dated RPI swaps (10 year maturity or more) have recently averaged around 15bp, while the spreads on CPI swaps with similar maturity have been closer to 40bp, implying a difference of 25bp. To reflect the uncertainty around these estimates, we present them as a range of 20–30bp.

Figure 7.2 Implied RPI–CPI wedge from inflation swaps



Source: Oxera analysis of mid-prices, based on data from Bloomberg and Datastream.

This implied wedge is generally quite low compared with the most recent forecasts of the wedge which are at least 100bp or more (see section 4). This concurs with the observations by the stakeholders that the wedge is not currently 'priced correctly' by the market. , driven largely by 'mispricing' of CPI swaps, as far as we understand. In other words, the market-implied CPI inflation is not necessarily a good indicator of inflation expectations.

As another indicator, we also consider evidence on the illiquidity premia between nominal and inflation-linked instruments for established products. For example, Pflueger and Viceira (2011) find that, on average, inflation-linked US government bonds trade at a liquidity premium of 70–105bp to nominal government bonds.[76] These estimates reflect relatively lower liquidity premia of around 40–80bp between 2004 and 2007 and after the crisis in 2009, but also higher liquidity premia of around 70–120bp following the introduction of inflation-linked government bonds in the market. In other words, when the market was only starting to develop, liquidity premia were 30–40bp higher on average compared with when the market entered a more mature stage.

This evidence suggests that, even in established markets, inflation-linked products tend to demand a liquidity premium relative to nominal products.

With respect to a CPI-linked market in the UK, therefore, the relevant question is whether initially the market might be materially more illiquid compared with the established RPI-linked market, rather than relative to the nominal bond market. Using the evidence presented above, an additional liquidity premium relative to an RPI-linked instrument in the range of 20–40bp might be plausible.[77] In

[76] Pflueger, C.E. and Viceira, L.M. (2011), 'An Empirical Decomposition of Risk and Liquidity in Nominal and Inflation-Indexed Government Bonds'.
[77] This combines the evidence on bid-ask spreads on CPI swaps (which are around 20–30bp higher than spreads on RPI swaps) together with the empirical evidence presented in Pflueger and Viceira (which suggests that liquidity premia in a nascent market could be 30-40bp higher relative to a more mature market).

addition, as noted by some stakeholders, CPI-linked issuance might be associated with higher transaction costs.

While some of this evidence provides insights into the functioning of inflation-linked markets, it is difficult to draw any firm conclusions. We would caution against reading across any of this evidence directly into a potential estimate of the costs of CPI-linked debt.

7.2.4 Possible sources of demand for CPI-linked assets

There are a number of indicators that suggest a growing demand for CPI-linked instruments. Demand for inflation-linked products is likely to continue to outstrip supply. According to a 2011 survey, less than 20% of defined benefit pension schemes had at least 50% of their inflation-linked pensions backed with inflation-linked assets (such as index-linked gilts).[78] The need to hedge their inflation exposure will continue to fuel demand for inflation-linked assets. Given the overall limited supply of such assets, CPI-linked assets could certainly fill some of this demand. The overall trend in pension schemes funding continues to be one of increasing inflation-hedging.[79]

The exposure of pension fund liabilities to CPI is also growing. Most defined benefit schemes appear to have some CPI-linked exposure. The Pension Protection Fund (PPF) has recently estimated that around 30% of defined benefit schemes have moved to CPI-linkage for post-retirement increases, and 80% for pre-retirement increases.[80] However, in its most recent funding update the PPF no longer assumes that a liquid market in CPI-linked instruments will emerge in the near future.[81]

7.2.5 Summary observations

In conclusion, it is the case that a CPI-linked debt market is in its infancy, and predicting the costs and speed of development of such markets is difficult.

On the one hand, as with any new financial instrument in the market, assuming that, at least initially, CPI-linked debt might be more expensive than other debt instruments might be reasonable. On the other hand, there are other drivers, such as growing pension fund demand for CPI-linked assets and potential 'first-mover' advantages, which could help unlock a CPI-linked market more rapidly than observed historically and at relatively competitive costs.

Given the uncertainty around the cost and availability of CPI-linked products, at this stage, it might be reasonable for Ofwat not to make any assumptions about the industry's ability to issue CPI-linked debt in AMP7. However, if more evidence emerges to the extent that new CPI-linked instruments are issued in the market, Ofwat may consider how to take this evidence into account. In practice, companies' financing choices are driven by a range of factors, not just the indexation metric used by the regulator in the price control. It may well be the case that companies continue to use a mix of nominal and RPI-linked debt, as well as explore opportunities for CPI-linked issuances. This may reveal useful information about the costs of such products for future regulatory periods.

Overall, these observations also do not suggest any material changes to the financing costs of the industry under any of the indexation options considered.

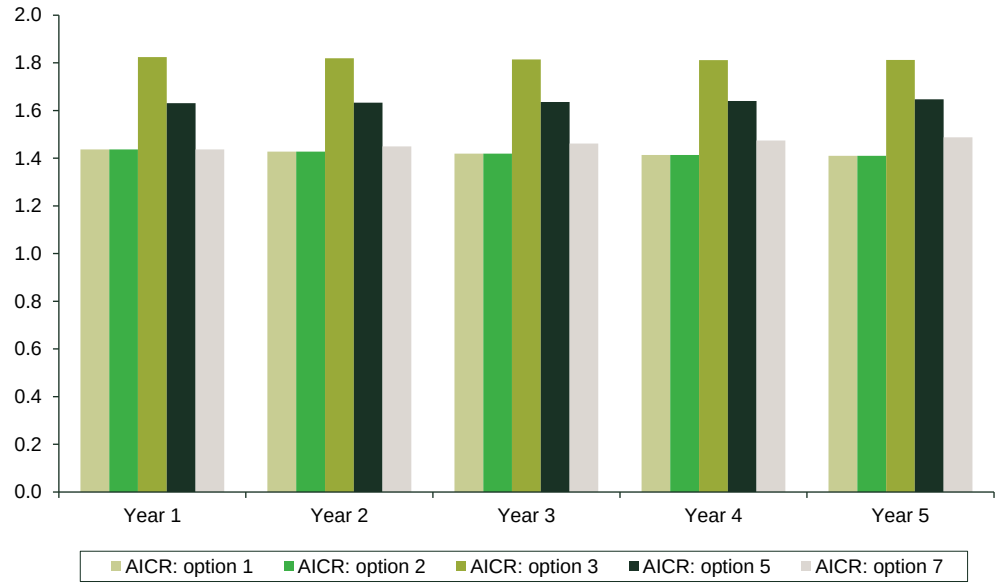
[78] Pension Insurance Corporation (2011), 'UK final salary pension schemes: inflation hedging and the change to indexation from RPI to CPI', survey results, December.
[79] KPMG (2015), 'Navigating the UK LDI market'.
[80] Pension Protection Fund (2013), 'PPF long-term funding strategy update', October.
[81] Pension Protection Fund (2015), 'PPF long-term funding strategy update', July.

7.3 Impact on financeability

As discussed in section 3, a change to the indexation of revenues only will have no impact on forecast revenues and cash flows. A change to the indexation of the RCV will bring cash flows forward by increasing the proportion of the allowed return that is realised in-period rather than through RCV growth. The exact impact on forecast cash flows will vary depending on how much of the RCV is switched to CPI indexation. All else being equal, this will improve credit metrics in the short term and medium term.

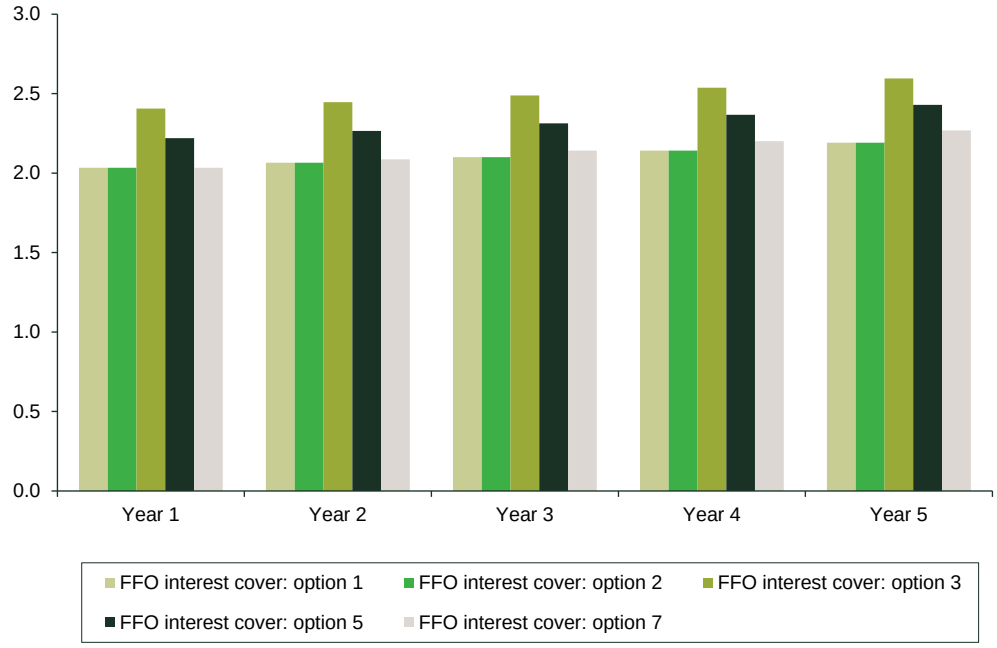
This is illustrated in the figures below using the same stylised assumptions as in section 7.1for some of the key ratios considered by the main credit rating agencies (notably, Moody's and Standard & Poor's): the adjusted interest coverage ratio (AICR), the funds from operations (FFO) interest coverage ratio, and the FFO to net debt ratio.

Figure 7.3 Changes in AICR under different indexation options



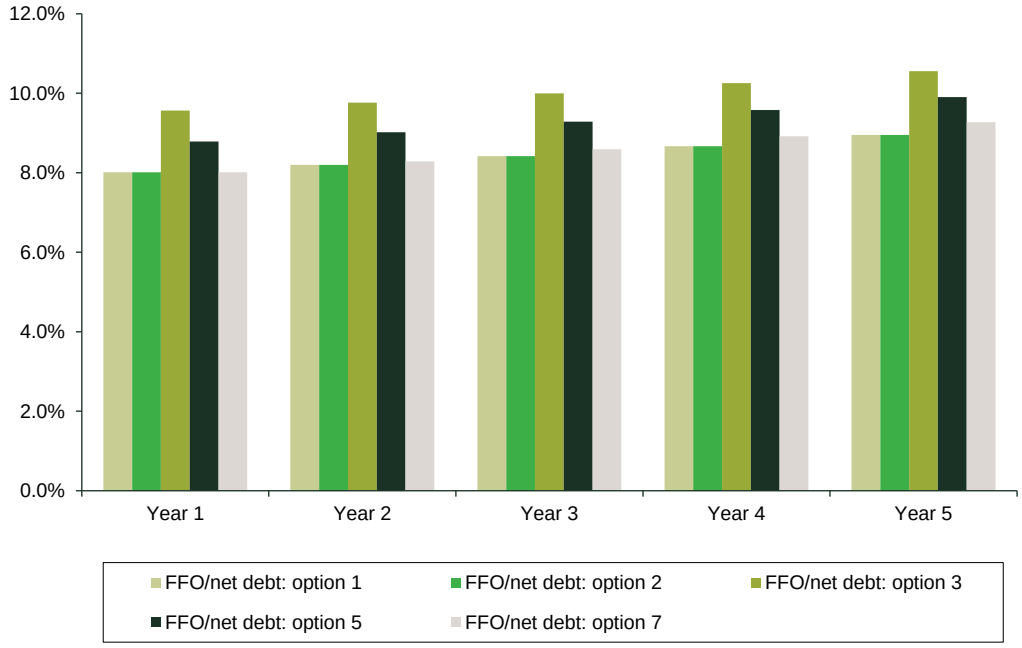
Source: Oxera.

Figure 7.4 Changes in FFO interest cover under different indexation options



Source: Oxera.

Figure 7.5 Changes in FFO/net debt under different indexation options



Source: Oxera.

In Figures Figure 7.3–Figure 7.5, it is assumed that 50% of existing debt is index-linked. The results would be similar under different capital structures. Assuming a different proportion of index-linked debt will simply shift the absolute level of the ratios either up or down, depending on whether the share of index-linked debt is increased or reduced.[82]

[82] Appendix A3 shows additional sensitivities.

The short-term positive impact on ratios, in the absence of any other changes, is also noted by Moody's, which states that 'higher current returns could be credit positive'.[83]

The practical implications for the financial sustainability of each individual water company will differ as companies may wish to adjust their debt levels and dividend distributions, if their cash flows are indeed increased in the short term. However, assuming that the NPV-neutrality of any proposed change is preserved, the proposed options for change in principle should not negatively affect financeability.

If PAYG and RCV run-off rate levers are used to smooth the potential bill impacts of the change, then directionally this could remove any positive benefit of higher cash flows resulting from the change—although the exact impact it will have on credit metrics will also depend on how rating agencies treat adjustments to PAYG ratios and RCV run-off rates. For example, Moody's approach is to 'look through' adjustments to PAYG ratios and RCV run-off rates in calculating certain ratios and instead focus on the underlying operational cash-flow generation of the business. However, at worst the metric would simply revert back to the forecast levels under the current regime.

We note that Moody's overall assessment of the Water 2020 proposals is that they are likely to be credit-negative.[84] However, this assessment takes into account all of the proposed reforms, not just the changes to indexation.

Moody's highlights the risk that a transition to CPI could put downward pressure on returns—e.g. if Ofwat underestimates the RPI–CPI differential or if confidence in the regulatory framework is eroded through pressure on companies to reverse the bill increases through other regulatory levers.[85] The issue of regulatory credibility and stability is one that has emerged strongly in our stakeholder engagement, and is discussed in more depth in section 8.

Looking beyond a five-year price control period will produce a similar picture insofar as cash flows will be brought forward not just for the next five-year period, but—more likely—for the next 20 years, although the difference with RPI-linked revenues will diminish over time, and gradually reverse. It is not clear that detailed forecasting of what the industry capital structure and dividend policy will look like this far into the future provides any additional insight for informing Ofwat's current policy decision.

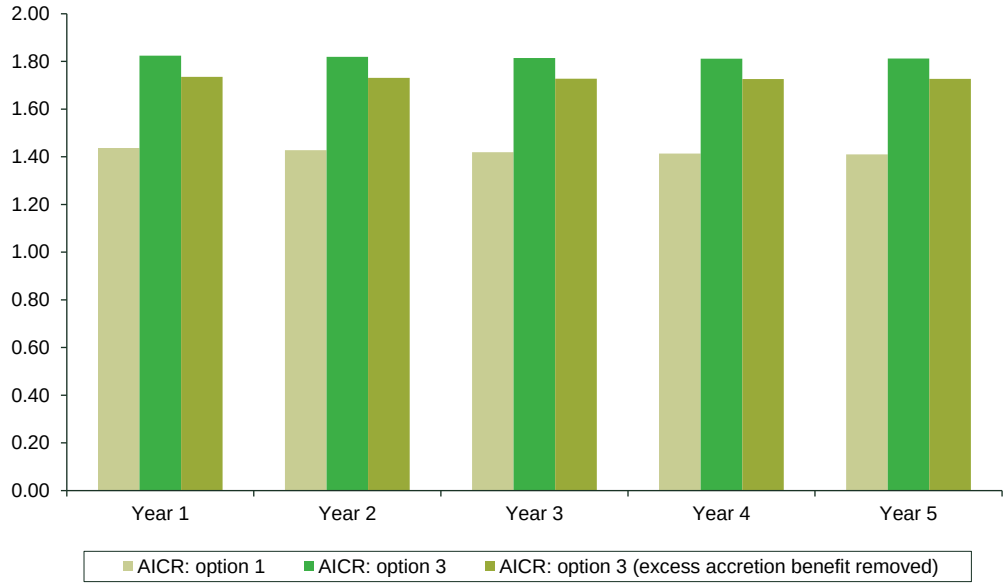
In the longer term, the evolution of the sector's credit quality and financing costs may depend on the extent to which current benefits of RPI-linked debt diminish over time as revenues and asset growth become CPI-linked, and the extent to which CPI-linked debt may emerge as a substitute for RPI-linked debt.

For example, as noted earlier, Moody's takes into account only the cash interest payments due on RPI-linked debt in calculating the AICR,[86] and excludes the inflation accretion of the principal. If, in the future, this methodology is updated and the full accretion of index-linked debt is included in the calculation, this would, all else being equal, put downward pressure on credit metrics, as illustrated in Figure 7.6. However, the overall effect under option 3 would still be

[83] Moody's (2016), 'Transition to CPI creates risks for water and energy networks', 13 January, p. 1.
[84] Moody's (2016), '"Water 2020" Proposals Are Credit Negative', 13 January.
[85] Moody's (2016), 'Transition to CPI creates risks for water and energy networks', 13 January.
[86] For example, see Moody's (2016), 'Transition to CPI creates risks for water and energy networks', 13 January.

an improvement in ratios, before any potential adjustments to PAYG or run-off rates.

Figure 7.6 Changes in AICR if the benefits of excess accretion are removed



Source: Oxera.

Overall, assessing the longer-term impact of any proposed change in financeability of the industry is uncertain. It would be reasonable to assume that some changes in the financing mix and debt levels might be required by companies; however, the extent to which such changes go beyond 'normal' cash-flow and risk-management requirements of a regulated business is unclear. Therefore, there is no obvious benefit or cost to consumers under any of the alternative indexation options considered.

8 Perceptions of regulatory risk

Economic regulation means that companies are exposed to potential for regulatory decisions to adversely impact on returns. Long term investment in the sector is subject to regulatory risk as key regulatory parameters, such as the allowed rate of return and cost allowances, are reset at each price review.

A change to the regulatory framework may affect perceptions of regulatory risk, which in turn, if not appropriately mitigated, could manifest itself as a potential cost to consumers by affecting the return expectations of investors.

Regulatory risk can be mitigated by the regulator providing transparency around its approach and reasoning and developing a track record of consistency. No change in the regulatory framework may not always imply lower regulatory risk. If changes in the external environment are not reflected in the regulatory framework over time, then this may increase the risk of sudden changes in the future.

In this section, we first summarise stakeholder views on regulatory risk based on our stakeholder interviews in section 8.1. We then discuss how Ofwat might alleviate some of the stakeholder concerns identified (section 8.2).

A summary of our conclusions and the implications for the overall assessment of benefits and costs of the different options is provided upfront.

Key findings

Nearly all stakeholders have expressed concerns that any change to indexation which involves changes to the indexation of the RCV could add complexity, and, therefore, additional uncertainty to Ofwat's assessment of allowed returns and/or allowed costs which may not be justified or occur in the absence of any change. However, Ofwat has stated that its intention is to ensure that any change is value and bill neutral in NPV terms over time in nominal terms.

The concept of the implicit regulatory contract—at least as regards sunk investment—that assumes RPI indexation of the RCV, is one that resonates strongly with the stakeholders.

Furthermore, stakeholders from the investor community have told us that they consider the adjustments to the cash-flow profiles through the use of PAYG levers or run-off rates to be less transparent and predictable than the well-established RCV indexation mechanism.

This suggests that, all else being equal, options that involve changes to the existing RCV are more likely to increase perceptions of regulatory risk than the other options considered.

However, the more clarity and transparency Ofwat can provide on how the NPV-neutrality commitment will be achieved in practice through the transition, the more these concerns are likely to be alleviated.

Changes to the regulatory framework can affect the perceived risk of a regulated sector. However, Ofwat's track record of regulating the sector should provide reassurance that any change will be implemented and managed in a reasonable way.

Further, where the regulator does not respond to changes that adversely impact on the legitimacy of the regulatory regime, this could also increase perceptions of regulatory risk in the longer term.

Finally, it is worth noting that any change will be implemented in the context of Ofwat's duties, including its financeability duty.

Overall, it is not clear that the concerns raised should translate into an increase in regulatory risk resulting in a cost to companies (and therefore a cost that needs to be passed on to consumers) under any of the options considered.

The overall impact of change also needs to be considered in the round, taking into account the evidence on the impact on operational and financial risk presented in earlier sections.

Evaluation of the options

Table 8.1 summarises the implications of the analysis in this section for the overall assessment of the benefits and costs of the different options for change.

Table 8.1 Options for change: impact on regulatory risk

Option for change	Benefit or cost relative to Option 1 (no change)
Option 2: only revenue indexation is changed	Could be a cost, but difficult to quantify. Perceived increase in regulatory risk likely to be highest the faster the transition of the RCV indexation to CPI. Ofwat could take mitigating actions to ensure that perceptions do not translate into a direct cost to consumers.
Option 3: full switch	
Option 4: transition based on the notional proportion of RPI-linked debt	
Option 5: transition based on Water 2020 preferred option	
Option 6: transition based on notional equity	
Option 7: transition based on new RCV only	

Source: Oxera.

8.1 Summary of key issues raised by stakeholders

As explained earlier, economic regulation exposes investors to regulatory risk since key regulatory parameters, such as the allowed rate of return and cost allowances, are reset at each price review.

A change to the regulatory framework may affect perceptions of regulatory risk. Therefore, it is important to consider stakeholder views regarding the proposed change, and, if appropriate and necessary, consider ways to mitigate any increased perceptions of regulatory risk.

To understand the impact of different indexation options on the perceptions of regulatory risk, Oxera has conducted structured interviews with a range of stakeholders, including credit-rating agencies, debt investors, equity investors, pension insurers, banks and equity analysts.

By far the biggest theme emerging from the stakeholder discussions is the extent to which Ofwat can credibly commit to preserve the NPV-neutrality through the transition to an alternative indexation mechanism. In particular, for options involving changes to the indexation of the RCV and which subsequently imply bill increases, nearly all stakeholders have expressed concerns that this could add complexity, and, therefore, additional uncertainty to Ofwat's assessment of allowed returns and/or allowed costs which may not be justified in the absence of any change.

In the interviews we undertook, most stakeholders appeared generally accepting of the fact that some change might be justified on other grounds (e.g. from a consumer perspective); however, in its current form, Ofwat's proposed option for

change was generally associated with a perception of heightened regulatory uncertainty and risk, particularly given the lack of clarity post-2025.

For example, Credit Suisse notes that it has seen 'the transition as almost inevitable', but it 'would hope for a more gradual transition and clarity on post-2025 indexation'.[87]

The concept of the implicit regulatory contract—at least as regards sunk investment—that assumes RPI indexation of the RCV, is one that resonates strongly with the stakeholders.

To the extent that changes in indexation would, all else being equal, increase prices, Ofwat may expect companies to use PAYG levers to manage the effects on customer bills. Stakeholders felt that this substituted the well-established RCV indexation mechanism with a less predictable alternative, to their detriment.

8.2 NPV-neutrality commitment

Based on the feedback received from stakeholders, it is evident that the more clarity Ofwat can provide on how the NPV-neutrality commitment will be achieved in practice, the more the concerns raised are likely to be alleviated.

For example, it is likely to be important to continue to provide assurances during ongoing discussions with the industry that Ofwat will enable companies to use cash-flow profiling tools such as PAYG/RCV run off ratios to maintain balance between cash flows within a price control period and RCV growth.

As discussed previously, a change to the indexation of the RCV will result in higher cash flows within the price control period and lower RCV growth, all else being equal. Concerns of debt and equity investors may differ in this regard. Debt investors may be concerned that the additional cash flows could be used to pay higher dividends, adversely affecting credit quality in the longer term. Equity investors may be concerned about the reduction in RCV growth rates, affecting the future value of the company. Additionally, there might be other financeability or bill profile concerns which the companies may wish to address through the use of cash-flow profiling tools.

It might also be helpful to consider any perceived sources of additional uncertainty around the estimation of key regulatory parameters, such as the allowed rate of return and cost allowances, in the wider context of the overall 'normal' level of uncertainty associated with resetting these parameters at any price review.

It is also worth noting that any change will be implemented in the context of Ofwat's duties, including its financeability duty.

However, as with any change to the regulatory framework, there are inevitable limits on what can be committed to, in particular beyond a five-year price control period. In this regard, the regulator's track record of managing change is likely to be an important driver of the overall perceived risk and stability of the sector.

That said, there are some elements that could help to ensure NPV-neutrality in practice:

- ensuring that nominal TOTEX allowances are not affected by changing the indexation measure (section 8.2.1);

[87] Credit Suisse (2015), 'Initial proposals on 2020 regulation', 11 December.

- ensuring that the nominal allowed WACC is not affected by changing the indexation measure (section 8.2.2).

8.2.1 Deriving CPI-based TOTEX allowances

As discussed in section 3, adjustments can be made to Ofwat's cost assessment framework such that the nominal assessment of TOTEX is unaffected by the change of the indexation metric.

For the econometric modelling, assuming a similar approach to PR14, Ofwat could undertake its cost assessment using a different price base. This would require historical nominal outturn costs of companies (and if relevant forecast costs) to be rebased in real terms to the alternative inflation measure. This would change the outputs of the modelling, but if then applied correctly, this should not affect the assessment of efficient levels of nominal costs.

Where costs are considered outside of an econometric framework, similar considerations would apply. For example, any assumptions about the real growth rates applied to costs could be rebased to ensure that the projections of nominal costs stay the same.

As there are many factors that influence the outcome of the cost assessment, it might be challenging to demonstrate precisely whether the outcome would have been exactly the same under a fully RPI-linked price control. However, Ofwat could provide guidance and clarity on the methodology in the price review process, in particular around any changes that may be required as a result of any change to indexation. This should help companies to evaluate the impact of the proposed changes, and reassure them that no undue bias has been introduced into the process.

8.2.2 Deriving a CPI-based real WACC

A reasonable assumption in deriving a CPI-based real WACC (which is necessary if the approach to the RCV indexation is changed) is that the nominal WACC required by investors is the same, regardless of the indexation approach taken by the regulator. In this case, as long as the regulator adjusts its methodology for estimating the real WACC appropriately, and the WACC is estimated neutrally (i.e. there is no systematic over- or under-estimating inherent in the methodology), any change should be NPV-neutral for the company. The transparency around the derivation of a CPI-based real WACC and how it compares to an RPI-based real WACC should also help maintain investor confidence.

This section reviews Ofwat's current methodology for estimating the WACC, and discusses how it may need to be adjusted to preserve NPV-neutrality. It concludes that, for options that involve changes to the indexation of the RCV, it would indeed be appropriate for the real CPI-based WACC to equal the forecast real RPI-based WACC plus a neutral forecast of the RPI–CPI wedge.

Cost of equity

Regulators, Ofwat included, have typically placed significant weight on long-run historical evidence on observed equity market returns to inform their assumptions of the total market return (TMR) and/or the equity risk premium

(ERP).[88] Typically, the most commonly cited source is the evidence collected by Dimson, Marsh and Staunton (DMS), which dates back to 1900.[89]

The evidence has generally been used to directly inform required real equity returns for the forthcoming price control period. While regulators typically do not state explicitly the assumed nominal market return underpinning their assumptions, the implied nominal equity market return for the price control period is effectively equal to the assumed real TMR plus the forecast RPI.

Therefore, to derive a CPI-based real TMR in future price control periods, it would be reasonable to uplift the historical estimates of the TMR by the forecast RPI–CPI wedge. For example, in PR14 Ofwat used a real TMR of 6.75% to derive a real RPI-based cost of equity. Assuming an RPI–CPI wedge of 1% (as an illustration) would translate into a CPI-based real TMR of 7.75%.

In summary, to ensure that the nominal cost of equity stays the same, all else being equal, it is reasonable to uplift any long-run historical estimates of the real TMR (or ERP) by the RPI–CPI wedge.

Similar adjustments can be made to other data that is expressed in real terms relative to RPI, such as real yields on RPI-linked government bonds.

Cost of debt

Regulators use a range of evidence to estimate the cost of debt. In PR14, Ofwat primarily relied on evidence on nominal bond yields (using iBoxx corporate bond indices)[90] which it then deflated using its estimate of RPI inflation.

As the methodology currently stands, Ofwat could estimate the real cost of debt by deflating the nominal bond yields by an appropriate estimate of the CPI inflation instead. As long as there is no systematic bias in the regulator's inflation assumptions, this should produce a reasonable estimate of the real CPI-based cost of debt.

Specifically for the cost of new debt, if evidence on the costs of CPI-linked bonds becomes available, it might be appropriate to give explicit consideration to such evidence in light of the concerns about the potentially higher costs of such debt identified previously, if it is anticipated that this will be a significant source of financing in the next control period.

[88] For example, see Ofwat (2014), 'Final price control determination notice: policy chapter A7 – risk and reward', December.
[89] Dimson, E., Marsh, P. and Staunton, M. (2014), 'Credit Suisse Global Investment Sourcebook 2014'.
[90] Ofwat (2014), 'Final price control determination notice: policy chapter A7 – risk and reward', December.

9 Overall assessment of benefits and costs

In summary, we have considered the following options for change in this report.

Table 9.1 Options for change

Option	Indexation of revenues	Indexation of the RCV	
Option 1: no change	RPI	RPI	No change in the forecast level of bills
Option 2: only revenue indexation is changed	CPI (or CPIH)	RPI	
Option 3: full switch	CPI (or CPIH)	All RCV indexed to CPI (CPIH)	Options imply a change in the forecast level of bills
Option 4: transition based on the notional proportion of RPI-linked debt	CPI (or CPIH)	15% of the RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 5: transition based on Water 2020 preferred option	CPI (or CPIH)	50% of the RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 6: transition based on notional equity	CPI (or CPIH)	62.5% of existing RCV indexed to RPI; the rest, including new RCV, to CPI (or CPIH)	
Option 7: transition based on new RCV only	CPI (or CPIH)	existing RCV indexed to RPI; new RCV additions post-2020 indexed to CPI (or CPIH)	

Source: Oxera.

Table 9.2 summarises the overall assessment of the benefits and costs. The assessment applies equally to companies operating in England and Wales.

Table 9.2 Benefits and costs: summary

Dimension	Benefit or cost relative to Option 1 (no change)?	Does the impact differ significantly by option?
Legitimacy of the inflation statistic	Overall, any change is likely to bring a benefit, but one that cannot be reliably quantified.	Options that involve faster transition of the RCV to CPI (or CPIH) indexation might be preferable.
'Fairness' of consumer bills and volatility of consumer bills	Overall, any change is likely to bring a benefit, but one that cannot be reliably quantified.	Difficult to distinguish between the options on the basis of these two specific criteria.
Reflectivity of movements in companies' operating costs	No material cost or benefit.	The impact is similar under all options considered.
Impact on financing costs	No material benefit or cost.	The impact is similar under all options considered.
Impact on regulatory risk	Overall, there could be a cost, but difficult to quantify. Ofwat could take mitigating actions to ensure that perceptions do not translate into a direct cost to consumers.	Perceived increase in regulatory risk likely to be higher, the faster the transition of the RCV indexation to CPI (or CPIH).

Source: Oxera.

Overall, on the basis of the various criteria considered, there is a clear case to change the basis of revenue indexation away from RPI. There are also good reasons to change the basis of the RCV indexation. This would reduce the reliance of regulation on an inflation statistic that is gradually falling out of use, is statistically flawed and inherently more volatile. In turn, this is likely to increase the legitimacy of the regulatory framework and reduce volatility of bills.

As regards the choice between CPI and CPIH, at this stage, CPI emerges as the preferred statistic of the two. However, if the UKSA decision favours the use of CPIH as the headline measure of inflation, this assessment may need to be revisited.

From a pure operational and financial risk perspective, for the industry on average, there is no strong rationale for taking a phased approach to transitioning the indexation of the RCV away from RPI to a different metric such as CPI. In other words, there is no evidence that financing costs would go up to the industry if a switch to a different inflation statistic is implemented in full for both revenues and the RCV, resulting in a cost to consumers.

However, we are mindful of the potential bill impact of a fast transition, and the impact that this appears to have on the perceived credibility of Ofwat's NPV-neutrality commitment. Therefore, on balance, there is a credible case for some form of transition of the RCV indexation.

The desirable speed of transition may depend on the extent to which Ofwat and the industry can work together to alleviate some of the existing concerns about the NPV-neutrality of the proposed changes, and on the emerging bill profiles (taking into account other factors affecting forecast revenues for the next regulatory period).

A1 Regulatory precedent

A1.1 Ofcom Fixed Access Market Review 2013

Historically, RPI has been the default inflation index used by Ofcom, with several minor exceptions.[91] In 2013, Ofcom published its proposal for new charge controls for local loop unbundling (LLU) and wholesale line rental (WLR) services.[92] The proposed controls follow a form of price cap regulation, although at the time Ofcom was considering what would be an appropriate inflation index. The possible indices mentioned included RPI, RPIJ, and CPI.

In 2012, Ofcom had decided that RPI was an appropriate index to use in its charge controls. However, in January 2013, the ONS announced the result of its October 2012 consultation into RPI and determined that it did not meet international standards. Following this announcement, the UKSA removed RPI as a national statistic due to deliberations over the appropriateness of the index by several governing bodies. As a result of these developments, Ofcom revisited the issue of determining the most appropriate index to use.

The review considered several criteria in determining which index would be most appropriate for the charge controls. The main findings are presented in Table A1.1.

Table A1.1 Ofcom's decision criteria

Factor	Conclusions
Official status	The ONS found that RPI did not meet international standards. RPI also lost its designation as a national statistic. The ONS did not identify any problematic aspects in the calculation of CPI, which remains a national statistic. At the time of the report, RPIJ was considered an experimental statistic and was not considered for the charge controls.
Cost causality	One operating cost element (BT's Cumulo payments) was found to be explicitly linked to RPI. Of the remaining operating costs, neither RPI nor CPI was found to be a clear predictor of cost movements. Parts of the RAB (the valuation of copper and duct assets) are linked to RPI due to historical and current regulatory practice. The cost of capital is calculated from a risk-free rate which uses government debt as a proxy. The debt is currently linked to RPI. However, the overall allowed rate of return is determined in nominal terms.
Exogeneity	Both RPI and CPI were found to be immune to the influence of the regulated firm.
Availability of independent forecasts	CPI forms the basis of the Bank of England's official inflation target. While actual CPI will vary, because the objective of monetary policy is to achieve the target inflation rate, CPI is expected to be around the target rate over the medium to long term.
Regulatory predictability	Given the removal of its designation as a national statistic, while RPI has formed the basis of previous regulatory price controls, it can no longer be expected to remain the preferred index going forward.

Source: Ofcom (2013), 'Fixed access market reviews: Approach to setting LLU and WLR Charge Controls', 20 August.

[91] Exceptions in the cases of second class stamps and large letters. Ofcom indicated that CPI was used in the first case due to distributional issues; many vulnerable customers' incomes are dependent on pensions or benefits, which are indexed to CPI.
[92] Ofcom (2013), 'Fixed access market reviews: Approach to setting LLU and WLR Charge Controls', 20 August.

Ofcom uses a current cost accounting (CCA) approach to value post-1997 copper and duct assets, with RPI as the basis for estimating how replacement costs move over time. The review concludes that because part of the asset base is indexed to RPI, it would be consistent with how assets were traditionally valued to continue forecasting replacement costs for post-1997 assets using RPI indexation.[93]

In light of the benefits and costs, Ofcom proposed using CPI in future charge controls, but with the continued use of RPI in forecasting the replacement costs of copper and duct assets.

A1.2 Other evidence from Ofcom

Ofcom is considering the implementation of CPI-based price controls in other areas, such as licence fees for 900 MHz and 1,800 MHz radio frequency users.[94] The most recent consultation indicates that RPI will continue to be used for the indexation of annual licence fees (ALFs). Because the inflation assumption built into the calculation of real WACC is then offset by the subsequent inflation adjustment, and because RPI has historically been used as the measure of inflation, the decision to continue using RPI in the calculation of the ALFs is purely down to avoiding additional adjustments to the calculation of the real WACC due to the use of two different inflation indices at different stages of the price control. However, the consultation calls for views on whether RPI or CPI (or another index) would be a more suitable measure of inflation.

Following the consultation, Ofcom has subsequently made a decision to use CPI as the inflation index in determining ALFs.[95]

A1.3 Ofgem indexation of future OFTO and interconnector licences

In UK energy markets, current Offshore Transmission Owners (OFTOs) and interconnector licences are linked to RPI. In October 2015, Ofgem published an open letter calling for views on the indexation of future controls pertaining to OFTO and interconnector licences.[96]. It stated that 'relevant authorities have highlighted that indices other than RPI may better serve consumers and investors alike, by being more accurate and consistent with international best practice,' in line with Ofcom's concerns about RPI's loss of designation as a national statistic.[97]

The call did not indicate which index Ofgem was intending to consider, but did mention both CPI and CPIH in its open letter.

A1.4 NATS En Route Ltd Price Control Review 2011–14

In 2010, the UK Civil Aviation Authority (CAA) specified a set of future price controls for NATS En Route Ltd. (NERL) charges for air traffic control, indexed to RPI.[98] At the time, this was based on NERL's proposed business plan for the

[93] Ofcom (2013), 'Fixed access market reviews: Approach to setting LLU and WLR charge controls', 20 August, para. A5.1.
[94] Ofcom (2013), 'Annual licence fees for 900MHz and 1800MHz spectrum', consultation, 10 October, paras 5.41–5.47.
[95] Ofcom (2014), 'Annual licence fees for 900 MHz and 1800 MHz spectrum', 19 February, para. 4.14.
[96] Ofgem (2015), 'Indexation for future OFTO and interconnector licences', 14 October.
[97] Ofgem (2015), 'Indexation for future OFTO and interconnector licences', 14 October, p. 2.
[98] Charges in the price control are specified for control of air traffic flow in UK airspace for NATS En Route Ltd. only, and not terminal air navigation services or London approach.

price control period, which in turn was based on the expectation that the price control period and all inputs in NERL's cost base would be indexed by RPI.[99]

However, due to externally imposed regulation in the Revised Charging Regulation, the indexation used is required to be from Eurostat, which uses CPI.[100]

The CAA proposed to reconcile the indices by taking the projected nominal costs based on NERL's business plans (which have inputs indexed to RPI), and restate them in real terms using a CPI deflator.[101] This presents some risk to NERL as the indices may not move consistently, and the CAA allowed for an additional hedging cost to account for this risk.[102] It has indicated that this arrangement is transitional and it expects NERL to account for costs in future price control reviews using CPI indexation.[103]

The CAA recognised that NERL's cost base may be directly linked to changes in RPI in the form of government index-linked debt.[104] There was a decision made to continue uplifting the RCV and indexing the WACC and depreciation by RPI. There are no adjustments for any outturn differences between CPI and RPI in this regard.

Business plan projections for the latest price control period (2015–19) were prepared on the basis of CPI, and no further allowance for the potential hedging costs of the RPI–CPI mismatch was granted.

A1.5 Water Industry Commission for Scotland 2015–21 determination

The 2015–21 price control determination by WICS indicates a shift from the historical use of RPI in indexing price controls to CPI for the regulation of the water industry in Scotland.

Previous business plans for Scottish Water, the water supplier in Scotland, used RPI forecasts to derive outturn expenditure profiles. The forecast increase in costs was assumed to be approximately 2.9% per year, based on an inflation rate of 2% for CPI and a wedge of 0.9% between RPI and CPI. Price reductions relative to RPI inflation can be perceived as an increase compared with CPI inflation, which is the government's official measure of inflation. WICS cited that this perceived increase in real household prices could be a concern for water customers.

The draft business plan submitted by Scottish Water for the 2015–21 review period indicated an intention to shift from RPI to CPI using the 2% per year assumption. This was supported by WICS, which believed CPI would be better understood by consumers because of its status as an official measure of

[99] Civil Aviation Authority (2011), 'NATS (En Route) plc price control: CAA formal proposals for control period 3 (2011-2014) under Section 11 of Transport Act 2000', October, para. 4.11.
[100] European Commission (2013), 'Commission implementing regulation (EU) No 391/2013 of 3 May 2013 laying down a common charging scheme for air navigation services', *Official Journal of the European Union*, 9 May, Article 7.
[101] Civil Aviation Authority (2011), 'NATS (En Route) plc price control: CAA formal proposals for control period 3 (2011-2014) under Section 11 of Transport Act 2000', October, para. 4.12.
[102] Civil Aviation Authority (2010), 'NATS (En Route) plc CP3 Price Control Review 2011-2014: CAA Decision – Appendix 2: Statement of Regulatory Policy', December, para. 23.
[103] Civil Aviation Authority (2010), 'NATS (En Route) plc CP3 Price Control Review 2011-2014: CAA Decision – Appendix 2: Statement of Regulatory Policy', December, para. 23.
[104] Civil Aviation Authority (2011), 'NATS (En Route) plc price control: CAA formal proposals for control period 3 (2011-2014) under Section 11 of Transport Act 2000', October, para. 4.14.

inflation, and would reduce the risk that bills would be perceived as increasing in real terms.[105]

Deriving an average wedge between RPI and CPI of 0.75% per year based on its own analysis, WICS published a draft determination that included the price caps it would have proposed using RPI, for comparison purposes, and the corresponding price caps using CPI and the assumed wedge.[106] The final determination shows that Scottish Water's charges for household customers over the entire 2015–21 period are capped at CPI - 1.8%. The cap makes an allowance for prices to rise up to the nominal rate of 1.6% per year from 2015–18; prices are capped at CPI - 0.3% from 2018–21. Non-household price caps are set at CPI - 0.3% for the entire 2015–21 period.[107] Because WICS does not regulate Scottish Water using a regulatory building blocks approach, there was no need to recalculate a cost of capital or RCV based on a move to CPI.[108]

[105] Water Industry Commission for Scotland (2014), 'The Strategic Review of Charges 2015-21: Draft Determination', 20 March.
[106] Water Industry Commission for Scotland (2014), 'The Strategic Review of Charges 2015-21: Draft Determination', 20 March.
[107] Water Industry Commission for Scotland (2014), 'The Strategic Review of Charges 2015-21: Final Determination', 20 March.
[108] Ofwat (2015), 'Water 2020: Regulatory framework for wholesale markets and the 2019 price review', December, para. 5.7.6.2.

A2 Further supporting evidence on inflation indices

A2.1 Formula effect

The three commonly used approaches to calculating averages within an index are:

- the arithmetic mean of price relatives (Carli);
- the ratio of arithmetic mean prices (Dutot);
- the geometric mean (Jevons).

RPI uses a combination of Carli and Dutot, while CPI and CPIH predominantly use the Jevons formula, with some Dutot.

The Carli formula looks at the rate of change in each store and then takes the average of those changes:

$$I_{t,0} = \frac{1}{n}\sum_{i=1}^{n}\frac{p_{i,t}}{p_{i,0}}$$

The Dutot formula averages the prices in each period and then calculates the rate of change:

$$I_{t,0} = \frac{\sum_{i=1}^{n}\frac{p_{i,t}}{n}}{\sum_{i=1}^{n}\frac{p_{i,0}}{n}}$$

The Jevons formula takes the geometric mean of the rate of change or the ratio of the geometric mean prices:

$$I_{t,0} = \sqrt[n]{\prod_{i=1}^{n}\frac{p_{i,t}}{p_{i,0}}} \quad \text{or} \quad I_{t,0} = \frac{\sqrt[n]{\prod_{i=1}^{n}p_{i,t}}}{\sqrt[n]{\prod_{i=1}^{n}p_{i,0}}}$$

The Jevons formula takes into account the possibility that consumers will substitute between goods in response to changes in the product prices. The Dutot and Carli formulae, on the other hand, imply that quantities purchased remain fixed regardless of any changes in relative prices. The Jevons formula will always give either the same or a lower price increase than the Carli.[109]

It is not possible to establish a similar general result between the Carli and Dutot formulae.[110]

- The Dutot will be greater than the Carli if base prices and price relatives are positively correlated, and less than the Carli otherwise. This is because the Dutot effectively gives greater weight to goods which are more expensive in

[109] This can be empirically observed by comparing RPI and RPIJ—a variant of RPI published by the ONS that uses the Jevons formula.
[110] Institute of Fiscal Studies (2012), 'A winning formula? Elementary indices in the Retail Prices Index', IFS Working Paper W12/22.

the base period, and so if these goods also see the fastest price increases, the Dutot will be greater than the Carli.

- If the variance of prices is increasing, the Dutot will be greater than the Jevons. If this is not the case, it is possible for the Dutot to be less than the Jevons.

A2.2 Example of time reversal

Table A2.1 provides the underlying calculations for the example provided in section 4.2.2.

Table A2.1 Illustrative example of price changes with calculations

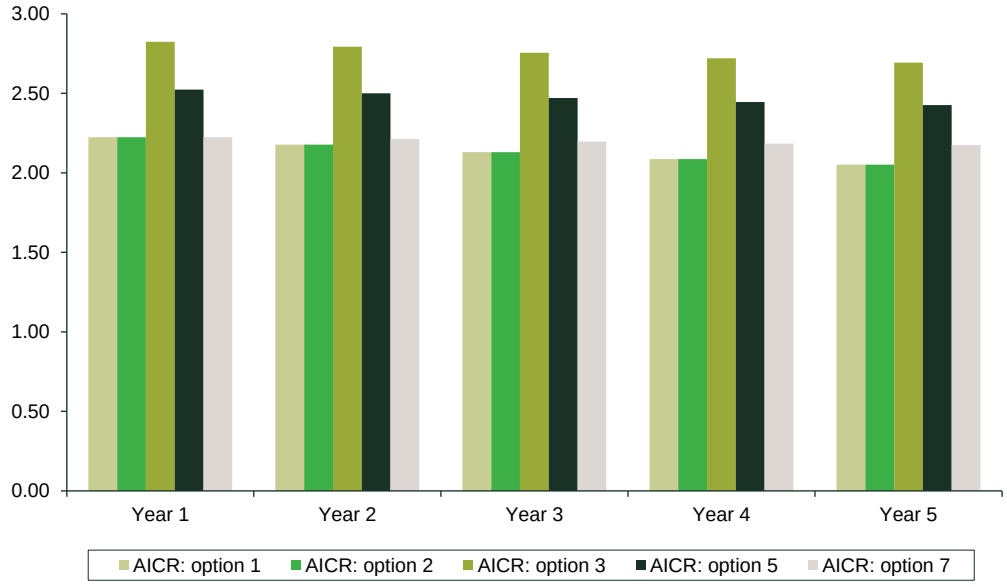
	Year 1	Year 2	Year 3
Product A	£10	£20	£10
Product B	£30	£20	£30
Product C	£50	£25	£50
Inflation indices			
Carli - change	–	(20/10+20/30+25/50)/3 = 1.06	(10/20+30/20+50/25)/3 = 1.33
Carli - index	1.00	1.00×1.06 = 1.06	1.06×1.33 = 1.41
Dutot - change	–	(20/3+20/3+25/3) / (10/3+30/3+50/3) = 0.72	(10/3+30/3+50/3) / (20/3+20/3+25/3) = 1.38
Dutot - index	1.00	1.00×0.72 = 0.72	0.72×1.38 = 1.00
Jevons - change	-	(20/10x20/30x25/50)^(1/3) = 0.87	(10/20×30/20x50/25)^(1/3) = 1.14
Jevons - index	1.00	1.00×0.87 = 0.87	0.87×1.14 = 1.00

Source: Oxera analysis.

A3 Financeability: additional sensitivities

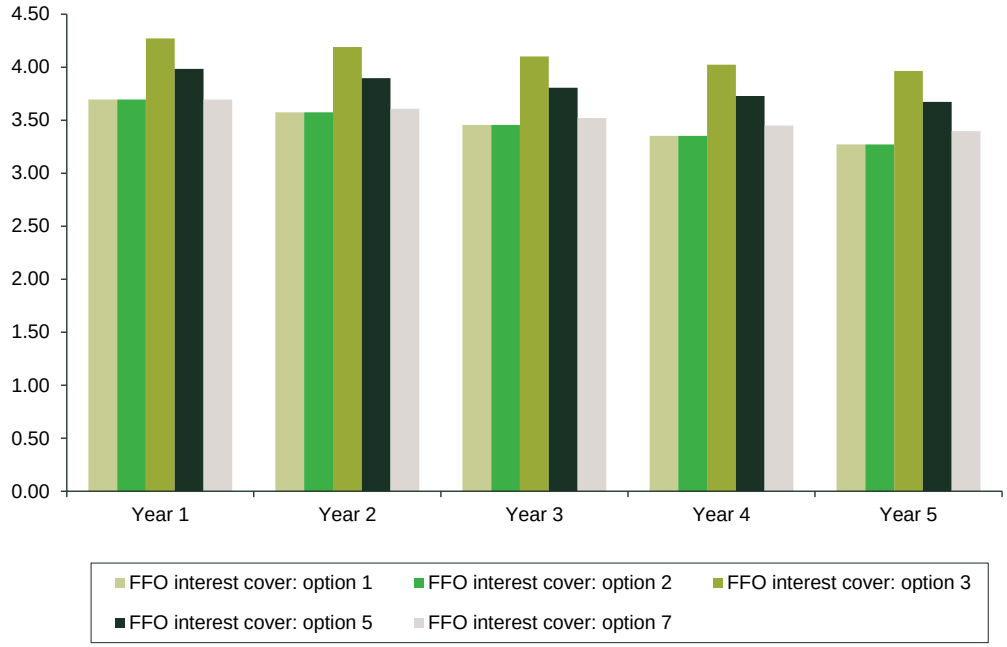
The figures below illustrate the impact of different indexation options on the AICR, the FFO interest coverage ratio, and the FFO to net debt, assuming that 100% of existing debt is index-linked. All other assumptions are the same as in section 7.3.

Figure A3.1 Changes in AICR under different indexation options, 100% of existing debt RPI-linked



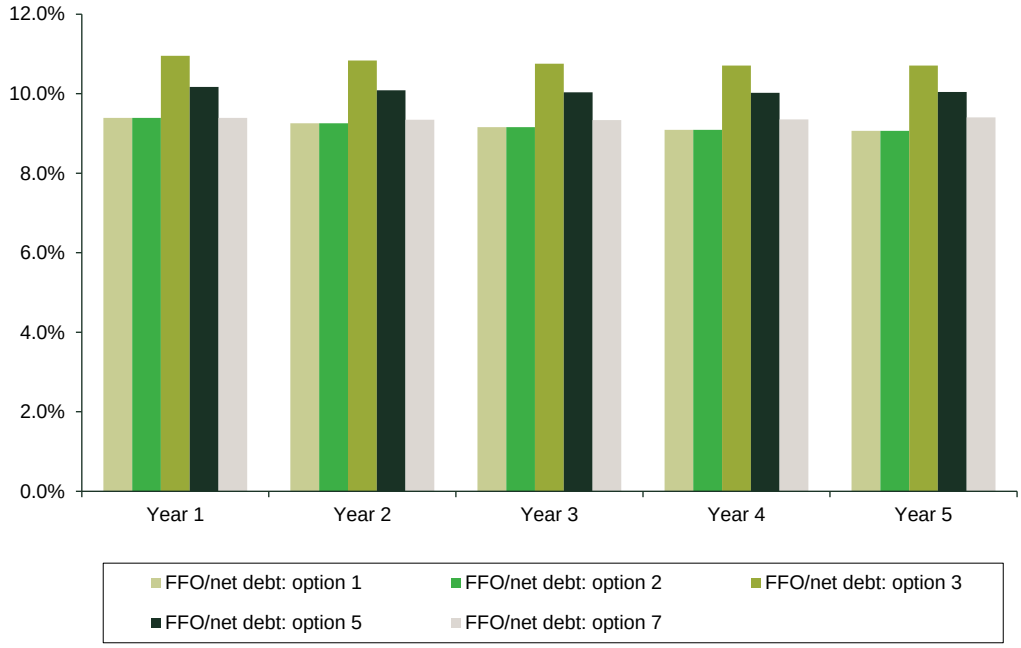
Source: Oxera.

Figure A3.2 Changes in FFO interest cover under different indexation options, 100% of existing debt RPI-linked



Source: Oxera.

Figure A3.3 Changes in FFO/net debt under different indexation options, 100% of existing debt RPI-linked



Source: Oxera.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