



# **Review of UKRN recommendations on the appropriate inflation index for estimating historical TMR**

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## Executive Summary

National Grid plc (NG plc) commissioned NERA Economic Consulting (NERA) to review the recommendations on the appropriate inflation index used for estimating historical real Total Market Return (TMR), as presented in the report by Wright, Burns, Mason and Pickford prepared for the UK Regulators network (“UKRN report”).<sup>1</sup>

The UKRN report recommends that CPI inflation should be used as a basis of setting real allowed rates of return at future reviews. It also argues that historical real returns should be analysed in reference to historical CPI inflation published by the Bank of England (BoE) in the Millennium dataset, as it is more consistent over time and therefore superior to RPI over the historical period since 1900. Drawing on historical CPI inflation from the Bank of England, the UKRN report estimates a real (CPI) TMR of 6 to 7 per cent based on long-run realised returns.

In this report, we show that the historical inflation data labelled as “CPI” in the BoE Millennium dataset does not represent a reliable measure of CPI inflation going back to 1900 and therefore should not be used as a basis of estimating historical real TMR. Instead, historical real TMR should be estimated using RPI inflation, which is the most reliable measure of UK historical inflation going back to 1900, supporting a real (RPI) TMR of around 7 per based on the arithmetic average of realised returns. To estimate the equivalent historical TMR on a CPI-deflated basis, historical RPI-deflated returns should be adjusted using the historical RPI-CPI wedge estimated since 1989 of 71bps, the only period for which reliable CPI and RPI data is available.

### **Our review of BoE “CPI” data shows it is not a reliable measure of CPI inflation going back to 1900 and should not be used to calculate historical real TMR**

The UKRN report uses data on historical CPI inflation reported in the BoE Millennium dataset to calculate the historical real TMR. The BoE CPI data is based on a number of sources for different periods, summarised in Table 1 below, together with the sources for the BoE alternative RPI data.

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<sup>1</sup> Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003).

**Table 1**  
**Sources of BoE CPI and RPI Millennium series inflation data and RPI-CPI wedge**

Period	RPI source	CPI source	RPI-CPI wedge
1989-2016	Official ONS RPI index	Official ONS CPI index	71 bps
1950-1988	Official ONS RPI index	Modelled back series of CPI (ONS, 2013)	28 bps
1915-1949	Implied deflator for consumers' expenditure (O'Donoghue et. Al., 2004)	Implied deflator for consumers' expenditure (O'Donoghue et. al., 2004)	0 bps
1900-1914	Implied deflator for consumers' expenditure (O'Donoghue et.al., 2004)	Cost of living index (Feinstein, 1991)	-30 bps

*Source: Bank of England (2017), A millennium of macroeconomic data for the UK, tab A47. Wages and prices*

Based on our review of these different data sources, we find that the BoE “CPI” data is unreliable and inconsistent for the years before 1989 when CPI official data started being published, which represents the vast majority of the historical period over which total market returns are being analysed (since 1900). Specifically:

- For **1950-1988**, the “CPI” data is based on ONS (2013) back-estimates of “CPI” derived from the official RPI index and the ONS (2013) paper itself raises significant concerns regarding the reliability of this data, noting the estimates are only approximate as sufficient data to calculate CPI prior to 1987 does not exist.<sup>2</sup>
- For **1915-1949**, the BoE data for “CPI” and “RPI” is identical, based on a single series of inflation data published by O’Donoghue et. al. (2004). We have analysed this source and found that this reflects actual RPI inflation after 1947 and estimates by Feinstein (1972) of the RPI index before 1947. There is therefore no CPI data available for this period.
- For **1900-1914**, the “CPI” data is based on Feinstein (1991), which estimates a cost of living index for working class households only and not CPI inflation, which has a much wider definition and covers all private and institutional households.

In contrast to the UKRN report, we conclude that the BoE’s “CPI” historical data is unreliable and inconsistent over time. Indeed, the “CPI” series includes RPI data for a substantial portion (35 years) of the historical period and the data for other historical periods is not a reliable estimate of CPI inflation historically.

<sup>2</sup> “The method provides only approximate results and there is no way to determine how accurate our method is as sufficient data to calculate the CPI do not exist prior to 1987.” Source: ONS (2013), Modelling a Back Series for the Consumer Price index, Robert O’Neill and Jeff Ralph, p.4.

In summary, we conclude that the historical inflation data labelled as “CPI” in the BoE Millennium dataset does not represent a reliable measure of historical CPI inflation going back to 1900 and therefore should not be used as a basis of analysing historical real returns.

**Historical RPI inflation represents the most reliable and consistent source for estimating UK inflation for the period since 1900**

We conclude that RPI represents the most reliable measure of UK inflation historically and therefore should be used to analyse historical real TMR for the period since 1900.

Our recommendation is consistent with the view presented in O’Donoghue et. al. (2004), which concludes that RPI data presented in the “*unofficial national accounts*”<sup>3</sup> from Feinstein (1972) for the period before 1947 and the official RPI data post-1947 represent the appropriate data to be used for making “*long-run comparisons [...] of consumer price inflation*”.<sup>4</sup> Similarly, the ONS published *Long term indicator of prices of consumer goods and services* also uses the same RPI data as O’Donoghue et. al. (2004).<sup>5</sup>

**Historical data supports a real (RPI) TMR of around 7 per cent based on arithmetic mean**

Different historical RPI inflation estimates are available from Dimson Marsh and Staunton (DMS) and the BoE, with BoE around 20bps higher. We conclude that it is reasonable to retain DMS real returns as a basis of analysing historical returns, given:

- the DMS data matches the timing of the nominal equity returns index (year-end values) while the BoE data does not (year average values);
- the difference between DMS and BoE is principally driven by the period around WW2, which according to the authors of the BoE inflation estimates may be particularly unreliable; and
- DMS has been the basis of estimating returns at previous reviews and represents a familiar reference point for investors.

This supports a real (RPI-deflated) TMR of around 7 per cent based on the arithmetic mean of realised returns.

**Conversion to equivalent CPI-deflated historical real TMR should be based on a wedge estimated since 1989 of 71 bps, as no reliable CPI data available for earlier periods**

To estimate the equivalent historical TMR on a CPI-deflated basis, the historical RPI-deflated TMR should be adjusted using the historical RPI-CPI wedge. The wedge should be estimated from data post 1989 only, as no reliable CPI data exists prior to this period (as discussed above). This supports a wedge of 71bps.

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<sup>3</sup> O’Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750, p.39.

<sup>4</sup> O’Donoghue, Goulding, Allen (March 2004), op.cit., p.38.

<sup>5</sup> Available at ONS website: <https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/cdco/mm23>



We note that the UKRN report argues that the historical RPI-CPI wedge has been only 14bps over the 20<sup>th</sup> century.<sup>6</sup> However, we explain that it is impossible to estimate the historical wedge since 1900, as there is no reliable CPI data prior to 1989. The unreliability of the UKRN historical “RPI-CPI” wedge estimate is particularly obvious considering the CPI data sources prior to 1949, which includes a 35 year period during which the “CPI” series is based on RPI data and hence provides a zero wedge by design and a 15 year period where “CPI” data is based on a cost of living index for working class households only which is not a CPI measure and indeed provides a significantly negative RPI-CPI wedge.

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<sup>6</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p.D-122.

# 1. Introduction

National Grid plc (NG plc) commissioned NERA Economic Consulting (NERA) to review the recommendations on the appropriate inflation index used for estimating historical real Total Market Return (TMR), as presented in the report by Wright, Burns, Mason and Pickford prepared for the UK Regulators network (“UKRN report”).<sup>7</sup>

Wright et al. (2018) were asked to advise UK regulators on the appropriate methodology for setting the cost of capital at future price controls. The UKRN report makes ten broad recommendations on the cost of capital, including on the appropriate inflation index for calculating the historical real TMR. In its RIIO-2 Framework Consultation, Ofgem quotes the UKRN estimates of historical real TMR as one of the sources of evidence relevant for setting the TMR at RIIO-2 controls.<sup>8</sup>

This report has been prepared to support National Grid’s response to Ofgem’s RIIO-2 Framework Consultation on the appropriate inflation index for calculating historical real TMR. We do not comment on any other recommendations presented in the UKRN report.

We note that the objective of this report is to comment on how a historical real TMR should be calculated, but we do not comment on whether and how the historical TMR figure should be adjusted to calculate the real forward looking TMR estimate.

This report is structured as follows:

- Section 2 summarises the UKRN recommendations on the appropriate inflation index for calculating historical TMR in real terms;
- Section 3 assesses the reliability of historical CPI inflation data from the BoE Millennium dataset for estimating historical real TMR;
- Section 4 sets out our recommended approach on estimating historical real TMR.

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<sup>7</sup> Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003).

<sup>8</sup> Ofgem (March 2018), RIIO-2 Framework Consultation, para 7.41.

## 2. Summary of UKRN recommendations on the appropriate inflation index used to calculate historical real TMR

The UKRN report recommends that going forward, regulators should estimate the real WACC in reference to the inflation measure chosen by HM Treasury and as implemented by the Bank of England (BoE) for inflation targeting (currently CPI), as opposed to the RPI index used by UK regulators since privatisation.<sup>9</sup>

The UKRN report highlights a number of shortcomings of RPI inflation which it considers make it inappropriate for estimating the WACC in real terms at future reviews, including: i) divergence of RPI from the inflation index used by the Bank of England (currently CPI); ii) the methodology for constructing RPI does not follow international standard practice (while CPI does) and iii) changes to the RPI calculation methodology over time imply that RPI is not comparable over time (while consistent estimates of historical CPI exist).<sup>10</sup>

To determine a real WACC return going forward, the UKRN report recommends that historical real returns should be analysed by deflating historical total market returns calculated in nominal terms (based on data from Dimson, Marsh and Staunton, DMS) with historical CPI inflation as published by the Bank of England in its “Millennium” dataset. The UKRN report argues that historical RPI inflation has been subject to methodology changes in the past and is therefore not comparable over time, while historical CPI data is available using a consistent methodology, thus making CPI “*distinctly superior to the RPI*” in analysing historical real returns.<sup>11</sup>

Based on this approach, the UKRN report presents an estimate of historical real CPI-deflated TMR of 6 to 7 per cent.<sup>12</sup> In its RIIO-2 framework consultation, Ofgem presents a corresponding real RPI-deflated TMR of 5 to 6 per cent.<sup>13</sup>

At past reviews, UK regulators have used similar ranges for historical real TMR as presented in the UKRN report. However, these ranges have been interpreted as being expressed in RPI-deflated terms. For example, the CMA in its 2014 Northern Ireland Electricity determination presented historical real RPI-deflated TMR of 6 to 7 per cent.<sup>14</sup>

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<sup>9</sup> Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003), p.30.

<sup>10</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p.30 and appendix D.

<sup>11</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p.31 and appendix D.

<sup>12</sup> Wright, Burns, Mason, Pickford (2018), op. cit., appendix E. The UKRN report calculates the historical returns based on geometric (compound) historical returns and a 1 to 2 percentage points adjustment to arithmetic average.

<sup>13</sup> Ofgem (March 2018), RIIO-2 Framework Consultation, para 7.41.

<sup>14</sup> CMA (March 2014), Northern Ireland Electricity Limited price determination, para 13.141, p. 13-27.

### 3. Reliability of historical CPI vs. RPI inflation data

The UKRN report recommends that CPI inflation should be used both as a basis of:

- determining allowed WACC in real terms going forward; and
- analysing historical real total market returns going back to 1900.

In relation to the first recommendation, we agree that *going forward* there may be potential merit in determining the allowed WACC in real terms using the same inflation index as used by the Bank of England for inflation targeting, which is currently CPI, but as recognised by the UKRN report may become CPIH in the future.<sup>15</sup> However, we note that regulators may also consider other factors in determining the appropriate price control index, e.g. the impact of companies existing RPI-linked liabilities, implications for customer bills or the ability of the price control index to track companies' costs.

The second recommendation is less straightforward. The appropriateness of using the BoE's Millennium CPI inflation data, as proposed by the UKRN report, as a basis of analysing *historical* real TMR depends on the reliability of this data as a measure of historical CPI inflation for the UK since 1900, given the official CPI index only became available in 1989.

To consider this issue, in this section we analyse the CPI data from the Bank of England's Millennium dataset for the historical period 1900-2016 and comment on its reliability relative to the alternative RPI data.<sup>16</sup>

#### 3.1. Review of BoE CPI and RPI inflation data

The data for historical CPI and RPI inflation in the BoE Millennium dataset has been compiled by the BoE from a number of sources for different historical periods, including official national statistics and various papers including those by the ONS as well as academics. These different sources are summarised in Table 3.1 below. We also show the corresponding estimates of the RPI-CPI wedge over each of the sub-periods.

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<sup>15</sup> Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003), p. D-122.

<sup>16</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p. D-111.

**Table 3.1**  
**Sources of BoE CPI and RPI Millennium series inflation data and RPI-CPI wedge**

Period	RPI source	CPI source	RPI-CPI wedge
1989-2016	Official ONS RPI index	Official ONS CPI index	71 bps
1950-1988	Official ONS RPI index	Modelled back series of CPI (ONS, 2013)	28 bps
1915-1949	Implied deflator for consumers' expenditure (O'Donoghue et. Al., 2004)	Implied deflator for consumers' expenditure (O'Donoghue et. al., 2004)	0 bps
1900-1914	Implied deflator for consumers' expenditure (O'Donoghue et.al., 2004)	Cost of living index (Feinstein, 1991)	-30 bps

*Source: Bank of England (2017), A millennium of macroeconomic data for the UK, tab A47. Wages and prices*

Our review of the BoE Millennium data for CPI and its original sources poses a serious challenge to UKRN's claim that the BoE historical CPI inflation data is superior to RPI as a measure of historical UK inflation, as we discuss below.

### **1989-2016 period:**

For the period 1989 to 2016, the BoE Millennium dataset relies on official RPI and CPI indices as published by the ONS.

For this period, we therefore conclude that the data is equally reliable as it is based on official published estimates by the ONS.

### **1950-1988 period:**

As for the most recent period, for the period 1950 to 1988, the RPI data included in the Millennium dataset relies on official RPI indices published by the ONS.

In contrast, there are no official CPI inflation estimates for this period as CPI was introduced only in 1989. Instead, the BoE CPI data is based on estimates by O'Neill and Ralph from the ONS (2013), who derive the CPI index from the official published RPI index.<sup>17</sup> Specifically, the ONS (2013) paper estimates CPI for 12 two-digit CPI category levels as well as the All items index, based on data for the available RPI sub-indices adjusted to match as closely as possible the CPI categories and using econometric modelling of the formula effect based on an ARIMA model.<sup>18</sup>

<sup>17</sup> ONS (2013), Modelling a Back Series for the Consumer Price index, Robert O'Neill and Jeff Ralph.

<sup>18</sup> ONS (2013), op. cit., p.4.

The ONS (2013) paper highlights in a number of places that the modelled CPI historical data is only approximate and cautions from relying on the estimates:

*“The method provides only approximate results and there is no way to determine how accurate our method is as **sufficient data to calculate the CPI do not exist prior to 1987.**”*<sup>19</sup> [emphasis added]

*“It is difficult to assess the accuracy of the series, as the true CPI can never be known. For that reason it is also worth emphasising that **these modelled estimates can only be considered as broad indications of the level of the CPI series at best and caution should be exercised when using these series.**”*<sup>20</sup> [emphasis added]

We therefore conclude that for the period 1950 to 1988, BoE’s RPI data is reliable as it is based on official national statistics. We conclude the BoE CPI data is substantially less reliable, given it is based on a back-modelled CPI index by the ONS (2013), which itself highlights the potential unreliability of the derived estimates.

### **1915-1949 period:**

For the period 1915 to 1949, the RPI and CPI data in the BoE Millennium dataset is **identical**, based on the paper by O’Donoghue et. al. (2004) from the ONS and House of Commons Library.

O’Donoghue et. al. (2004) present their view on the appropriate index for undertaking long-run comparisons of consumer price inflation in the UK since 1750:

*This article presents a composite price index covering the period since 1750, which allows **long-run comparisons to be made of consumer price inflation** and the purchasing power of the pound. It **replaces similar indices that have been published in the past by the Office for National Statistics, the Bank of England and the House of Commons Library.** The article describes and assesses the sources which make up this composite price index, and explains why some sources are preferred over others for the purpose of long-run comparisons.*<sup>21</sup> [emphasis added]

The O’Donoghue et. al. (2004) index represents a composite inflation index for the period since 1750, relying on a number of sources for different sub-periods, which the authors consider are most appropriate for making long-run comparisons of consumer price inflation in the UK.

For the period 1948 to 1949 (and indeed for the full post-1947 period), the O’Donoghue et. al. (2004) index is based on the official published RPI index (RPI was introduced in the UK in 1947).

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<sup>19</sup> ONS (2013), op. cit., p.4.

<sup>20</sup> ONS (2013), op. cit., p.7.

<sup>21</sup> O’Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750, p.38-46.

For the period 1915 to 1947, the O'Donoghue et. al. (2004) index is based on estimates by Feinstein (1972).<sup>22</sup> O'Donoghue et. al. (2004) note the following about the Feinstein (1972) data:

*“During this period (1870-1947), the implied deflator for consumers’ expenditure is used, derived from estimates of consumers’ expenditure valued at current and constant prices. These are taken from the **unofficial national accounts of the United Kingdom, prepared by the Department of Applied Economics at Cambridge University (Feinstein, 1972)**. These results were put together in a form which was as nearly as possible consistent in concept and definition with the then Central Statistical Office’s (post-1947) official estimates of the National Accounts.”*<sup>23</sup>  
[emphasis added]

The above description by O'Donoghue et. al. (2004) suggests that the Feinstein (1972) data was compiled with the intention to replicate the official post-1947 official national statistic, which was the RPI index. Indeed, CPI inflation was introduced in the UK only in 1989, 17 years after the Feinstein (1972) data was published.

Our interpretation that the Feinstein (1972) data as presented in O'Donoghue et. al. (2004) attempts to replicate RPI inflation is also consistent with the fact that the BoE Millennium dataset uses the same source as a basis for estimating RPI inflation for the earlier period 1900 to 1914, while it uses a different dataset for CPI.

We therefore conclude there is no data for CPI inflation available for the period 1915 to 1949. The Bank of England Millennium dataset induces only one source, O'Donoghue et. al. (2004), which is based on actual RPI inflation for 1948 to 1949 and Feinstein (1972) data, which intends to replicate the post-1947 official estimate, i.e. the RPI.

### **1900-1914 period:**

For the period 1900 to 1914, the RPI inflation in the BoE Millennium dataset is based on the same O'Donoghue et. al. (2004) index based on Feinstein (1972) data, as used for the following period 1915 to 1949 discussed above.

The CPI data for this period is based on estimates of the cost of living index from Feinstein (1991).<sup>24</sup> According to the description in Feinstein (1991), the objective of the estimates of the cost of living index was to *“investigate one crucial aspect of these trends in living standards from 1970 to the First World War: the **changes in the price of goods and services purchased by working-class households**”*<sup>25</sup> [emphasis added]

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<sup>22</sup> Feinstein (1972), National income, expenditure and output of the United Kingdom, 1855-1965, Cambridge University Press.

<sup>23</sup> O'Donoghue, Goulding, Allen (March 2004), op. cit., p.39.

<sup>24</sup> Feinstein (1991), A new look at the cost of living 1870-1914; in Foreman-Peck (1991), New perspectives on the late Victorian economy: essays in quantitative economic history 1860-1914, Cambridge University Press, chapter 6.

<sup>25</sup> Feinstein (1991), op. cit., p.152.

From this description, it does not appear that the cost of living index from Feinstein (1991) intends to represent a measure of historical CPI inflation. Indeed, the definition of Feinstein's (1991) cost of living index is substantially more narrowly focussed on working-class households only, as opposed to "*spending by all private and institutional households*" which is covered by the CPI.<sup>26</sup> The reliability of (Feinstein 1991) as a measure of historical CPI inflation prior to 1914 is therefore highly questionable.

Indeed, the reliability of any data prior to 1914 as estimates of historical CPI inflation is highly questionable, given no CPI data exists for the subsequent period 1915 to 1949 either (as explained above, the BoE Millennium "CPI" data is in fact based on RPI) and going back further in history is unlikely to improve data availability and quality. This is further supported by the implied estimate of the "RPI-CPI" wedge from the BoE Millennium dataset which for the period 1900 to 1914 shows a negative 30 bps, which has the opposite sign than would be expected.

We therefore conclude that for the period 1900-1914, the RPI data from O'Donoghue et. al. (2004) index based on Feinstein (1972) as a measure of historical RPI is substantially more reliable than the cost of living index from Feinstein (1991) which reflects the cost of living index for working-class households only and not CPI inflation, which has a much wider definition and covers all private and institutional households.

### **3.2. Conclusions: There is no reliable measure of CPI inflation going back to 1900**

Our detailed review of the BoE Millennium dataset and its original sources reveals that the data presented as historical CPI inflation is unreliable and inconsistent for the years before 1989 when CPI official data started being published, which represents the vast majority of the historical period analysed (since 1900). Specifically:

- For the period 1950 to 1988, the "CPI" data is based on ONS (2013) back-estimates of the CPI index derived from the official RPI index and the ONS (2013) paper itself raises significant concerns regarding the reliability of this data, noting the estimates are only approximate as sufficient data to calculate CPI prior to 1987 does not exist.
- For the period 1915 to 1949, the BoE data for "CPI" and "RPI" is identical, based on a single series of inflation data published by O'Donoghue et. al. (2004). Our analysis of this source reveals that it reflects actual RPI inflation after 1947 and estimates by Feinstein (1972) of the RPI index before 1947. There is therefore no CPI data available for this period.
- For the period 1900 to 1914, the "CPI" data is based on Feinstein (1991), which estimates the *cost of living index for working-class households only* and not CPI inflation, which has a much wider definition and covers all private and institutional households.

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<sup>26</sup> ONS (2011), History and differences between the Consumer Price Index and Retail Price Index, p.8.



In summary, we conclude that the historical inflation data labelled as “CPI” in the BoE Millennium dataset does not represent a reliable measure of historical CPI inflation going back to 1900.

Our findings are in stark contrast with the UKRN report, which argues that the Bank of England’s historical CPI data is superior to historical RPI:

*“We would also argue that it [CPI] is the measure that currently has the greatest backward and forward comparability. Although the Bank of England’s Millennium data sets include estimates for both RPI and CPI going back in history, the **CPI estimates are on more a consistent basis whereas the RPI indices match the various switches of methodology since 1947.** We also have a **double check in the form of ONS estimates, whereas the ONS do not publish estimates pre-1947 for the RPI.** This enables us to construct very long-term real return series for UK assets on a consistent basis.”<sup>27</sup> [emphasis added]*

We find that UKRN’s assertions regarding superiority of the BoE’s historical CPI inflation data compared to RPI due to consistency of the estimates are wholly unfounded. As explained above, our review shows that the historical “CPI” estimates in the BoE Millennium dataset are in no way derived on a consistent basis and indeed are substantially more inconsistent over time compared to the RPI data. This is particularly true for the period before 1949, where the “CPI” data in fact reflects actual RPI or estimates of RPI (1915-1949) and a cost of living index covering working class households only and not CPI inflation (1900-1914).

In contrast, historical RPI data is based on official national statistics for more than half of the period (since 1947) and the “unofficial national accounts”<sup>28</sup> from Feinstein (1972) which intends to replicate historical RPI and which O’Donoghue et.al. (2004) consider as the appropriate index for undertaking long-run comparisons of consumer price inflation in the UK. It is correct that the actual RPI data post 1947 reflects any changes in ONS methodology over time. However, to the extent these changes were deemed by the ONS as appropriate for improving the RPI index as a measure of UK inflation, we do not consider this represents an issue.

Finally, we note that it is not clear to us what data the UKRN report refers to as a “double-check in form of ONS estimates” on the BoE historical CPI estimates while “the ONS do not publish estimates pre-1947 for the RPI”.<sup>29</sup> The data prior to 1947 included in O’Donoghue et.al. (2004) represents RPI not CPI inflation. We also note that the ONS recently started publishing a *Long term indicator of prices of consumer goods and services* going back to 1800.<sup>30</sup> Our review of this data reveals that it matches the RPI data in the BoE Millennium dataset for the period 1900-2016. We have therefore not been able to identify any data on historical CPI inflation prior to 1989 published by the ONS.

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<sup>27</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p. D-111.

<sup>28</sup> O’Donoghue, Goulding, Allen (March 2004), op. cit., p.39.

<sup>29</sup> Wright, Burns, Mason, Pickford (2018), op. cit., p. D-111.

<sup>30</sup> Available at ONS website: <https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/cdco/mm23>

## 4. Recommended approach for estimating real historical TMR

In this section, we present our recommendations on the appropriate approach to analysing historical real TMR.

### 4.1. RPI inflation should be used for analysing historical real TMR as no reliable historical CPI inflation data exists

We do not recommend for UK regulators to rely on historical “CPI” inflation data from the BoE Millennium dataset as a basis of estimating historical real returns. As we explain in section 3, our review of the BoE data labelled as “CPI” reveals that this is not a reliable measure of historical CPI going back to 1900. Indeed the dataset includes RPI data for a substantial portion (35 years) of the historical period and the data for other historical periods prior to 1989 is not a reliable estimate of CPI inflation historically.

We therefore conclude that even if regulators *in theory* wanted to analyse historical real returns using CPI inflation, there is no available and reliable historical CPI inflation data to do this *in practice*.

Instead, we recommend that historical RPI data is used to analyse historical real TMR, as RPI represents the most reliable measure of UK inflation historically.

Our recommendation is consistent with the view presented in O’Donoghue et. al. (2004), which considers that RPI data presented in the “*unofficial national accounts*”<sup>31</sup> from Feinstein (1972) for the period before 1947 and the official RPI data post-1947 represent the most appropriate data to be used for making “*long-run comparisons [...] of consumer price inflation*”.<sup>32</sup> Similarly, the ONS published *Long term indicator of prices of consumer goods and services* also uses the same RPI data as O’Donoghue et. al. (2004).<sup>33</sup>

In the following sections, we discuss two additional issues in relation to analysing historical real TMR:

- Should we rely on BoE or Dimson Marsh and Staunton (DMS) RPI inflation data to calculate historical real returns?
- How should we derive historical real returns on a CPI-deflated basis?

### 4.2. DMS historical RPI data should continue to be considered for estimating historical real TMR

One issue in relation to calculating historical returns in real RPI-deflated terms is the exact data source used as a basis of estimating historical RPI inflation.

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<sup>31</sup> O’Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750, p.39.

<sup>32</sup> O’Donoghue, Goulding, Allen (March 2004), op. cit., p.38.

<sup>33</sup> Available at ONS website: <https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/cdiko/mm23>

At previous reviews, UK regulators relied on DMS estimates of historical real TMR for the UK, based on official RPI inflation data from 1949 and an “index of retail prices” for the period prior to 1949.<sup>34</sup>

The UKRN report presents an alternative estimate of RPI inflation based on the Bank of England’s Millennium dataset, which also uses the official RPI inflation data from 1949 and estimates from O’Donoghue et al.(2004) based on Feinstein (1972) for the period prior to 1949, as discussed in section 3.

As shown in Table 4.1 below, the RPI inflation in the BoE dataset is slightly higher than the DMS dataset, by around 20bps on average over the period 1900 to 2016.

**Table 4.1**  
**BoE RPI inflation is around 20bps higher than DMS RPI inflation over 1900 to 2016 period**

	1900 – 2016
BoE RPI inflation (arithmetic average)	4.3%
DMS RPI inflation (arithmetic average)	4.1%

*Source: NERA calculations based on DMS and Bank of England data*

The historical RPI data from the Bank of England does not exactly match the DMS data for the two following reasons:

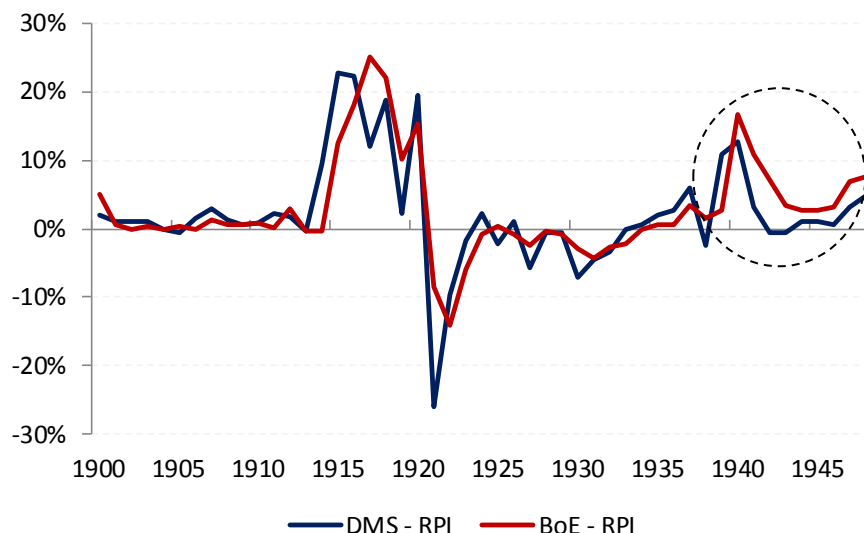
- The DMS inflation data (as well as equity returns data) is based on year-end values, while the Bank of England RPI inflation data is based on year-average values.<sup>35</sup> There is therefore a timing mismatch between the DMS nominal equity returns (year-end values) and the BoE inflation data (year-average values), while the DMS equity returns and inflation data are consistent (using year-end values).
- For the period prior to 1949, before official RPI index is available, both DMS and BoE rely on different estimates of RPI inflation: DMS use an index of retail prices while the BoE relies on O’Donoghue et. al. (2004).

Figure 4.1 below shows a comparison of the DMS and BoE RPI estimates prior to 1949.

<sup>34</sup> We note that since the 2016 publication, the DMS switched to using CPI inflation post 1988 for calculating real returns. (Source: DMS (2016), Credit Suisse Global Investment Returns Sourcebook 2016, p.180.) However, this change can be easily corrected by replacing the CPI data with RPI data as published by the ONS.

<sup>35</sup> NERA analysis of DMS data, BoE data and ONS RPI all items index data.

**Figure 4.1**  
**The difference between BoE and DMS RPI inflation prior to 1949 is driven by the WW2 period**



Source: NERA calculations based on DMS and Bank of England data

The comparison of the two RPI datasets is complicated by the timing mismatch of the two series (as discussed above). However, Figure 4.1 suggests that the key difference between the two datasets appears to be over the period during and after the Second World War. In relation to the war years, O'Donoghue et. al. (2004) note that the RPI estimates for this period are particularly unreliable:

*“Feinstein comments that there was a **heavy reliance on interpolation during the two wartime periods**. The year to year movements in prices during the **First and Second World Wars should therefore be treated with caution**. He also notes that in the period to 1920, the data includes Southern Ireland (comprising roughly 2 per cent of total consumers' expenditure), although this is unlikely to have had a significant effect on the implied deflator. From that date, the geographical coverage is the UK.”<sup>36</sup> [emphasis added]*

Indeed, if we exclude the years after 1939 from the sample, the difference between the DMS and BoE RPI data is only 6bps on average for the period prior to 1949.

We therefore conclude that it is not clear that the Bank of England historical RPI data based on O'Donoghue et. al. (2004) is superior to DMS RPI inflation used by regulators at previous reviews to estimate historical real TMR. The DMS data matches the timing of the nominal equity returns data (based on year-end values) and is almost identical to the BoE data with the exception of the period around WW2, where the BoE data is substantially higher, which is also the period for which the authors of the BoE data highlight the potential unreliability of

<sup>36</sup> O'Donoghue, Goulding, Allen (March 2004), op. cit., p.39.

their estimates. In addition, DMS has been the source of UK TMR estimates at successive price reviews and investors are familiar with this data source. We therefore consider it is reasonable to retain DMS real returns (based on DMS nominal returns and DMS RPI inflation) as a basis of analysing historical real returns for the UK. However, we note that regulators may consider estimating real returns using the alternative BoE RPI data as a sensitivity, which would result in TMR estimates that are around 20bps below DMS.

This supports a real RPI-deflated historical TMR estimate of around 7 per cent based on the arithmetic mean of historical returns.<sup>37</sup>

#### **4.3. Historical real CPI-deflated returns should be calculated using the historical RPI-CPI wedge since 1989**

To estimate the equivalent historical TMR on a CPI-deflated basis, the historical RPI-deflated TMR should be adjusted using the historical RPI-CPI wedge.

The UKRN report argues that the historical RPI-CPI wedge has been only 14bps over the 20<sup>th</sup> century while it has risen to 70bps over the period 2000-2016.<sup>38</sup> Our analysis in section 3 shows that the UKRN estimate of the historical “RPI-CPI” wedge going back to 1900 is not reliable, as there is no reliable data available for CPI prior to 1989. The unreliability of the UKRN historical “RPI-CPI” wedge estimate is particularly obvious considering the BoE’s “CPI” data sources prior to 1949 which includes a 35 year period during which the “CPI” series is based on the RPI data and hence provides a zero wedge by design and a 15 year period where the “CPI” data is based on a cost of living index for working class households only which is not a CPI measure and indeed provides a significantly negative RPI-CPI wedge. The “CPI” estimates for the period 1950-1988, back-solved from the official RPI index by ONS (2013), are also only approximate and the authors of the study caution from relying on this data.

We therefore conclude that the only period over which the historical RPI-CPI wedge can be reliably estimated is the period during which both indices exist, i.e. the period since 1989, which supports an RPI-CPI wedge of 71bps.<sup>39</sup> We note the UKRN report appears to argue that the RPI-CPI wedge of around 70bps is a recent (post-2000) phenomenon, while we note that this difference has been consistently observed in the data since 1989. We consider that any historical data prior to 1989 on CPI is unreliable and therefore should not be used as a basis of estimating the RPI-CPI historical wedge.

Our approach of relying on recent data as a basis of estimating the historical RPI-CPI wedge is consistent with the commentary on the historical reliability of inflation data from O’Donoghue et. al. (2004), who recognise that data quality reduces as we move further back in time:

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<sup>37</sup> NERA calculations based on DMS and BoE data over the period 1900 to 2016.

<sup>38</sup> Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003), p. D-122.

<sup>39</sup> NERA calculations based on ONS data.

*“It should be noted that in general the relevance and quality of the primary sources diminishes the further one goes back in time. This means that **comparisons further back in time and over long periods should be regarded as more approximate than comparisons over short periods in more recent years.**”<sup>40</sup>*

#### **4.4. Conclusions: Historical real TMR should be analysed based on RPI inflation supporting a 7 per cent real return; conversion to historical real CPI equivalent should be based on historical RPI-CPI wedge estimated since 1989 of 71 bps**

In summary, we conclude that:

- Historical real TMR should be analysed using historical RPI inflation to convert nominal to real returns, as this represents the only reliable source of consumer price inflation in the UK historically. The historical “CPI” data proposed by the UKRN report is not a reliable measure of historical CPI going back to 1900 and should therefore not be used for analysing historical real returns.
- Different historical RPI inflation estimates are used by the DMS and BoE, with BoE data around 20bps higher than DMS. We conclude that it is reasonable to retain DMS real returns as a basis of analysing historical returns, given:
  - the DMS data matches the timing of the nominal returns index (year-end values) while the BoE data does not (year average values);
  - the difference between DMS and BoE is principally driven by the period around WW2, which according to the authors of the BoE estimates may be particularly unreliable; and
  - DMS has been the basis of estimating returns at previous reviews and represents a familiar reference point for investors.

This supports a real (RPI) historical TMR of around 7 per cent based on the arithmetic mean of realised returns.

- To estimate the equivalent historical TMR on a CPI-deflated basis, the historical RPI-deflated TMR should be adjusted using the historical RPI-CPI wedge to calculate the CPI equivalent. The wedge should be estimated from data post 1989, as no reliable CPI data exists prior to this period. This supports a wedge of 71bps.

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<sup>40</sup> O’Donoghue, Goulding, Allen (March 2004), op. cit., p.38.

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