CFCM

CENTRE FOR FINANCE, CREDIT AND MACROECONOMICS

Working Paper 24/01

Did the Bank of England's Quantitative Easing Programme Become Fiscally Wasteful?

Michael Bleaney

Produced By:

Centre for Finance, Credit and Macroeconomics
School of Economics
Sir Clive Granger Building
University of Nottingham
University Park
Nottingham
NG7 2RD

www.nottingham.ac.uk/cfcm

Did the Bank of England's Quantitative Easing Programme Become Fiscally Wasteful?

Michael Bleaney

School of Economics, University of Nottingham, U.K.

Abstract

Nearly half of the government bonds purchased under the Bank of England's Quantitative Easing (QE) programme were bought in 2020-21, when long-term real yields on indexed debt were well below zero and therefore almost bound to entail a sizeable loss to taxpayers. In addition to this expansion of QE, some maturing issues from earlier rounds were rolled over at this time. In so far as QE had the intended effect of raising the prices of the assets bought, the marginal loss per £ increased with the size of the QE programme. There is no evidence that this marginal effect, or the risk that a sizeable QE programme might have a substantial fiscal cost, was taken into account by the Bank's Monetary Policy Committee or by the Government in its instructions to the Committee.

Keywords: interest rate, monetary policy, quantitative easing.

JEL No.: E58

[1]Corresponding author: Professor M F Bleaney, School of Economics, University of Nottingham, Nottingham NG7 2RD, UK. e-mail: michael.bleaney@nottingham.ac.uk

1. INTRODUCTION

Quantitative Easing (QE) refers to the purchase of longer-maturity bonds by the central bank in an effort to reduce their yield. It was first introduced in Japan in 1999. After the global financial crisis of 2007-8 it became a standard tool for boosting aggregate demand in the hands of central banks that had already reduced the policy interest rate to its lower bound. This paper focuses on the Bank of England's QE programme, for reasons that will be explained shortly.

In reaction to the Covid-19 epidemic, the Bank of England made bond purchases in 2020-21 as large as in the whole previous decade, at a time when (a) the yield on these bonds was exceptionally low and negative in real terms, thus risking a substantial fiscal loss; and (b) the heightened uncertainty was in any case likely to depress the effectiveness of interest rates in stimulating spending. A fall in output of 30 % was anticipated in the second quarter of 2020, together with associated uncertainties about shifting patterns of demand and supply chain delays and disruptions. The incentive to postpone any investment decision must therefore have been very strong. It is the potential fiscal cost, however, which is the focus of this paper.

Although QE in the UK was conceived as a cyclical measure that would be reversed once the recession was over, it is fair to say that it lasted far longer than anyone envisaged at the beginning. Asset purchases began in 2009 and continued, albeit with some interruption but with no reversals, until December 2021. If any of the bonds matured before the end of 2021, the proceeds were rolled over into new bond purchases. The Covid-19 epidemic that started in March 2020 gave QE a whole new lease of life: the assets held by the Bank of England's Asset Purchase Facility Fund (APF) increased from £445bn in February 2020 to a maximum figure of £895bn by the end of 2021. This increase of £450bn represented 20.1% of 2019 GDP.

Various observers have pointed out that QE, particularly in its later stages, already looks likely to incur substantial capital losses for which the taxpayer is ultimately liable (e.g. Allen et al., 2021; Tucker, 2022).[1] The losses are a consequence of the unusually high prices at which the bonds were acquired. This is not exclusively a UK problem (Gros and Shamsfakhr, 2022; Levin et al., 2022), but it is significantly more acute in the UK than elsewhere because of the longer average maturity of its stock of government debt (currently the longest maturity is fifty years for both conventional and indexed debt). The loss so far is quantified in the APF's 2023 Annual Report as the difference between the current market price and the purchase price of bonds of various maturities. The questions I ask here are:

1) In the light of the history of real interest rates, should the risk of substantial fiscal losses on the QE programme have been identified and taken into account in the decision-making process?

2) To the extent that QE was effective in pushing up bond prices, the marginal fiscal cost of each increment of QE increased with the size of the QE programme; was that taken into account?

3) Whose responsibility was it to consider these risks – the Bank of England's or the Treasury's?

I focus on real interest rates not just because they are one of the two components of nominal interest rates, the other being what I shall call "inflationary risk", which consists of expectations of inflation plus a risk premium, but particularly because real interest rates,

[1] The House of Lords Economic Affairs Committee 2021 Report on Quantitative Easing also agreed with a witness who drew attention to the "potentially enormous" taxpayer liability implied by the commitment of the Government to cover any losses, though they do not discuss the likelihood of such losses materialising.

rather than variations in inflationary risk, have been the main driver of nominal interest rates in the QE period (2009-21) and also during the whole period of central bank independence in the UK before QE began (1997-2021). Table 1 shows this using the standard deviation of the two components over these two periods. The 15-year inflationary risk component has been remarkably stable at just over 3 %, which seems to imply a good deal of confidence that inflation will not move far from the 2% target. The significant point is that the standard deviation of the yield on a 15-year indexed bond was four times as large as the standard deviation of inflationary risk.

Focusing on the market for index-linked bonds enables the analyst to see through the fog of inflation uncertainty. It is true that under QE the Bank of England decided not to buy any index-linked bonds, which are largely held by buy-and-hold investors such as pension funds and are therefore less liquid than conventional bonds, which raises the cost of buying them in significant quantities. That does not undermine the case for focusing on the market for index-linked bonds in analysing the possible fiscal costs of QE because, as Table 1 implies, this is the key to understanding nominal interest rates also.

Table 1. Statistical analysis of the components of nominal interest rates

%	15-year nominal bond yield (N)	15-year indexed bond yield (R)	Inflationary risk (Z)
December 1996 – December 2021			
Mean	3.61	0.52	3.08
Standard Deviation	1.61	1.77	0.44
December 2008 – December 2021			
Mean	2.41	–0.87	3.32
Standard Deviation	1.20	1.25	0.29

Notes. The data are based on estimates of end-of-month zero-coupon real and nominal yield curves as reported in the statistics section of the Bank of England website. The inflationary risk (Z) is calculated as (1+Z/100) = (1+N/100)÷(1+R/100).

I argue that the market's apparent belief in 2020-21 that ultra-low (and indeed negative) short-term real interest rates were likely to persist for the next 50 years, as evidenced by the flatness of the yield curve for index-linked bonds, should have been of little comfort because, throughout the (albeit limited) history of these bonds, the market has underestimated future movements in real interest rates. If real interest rates were to return reasonably swiftly to anything like their historical average, then the cost of QE purchases of conventional bonds at such high prices would turn out to be substantial.

The structure of the paper is as follows. The next section briefly summarises the Bank of England's QE programme. Section Three discusses the theory of the yield curve and considers the real interest rate at which the Bank bought long-term indexed bonds under QE against the background of historical experience. Section Four investigates the potential fiscal cost of QE in 2020-21, and Section Five asks whose responsibility it was to address the issue. Section Six concludes.

2. QUANTITATIVE EASING IN THE U.K.

Quantitative Easing in the UK has consisted of purchasing conventional government bonds of medium and long maturity in a manner that largely mirrors the maturity structure of outstanding debt, plus a small quantity of longer-maturity corporate bonds. Up to 2016 a total of £445bn of assets had been acquired, but at this point purchases ceased until early 2020. The outbreak of the Covid-19 pandemic caused the Bank of England in March 2020 to authorise further purchases of £200bn of government bonds, which were soon increased to £430bn, plus £20 bn of corporate debt, bringing the total assets held by the AFP to £875bn of government debt plus £20bn of corporate debt. From February 2022, a gradual programme of reversing QE began, which was referred to as Quantitative Tightening (QT), through a mixture of sales and maturing bonds not being rolled over. If QT continues at the pace at which it has begun, it should be complete by about 2030.

The striking feature of the last burst of QE, in 2020-21, is that the yield on the assets bought was extremely low by historical standards. The zero-coupon yield curve estimated by the Bank of England gives the yield at the end of January 2020 on a 5-year and a 20-year conventional government bond respectively as 0.38 % and 1.03 %, which had risen slightly to 0.76 % and 1.22 % by December 2021. The equivalent zero-coupon yield curve estimates for index-linked 5-year and 20-year bonds were respectively -2.62 % and -2.21 % on 31 January 2020 and -3.26 % and -2.49 % on 31 December 2021. The upward-sloping real yield curve reflected a belief that real interest rates would become less negative over time, but only to a limited extent.

3. THEORY AND HISTORICAL EXPERIENCE

Before we analyse the potential fiscal cost of the 2020-21 QE asset purchases in more detail, it is useful to remind ourselves about the theory of real interest rates.

The standard approach to explaining the yield curve (the relationship between short-term and long-term bond yields) is the expectations theory. An investor buying a bond at time t and intending to sell at time $t+2m$ may buy a bond of maturity $2m$; alternatively she may buy a succession of bonds of maturity $< 2m$, such as a bond of maturity m, followed by a second bond of maturity m at time $t+m$. The yield on this second bond is unknown at time t. The expectations theory says that these two strategies should be expected to produce identical returns, so that the spread between longer- and shorter-maturity bonds will reflect expected future interest rates. The only caveat to this is the likelihood that there is a risk premium attached to longer-maturity bonds, in case unexpected inflation undermines their real value, since the nominal yield is fixed for those who bought longer-maturity bonds at time *t*.

The expectations theory sounds like common sense but is incomplete for empirical purposes. This is because there is only one piece of information – the yield spread – and two unknowns that cannot be observed (the expectations of future yields, and the risk premium). So the expectations theory has to be supplemented by additional hypotheses about the determination of the risk premium and of interest rate expectations before it can be taken to the data. In the absence of anything better, it is standard to assume that the risk premium is a constant, so that it can be absorbed by an intercept term in any regression.[2] As for expectations, the usual approach is to assume that they are formed rationally, and are therefore based on a correct interpretation of all information available at time *t*. This is normally taken to imply that any forecast errors in future short rates should be random and uncorrelated with any variables known at time *t*, such as the term spread (e.g. Campbell and Shiller, 1991; Pflueger and Viceira, 2011). This joint hypothesis of expectations theory plus rational expectations can be tested by regressing the error in forecasting future interest rates on suitable controls and seeing if the null hypothesis that no explanatory variable is statistically significant is rejected as expected. Note that in order not to fail this test the forecasts do not have to be accurate in the sense that the errors are small in absolute value, but just randomly distributed about zero however large they are.

Expectations theory can be applied to the market for index-linked bonds in similar fashion (Pflueger and Viceira, 2011). In this case the slope of the yield curve reflects a combination of expected movements in short-term real rates and a real risk premium. The argument for a significant risk premium in index-linked bonds is in my view much weaker

[2] Since the rate of inflation is more volatile when it is higher, one might consider that the risk premium is more likely to be a function of recent inflation than absolutely constant over time, but I shall not pursue that issue here.

than in nominal bonds, since there is no inflation risk. It is true that there is a risk of fluctuations in real interest rates in the future, but some financial institutions, such as pension funds with defined-benefit liabilities for decades ahead, may actually be more interested in the longer-term real value of the fund than its short-term value. It is therefore a reasonable assumption, and also a convenient one, that the real risk premium is negligibly small, and that the real yield curve purely reflects expectations of future short rates. From now on I shall assume that the real risk premium is zero.

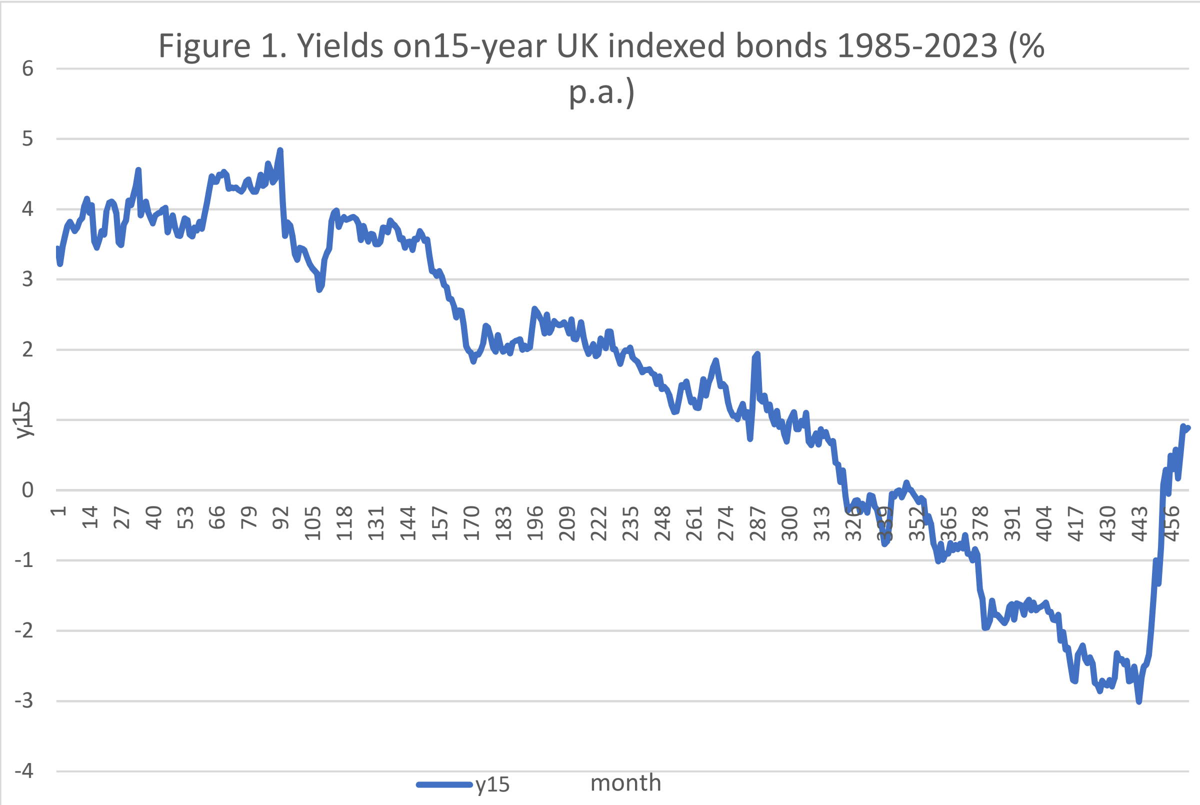
The expectations theory is just about the triangular relationship between current short-term interest rates, future short-term rates and the current yield on longer-maturity bonds; it says nothing about why interest rates are at the level that we observe. The equilibrium real interest rate is usually conceived as the rate that equalises planned saving and investment at full employment. Sources of medium-run changes in savings over decades may arise from fiscal policy or from demographic factors such as the ratio of retirees to employees in the population, because the former tend to be dissavers and the latter to be savers (e.g. Rachel and Summers, 2019). Investment intentions reflect the profit opportunities offered by technical progress and also macroeconomic conditions and the wider policy environment.

Over the 40-year history of indexed bond markets, real interest rates have changed considerably and in ways that the financial markets have consistently failed to predict; throughout the period the yield curve for UK indexed debt has been persistently but erroneously flat. The expectations theory of long-term indexed bond yields interprets this flatness to mean that whatever short-term rate we observe today will persist with little change into the indefinite future. That has just not happened. The analysis below is based on the indexed bond market in the United Kingdom, because the UK was the first advanced country to issue such bonds, and they cover the full range of maturities up to fifty years, which makes estimates of the yield curve more reliable. The indexation against inflation is not quite 100 %, but it is close enough to it that we can ignore this limitation.[3]

Figure 1 reproduces a graph of estimated fifteen-year zero-coupon real bond yields from the UK indexed debt market since 1985.[4] The pronounced downward trend is similar to that for world real interest rates derived from index-linked bonds (an average of G-7 countries other than Italy) in Rachel and Summers (2019, Fig 1). If the market had correctly predicted this, the yield curve should have had a significant negative slope, with long-term rates below their short-term rates.

[3] There has always been a lag in the indexation, which was eight months initially and three months on bonds issued after 2005-6. This means that holders are not compensated for differences between inflation in the three months before the bond matures and inflation in the three months prior to issue.

[4] I concentrate on 15-year and 20-year bond yields because they are close to the average maturity of index-linked bonds in issue, which is 18.8 years.



Notes. Source of data: end-month zero-coupon yield curves from the file glcrealmonthedata on the Bank of England Website. Month 1 = January 1985. January 2020 = Month 421; December 2021 = Month 444.

Table 2 gives some data about estimated zero-coupon yields on UK index-linked bonds. The rows refer to yields observed at 31 December 1987, 1992, 1997,… at five-year intervals up to 2022. Column A shows the yield on five-year bonds, and Column B shows the yield on 20-year bonds at the same date. In both cases the yield was solidly positive with no obvious trend until about 1997, after which it fell persistently until 2020; in 2022 it began to increase again. Column C shows the difference between them (the term spread), which is positive in six out of the eight cases but fairly small (the average is 0.39). Column D shows the yield on a strategy of investing in four successive 5-year bonds starting at the date that is indicated as an alternative to a 20-year bond (for 2012 and 2017, the comparison is for a 15-year and a 10-year bond respectively because the return on four successive five-year bonds is not yet known) and Column E shows how much that differs from the yield on a 20-year bond. What stands out from Column E is that for the whole period from 1987 to 2012, the realised return on a succession of 5-year bonds is more than one percentage point p.a. less than the yield on a 20-year bond. The downward trend is far greater than suggested by the initial term spread, which indicates that the market was far too optimistic about future yields on indexed bonds and did not anticipate the decline that actually occurred.

Table 2. Yields on UK index-linked bonds (% p.a.): comparing 5-year and 20-year maturities

At 31 Dec.	5-year	20-year	B – A	Four successive 5-year	B – D
	A	B	C	D	E
1987	2.95	4.16	1.21	2.84	1.32
1992	3.15	3.85	0.70	2.53	1.32
1997	3.21	3.05	-0.16	1.37	1.68
2002	2.05	2.16	0.11	0.14	2.02
2007	1.74	0.96	-0.78	-0.39	1.35
2012	-1.46	-0.03	1.43*	-1.09*	1.06*
2017	-2.12	-1.71	0.41**	-0.90**	-0.81**
2022	0.34	0.56	0.22		

Notes: *Three successive five-year bonds compared with a 15-year bond. **Two successive five-year bonds compared with a 10-year bond. The data are from the file glcrealmonthedata.xls on the Bank of England website for the date given in the left-hand column. The numbers refer to the estimated zero-coupon yield curve for index-linked bonds at 31 December of the year shown in the first column. A – the five-year bond yield; B – the 20-year bond yield; C – the 20-year/5-year yield spread (B – A); D – the average yield on four successive five-year bonds starting at the same date; E – the realised yield difference between a 20-year bond and four successive 5-year bonds (B – D).

Table 3. 15-year and 5-year UK indexed bond yields

Statistic	months	Mean	St. dev.	Minimum	Maximum
Term spread > 0					
Term spread (A)	210	0.592	0.409*	0.008	1.71
Ex post yield difference (B)	210	1.21	0.616	-0.892	2.63
Term spread < 0					
Term spread (A)	133	-0.350	0.306	-2.32	-0.001
Ex post yield difference (B)	133	1.06	0.671	-0.546	2.25

Notes. The data refer to end-of-month estimated yields (% p.a.) on UK government indexed bonds from January 1985 to July 2023. A – the yield differential between a 15-year and a 5-year bond at time *t*; B – the realised 15-year yield differential between a 15-year and three successive 5-year bonds ending at time t+15

Table 3 reinforces the point made by Table 2 by showing some relationships between the five-year bond yield at time *t*, the fifteen-year bond yield at time *t* and the fifteen-year yield on three successive five-year bonds at times *t*, *t*+5 and *t*+10, using the full set of end-of-month data from January 1985 to July 2013 (343 months). The Table separates the sample into cases when the spread between the fifteen-year and five-year bonds was positive (210 months) and when the spread was negative (133 months). When the spread was positive (the upper panel of Table 3), implying an expectation of rising short-term rates, it averaged +0.59 percentage points, but the average realised returns on a succession of five-year bonds turned out to be 0.63 percentage points *below* the current five-year yield, and therefore 1.21 percentage points below the return on a 15-year bond over the same period. When the spread was negative (the lower panel of Table 3), averaging -0.35 percentage points, the realised return on a succession of short-term bonds turned out to be on average 1.06 percentage points below the return on a 15-year bond. Thus throughout this period the future short-term real interest rate has been consistently lower than that implied by the expectations hypothesis, with a better return on a long bond than from a succession of short bonds.

It is difficult to glean information about *ex ante* real interest rates in earlier periods because we cannot observe inflationary expectations, but I make a brief attempt to do so, and also to judge the likelihood of negative real interest rates in the coming decades, in the Appendix.

4. POSSIBLE LOSSES ON QUANTITATIVE EASING

The scale of Quantitative Easing in 2020-21 was huge. In the financial years 2020-21 and 2021-22, QE government bond purchases amounted to £430bn. This represented 19.25 % of

2019 GDP and 63 % of total gilt sales of £680bn over the same period.[5] Haldane et al. (2016, pp. 11-12) plot the estimated impact of each major QE announcement up to 2016 on bond yields, using data from four jurisdictions: the UK, the USA, Japan and the Euro Area, and scaling the size of each announcement by GDP.[6] The authors note that, up to 2016 at least, the yield effect of each unit of QE seemed to have diminished, and they speculate that this may be because later episodes were less of a surprise to the bond market. Certainly in 2020-21 indexed bond yields in the UK did not react much either to the resumption of QE in March 2020 or to the announcement in late 2021 that it was going to be replaced shortly by Quantitative Tightening, which actually began in March 2022. The zero-coupon yield curve on 15-year indexed bonds showed a yield that was down to -2.47 % by August 2019 and that stayed in the range -2.30 to -3.00 until early 2022, only rising (i.e. becoming less negative) after the start of the Ukrainian war in March 2022. This was probably because the extra demand for bonds created by QE was matched by the massive expansion in the supply resulting from the huge budget deficits of the pandemic period.

There are four factors that determine the eventual fiscal loss from QE. (1) One is how negative is the real rate of return on the bonds if held to maturity. (2) The second factor is the likelihood of that cost being reduced because the assets bought under QE are sold before their maturity date, say within ten years, and for a better return than if they had been held to maturity. This is where the future path of real interest rates enters into the equation. (3) The third factor is whether inflation turns out in fact to be significantly different from the rate implied by the spread between indexed and conventional bonds. (4) Finally, the fourth factor is that, if QE had the desired effect of pushing up bond prices, then the likely fiscal cost of

---

[5] The figure of £680bn of gilt sales comes from the Debt Management Office's Annual Reports.

[6] It is not clear that the size of the announcement is the only relevant aspect for the impact on bond yields; the number of months over which it is spread, and therefore the monthly purchase rate, may also be relevant. Indeed comments in the August 2023 Monetary Report indicate that the Bank of England believes that the modest pace of asset disposals from the APF has kept the impact on yields relatively low.

further QE purchases was steadily increasing as QE was expanded. This last is an important but widely overlooked point.

In relation to point (1), it is clear that bonds were bought at heavily negative real yields. Throughout the QE period from March 2020 to November 2021, the real yield on 15-year index-linked bonds averaged about -2.5 % p.a., while the yield on 15-year conventional bonds averaged 0.6% p.a. up to January 2021, and then rose in February 2021, averaging 1.1 % p.a. between the end of February 2021 and the end of January 2022, just before the start of Quantitative Tightening. The Bank justified its policy by reference to both inflation and output being below target, and no mention was ever made in the Monetary Policy Reports of the possible cost of buying bonds with guaranteed negative real returns of such a magnitude if held to maturity. Table 4 shows the loss in real value over 15 years of different levels of negative annual return. The numbers are based on zero-coupon indexed bonds, but they would be similar for conventional bonds, assuming that inflation turned out much as expected. The yield on 15-year indexed bonds averaged about -2.5 %, implying an eventual loss of 31.5 % according to Table 3. Since 2020-21 QE was 19.25 % of 2019 GDP, the prospective fiscal loss amounts to 6.06 % of one year's GDP, which one would have thought was too substantial to be ignored.

As for point (2), selling a bond before maturity will only reduce the real loss on bonds bought with negative real yields if the yield at the date of sale is less than the coupon, which is small (< 1%) for the majority of index-linked bond issues. In fact the yield on 20-year indexed bonds returned above zero in October 2022, and reached +1% by May 2023. If the authorities had been luckier, the recovery of bond yields might not have occurred so early in the QT process, and more of the bonds might have been sold for a smaller capital loss than Table 3 suggests.

Point (3) refers to the fact that the realised real return on conventional bonds depends on the relationship between the spread of their yield over that on indexed bonds, which averaged 3.5% in 2020/21, and the realised inflation rate over the life of the bond. So far, because of the spike in inflation in 2022, realised inflation is running ahead of inflationary expectations, but that might be reversed if inflation falls below the 2% target again.

Point (4) is critical, because it suggests that much more thought should have been given to the advantages of limiting the size of the QE programme. If QE purchases had been smaller, then the price of bonds might have fallen somewhat, which would have reduced the possible fiscal loss from QE at the margin. Some evidence of the effect of QE on bond prices is offered in the Bank of England's May 2020 Monetary Policy Report. On page 18 there is a graph that shows yields on conventional 10-year bonds falling from 0.6 % in mid-February to 0.2 % by the end of the first week in March, then rising sharply to 0.8 % by 19 March, which was the day on which QE was announced. Yields immediately fell back after 19 March, stabilising at 0.3 % by mid-April. The Bank of England attributes the rise to the effect of Covid-19 on the budget deficit, and the reversal to the announcement of the rapid implementation of £200bn of QE. The Monetary Policy Committee decided to increase bond purchases by a further £100bn at the meeting of 19 June 2020, and by yet another £150bn at the 4 November meeting.[7]

The issue of the rising marginal cost as QE was expanded is perhaps best illustrated with the aid of a numerical example. Denote the size of the actual 2020-21 QE programme as X, and suppose (1) that it is all spent on 15-year index-linked bonds with a real yield of -2.50 %. and (2) that for every reduction in purchases by 1 percentage point, the yield on indexed bonds would have been increased by k percentage points. Note that for QE to have any

[7] Two members of the Monetary Policy Committee had argued for a £300bn QE package already at the March meeting.

purpose, *k* cannot be too close to zero. Suppose *k* = 0.02, which means QE of 0.5X would have a yield one percentage point less negative than QE of X, or –1.50 %. With X = 19.25 % of 2019 GDP and a likely fiscal loss as shown in Table 4, the loss on QE of size 0.5X is 0.5 x 19.25 x 20.3 = 1.95 % of 2019 GDP. Subtracting this from the fiscal loss figure for QE of size X of 6.06 % of 2019 GDP tells us that the addition of a second 0.5X had a prospective additional fiscal loss of 4.11 % of 2019 GDP, which is over twice the size of the first 0.5X. In other words the prospective marginal fiscal cost of additional QE was increasing quite steeply with the size of the QE programme.

This is further illustrated in Table 5, which shows the additional loss of increasing QE by a further 10% of X. The last 10 % increment that takes QE from 90 % to 100 % of X risks an extra fiscal loss of 5.03 % of X, or 50.3 % of the increment to QE, which would be a startlingly high wastage rate. On top of that, some of the bonds from earlier QE purchases matured and they were all rolled over. The real yield on index-linked bonds in 2019 was similar to that in 2020 and 2021, implying similar fiscal losses on these rollovers to those on new QE. Unfortunately the APF annual reports only state the number of bonds rolled over and not the value. Altogether nine issues were rolled over in the years 2019-21; this compares with about 60 conventional issues in the market, so maybe 15% of the £445 bn of pre-2020 APF assets were rolled over into new bonds paying solidly negative real yields.

Table 4. Potential real losses on an indexed bond with negative yield

15-year indexed bond (% p.a.)	Loss of real value at maturity (%)
-2.50	31.6
-2.25	28.9
-2.00	26.1
-1.75	23.3
-1.50	20.3
-1.25	17.2
-1.00	14.0
-0.75	10.9
-0.50	7.3
-0.25	3.7

Note: the table assumes that the bonds pay no coupon.

Table 5. A numerical example of the marginal fiscal cost of different levels of QE

(1)	(2)	(3)	(4)
Size of QE increase 2020/21	Average real yield for 15-year indexed bonds (%)	Expected real loss (%) if held to maturity	Extra loss compared to QE smaller by 0.1X (% of X)
X	-2.50	31.60	5.03
0.9X	-2.30	29.46	4.69
0.8X	-2.10	24.93	4.32
0.7X	-1.90	19.81	3.89
0.6X	-1.70	15.29	3.47
0.5X	-1.50	11.12	3.00

Notes. In column (1), X = actual QE purchases of government bonds in 2020-21 (£430bn). Column (2) assumes that the total QE purchases were equivalent to buying 15-year index-linked bonds at the stated real yield. Column (3) is the expected real % loss calculated as in Table 3. Column (4) is the increment to Column (3) relative to the row below.

5. ALLOCATING RESPONSIBILITY

Over the 24 months from January 2020 to December 2021, during which period the Bank of England acquired £430 bn of UK government bonds through its programme of Quantitative Easing, the end-of-month yield on 20-year conventional bonds averaged 1.00 % p.a. and the yield on 20-year indexed bonds averaged -2.41 % p.a. As discussed above, purchasing long-maturity bonds at these prices would incur a substantial fiscal cost if real interest rates were to return to near their historical average. The potential benefits of QE needed to be weighed against this possible cost in judging the optimal extent of QE purchases. Was the omission of this the fault of the Bank of England or the Government?

The Bank of England Act 1998 defines the objectives of the Bank to be: to maintain price stability and, subject to that, to support the economic policy of the Government, including its objectives for growth and employment. The exact definitions of "price stability" and "the economic policy" are specified in an annual letter from the Chancellor of the Exchequer to the Bank entitled "Remit for the Monetary Policy Committee". In the 2018 edition of this letter one element of economic policy is stated to be "a credible fiscal policy, returning the public finances to health, while providing the flexibility to support the economy." This is modified slightly by 2021 to "a credible fiscal policy, maintaining sustainable public finances, while providing the flexibility to support the economy." These letters also authorise the resort to unconventional measures (i.e. QE) in the event of an exceptional shock when conventional measures by themselves are insufficient, but make no mention of the possible fiscal cost of QE at the prices prevailing in 2020-21.

These letters certainly did not oblige the Bank to consider the possible losses on QE during the COVID-19 pandemic, but by mentioning "sustainable public finances" they gave it licence to do so, or at least to enter into a dialogue with the Treasury about it. The absence of any discussion of the issue in the BofE Monetary Reports of the period indicates a total lack of concern, or perhaps an attitude that it was a question for the Government rather than the Bank.

In short, both the Government and the Bank ignored the issue. Since it was the Government that wrote the rules by which an independent central bank should conduct monetary policy, a fair allocation of the responsibility might be approximately 25 % to the Bank of England and 75 % to the Government.

7. CONCLUSIONS

The Bank of England is required to set monetary policy in order to achieve an inflation target of 2 % p.a. and also to pay attention to output and growth. The inflation target is symmetric, which means that the Bank should seek to correct excessively low as much as excessively high inflation. It was therefore natural for the Bank to react to the global financial crisis of 2007-08 and the weakness of subsequent GDP growth by maintaining near-zero interest rates and supplementing them with QE up to 2016. By March 2020, with a large drop in output in prospect as a result of restrictions and supply disruptions associated with the Covid-19 epidemic, the Bank did not hesitate to vote for further large purchases of medium- and long-maturity government bonds, despite the prospect of eventual losses in real value. Both the Bank and the Treasury, who had ultimate responsibility for fiscal policy, ignored the fiscal implications of these prospective losses, and in particular they ignored the fact that, if QE achieved any of its purpose in pushing up the prices of these assets relative to what they might otherwise have been, the marginal cost of each £ of QE would be even higher than the average cost. This latter effect should have caused the authorities, and the Government in particular, to give serious thought to the question of the appropriate upper limit of QE.

Rather than acquiring assets at the very rapid rate of approximately £100bn per month immediately after the outbreak of the Covid-19 epidemic, which left the prices of government bonds more or less unchanged, the Bank should have proceeded much more cautiously in order to get an idea of the elasticity of demand. That information would have enabled the Bank to estimate the non-linear relationship between the rate of QE bond purchases and their likely eventual fiscal cost, and to adjust the size of QE expenditure appropriately, rather than charging ahead with an extremely large QE programme after about five minutes' thought (which is the impression given by the Report of the March 2020 meeting of the Monetary Policy Committee).

REFERENCES

Adler, G., R. Duval, D. Furceri, S.K. Çelik, K. Koloskova and M. Poplawski-Ribeiro (2017). Gone with the headwinds: global productivity, IMF Staff Discussion Note SDN/17/04.

Allen, W.A., J.S. Chadha and P. Turner (2021). Commentary: quantitative tightening: protecting monetary policy from fiscal encroachment, National Institute Economic Review 257:1, 1-8.

Bieshaar, H. and Kleinknecht, A. (1984). Kondratieff long waves in aggregate output? An econometric test, Konjunkturpolitik 30:5.

Campbell, J.Y. and R.J. Shiller (1991). Yield spreads and interest rate movements; a bird's eye view, Review of Economic Studies 58:3, 495-514.

Gordon, R.J. (2018). Slowing economic growth despite ongoing innovation, Explorations in Economic History 69, 1-12.

Gordon, R.J. and H. Sayed (2022). A new interpretation of productivity growth dynamics in the pre-pandemic and pandemic era US economy, 1950-2022, NBER Working Paper no. 30267.

Gros, D. and F. Shamsfakhr (2022). The real fiscal cost of central bank bond buying, CEPS Explainer 2022:04.

Haldane, A.G., M. Roberts-Sklar, T. Wieladek and C. Young (2016). QE: the story so far, Bank of England Staff Working Paper no. 624.

Jordà, Ò., K. Knoll, D. Kuvshinov, M. Schularick and A.M. Taylor (2017). The rate of return on everything, 1870-2015, Federal Reserve Bank of San Francisco Working Paper 2017-25.

Levin, A.T., B.H. Lu and W.R. Nelson (2022). Quantifying the costs and benefits of quantitative easing, NBER Working Paper no. 30749.

Mensch, G. (1979. Stalemate on technology: innovations overcome the depression, Cambridge, Massachusetts: Ballinger.

Pflueger, C.E. and L.M. Viceira ((2011). Inflation-indexed bonds and the expectations hypothesis, NBER Working Paper no. 16903.

Rachel, L. and L.H. Summers (2019). On secular stagnation in the industrialized world, Brookings Papers on Economic Activity, Spring, 1-76.

Solomou, S. (1986). Innovation clusters and Kondratieff long waves in economic growth, Cambridge Journal of Economics 10, 101-112.

Tucker, P. (2022). Quantitative easing, monetary policy implementation and the public finances, Report R223, Instititute of Fiscal Studies

APPENDIX 1 – Real Interest Rates Before 1983 and Future Prospects

Most of the twentieth century was a period of major disruption by wars and the Great Depression, followed by a transition to a world of persistent peacetime inflation. Jordà et al. (2017) estimate real returns on bonds in sixteen countries between 1870 and 2015 to have averaged 2.5 % p.a., but that is *ex post* rather than *ex ante*.

Going further back in history, we can however appeal to the fact that, once the inflation and post-war deflation associated with the Napoleonic wars were over, the price level in Britain remained more or less constant right up to 1914 (if anything the trend was slightly downwards). If we assume that the financial markets recognised this and anticipated stable prices with a high degree of probability, then we can interpret the evidence from long-term nominal interest rates in this period as largely reflecting beliefs about the real interest rate.

Table A1. UK interest rates 1825-1914 (%)

Interest rate	Data	Years	Mean	St. dev.	Minimum	Maximum
Bank rate	31 December	91	4.19	1.30	2.00	8.00
Bank rate	Year average	90	3.77	1.04	2.00	7.35
Consols yield	Year average	90	3.10	0.33	2.26	3.81

Notes. Calculated from the Bank of England data file “a millenium of macroeconomic data”

Table A1 gives some statistics relating to UK interest rates from the end of 1824 to the end of 1914. Bank Rate (the short-term policy rate) varied between 2.00 and 8.00 per cent per annum. For longer-maturity bonds, the Bank of England data file “a millenium of macroeconomic data” gives only the yearly average and not an end-of-year value. Comparing the two series for the Bank Rate in Table 3 shows that the year-average smooths the underlying data, cutting the standard deviation by 20 %, from 1.30 to 1.04 percentage points. Long-term interest rates are represented in Table 3 by the perpetual bonds known as Consolidated Annuities, which were first issued in 1752. These bonds pay a coupon twice yearly, but with no promise ever to return the principal. Their effective maturity is the inverse of the population's discount rate. The average yield on them from 1825 to 1914 was 3.10 %, with relatively little variation (the standard deviation of the year average is 0.33 %, and if we add 25 % to allow for the smoothing effect, it is still only 0.41 %). It is unlikely that, even at its minimum of 2.26 %, the yield was entirely accounted for by inflation risk and the risk premium, which means that the long-term real interest rate was always positive over this 90-year period, and much less variable than it has been over the last 40 years.

In short, all this suggests that the negative long-term real interest rates of 2020-21 were historically extremely unusual. Nevertheless the potential fiscal cost of large QE bond purchases need not have been a significant issue if there were good reason to believe that real interest rates would stay close to zero for decades, as the expectations theory would conclude from the absence of a strong upward slope in the real yield curve. Persistently negative real interest rates are not likely to happen unless the incentives to invest were to weaken dramatically, for instance if technical progress were come virtually to a halt. What insights can we glean from history about that?

The idea that there were cycles in investment and the rate of technical progress was suggested by Kondratieff in 1925 in an article originally published in Russian.[8] He posited a cycle of between 45 and 60 years in length since the Industrial Revolution. The cycle consisted of alternating periods of faster and lower growth. This idea has been picked up by various authors since (see Bieshaar and Kleinknecht, 1984, for a literature review). Bieshaar and Kleinknecht (1984) test for significant differences in trend rates of growth of real output

[8] For an English translation, see N.D. Kondratieff (1936), The long wave in economic life, *Review of Economics and Statistics* 17, no. 6.22

in a variety of countries between periods corresponding to the upswings and downswings of Kondratieff and later authors. They find that the change in trend between upswings and downswings was not statistically significant before 1890, but it was in the 20th century, essentially because of slow growth between 1913 and 1938. Solomou (1986) carries out a similar exercise for the rate of innovation, based on the identification of innovations by Mensch (1979). The assumption is that if innovations cluster together, the grounds for a new acceleration of investment and growth will be provided. The test is for the non-randomness of technical innovations according to Mensch's data, and Solomou's conclusion is that randomness in the rate of technical innovation cannot be ruled out. Thus the steadiness of real interest rates in the 19th century seems to be consistent with the smoothness of technical progress at the time.

Robert Gordon has made an intensive study of US productivity growth since 1920. He estimates that output per hour grew fast between 1920 and 1970, at an average annual rate of 2.82 %, slowing to 1.50 % between 1970 and 1996 before reaccelerating to 2.38 % from 1996 to 2006, and finally slowing to 0.93 % from 2006 to 2016 (Gordon, 2018, Tables 1 & 5). The rate of issue of new patents in the US actually grew faster in the decade 2006-16 (by 27 % between the two end-years) than in the average per decade between 1956 and 1996 (by 17.4 %); nevertheless Gordon and others have identified several factors that foreshadow a slower rate of productivity growth in the 21st than in the 20th century, such as slower labour force growth, the decreasing effectiveness of research effort as the easy discoveries lie largely in the past, and the deglobalisation of supply chains because of security and other concerns (Adler et al., 2017). Gordon's estimate of future trend productivity growth is 1.2 % p.a.

In later work Gordon and Sayed (2022) focus on the cyclical behaviour of US output per labour hour. This measure of labour productivity was markedly pro-cyclical in 1950-85, but this faded considerably in 1986-2006. They argue that the pro-cyclical pattern was dramatically reversed in 2008-09, when businesses reacted in panic to the global financial crisis by severe cuts in labour hours, with gradual rehiring over the period 2010-16. Their point is that, because of this, estimates starting in 2010 considerably underestimate the recent trend rate of productivity growth, and this may have stoked interest in the idea that we have entered a period of stagnation.

To sum up: the rate of technical progress as embodied in labour productivity has fluctuated but not in regular cycles, and may well be somewhat slower in the 21st century than it was in the 20th. This will probably be reflected in a lower rate of investment and therefore some reduction in the real rate of interest, but anecdotal evidence suggests that technical progress still continues at a reasonable pace. As a long-run trend, negative real interest rates therefore seem somewhat unlikely.