The Discount Rate Debate and Its Implications for Defined Benefit Pensions

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Abstract

While the Universities Superannuation Scheme recently reported the biggest deficit of any British pension fund, the union’s actuary finds no funding crisis for the scheme. The huge contrast can be explained by the current debate on whether low gilt yields imply low future returns on other asset classes. This article argues that falling interest rates since 1980s are essentially the result of successful monetary policies to control inflation, thereby the economy benefited and firms made good profits, giving rise to healthy funding level for the scheme. Since index-linked gilt yields are found to explain up to 99% variation of its past liabilities, the scheme is likely to be in surplus if a correct discount rate is used in the valuation. The implications are that many past closures of defined benefit schemes were unwarranted, expensive disputes could have been avoided and firms’ spending on such schemes are unnecessarily high.

JEL: G1, G22, G23, G3

Keywords: pension, defined benefit, discount rate, risk-free rate, equity risk premium

1. Introduction

In July 2017, the Universities Superannuation Scheme (USS), the largest defined benefit scheme in the UK, reported the biggest deficit of any British defined benefit (DB) fund at £12.6bn.1 In response to the deficit, the scheme sponsors, Universities UK (UUK), decided unilaterally to close the DB scheme to new members after April 2019. The actuary of the University and College Union representing the scheme members, however, finds the USS in a healthy state with no funding crisis. Consequently, after a successful ballot, over 60 universities and colleges resorted to strike actions in early 2018.

The huge contrast between the valuation outcomes of the USS and UCU is a predictable outcome of the current industry debate on the approach to discount rates, as pointed out by the Pensions Regulator in its 2017 Annual Funding Statement for Defined Benefit Pension Schemes. The debate focuses on whether the historical relationships between gilt yields and returns on other asset classes will hold true for the future. In essence, the USS believes that the current low interest rates imply low future returns on its assets and hence a low discount rate is used to value its liability, resulting in a huge deficit. On the other hand, the actuary of UCU adopts the view that the future returns on other asset classes such as equities remain high despite the current low interest rates, thereby giving rise to a relatively higher discount rate with no deficit in the scheme.

This article finds that lower discount rates due to falling gilt yields were the primary reason for the rise in liabilities of the USS in recent years. In particular, a simple model that uses index-linked gilt yield as the discount rate is found to explain up to 99.3% variation of liabilities of the USS in the past seven years. More importantly, current low gilt yields do not imply low returns on equities, the most

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1 The Economist published an article titled “Universities’ main pension pot faces the biggest deficit of any British fund” on 3 August 2017.
important asset for a DB pension scheme. Therefore, the liabilities of the USS have been overstated, and the scheme is more likely to be in surplus than deficit.

Generally speaking, interest rates contain information indicative of economic wellbeing and hence future equity returns; see Estrella (2005). Towards the end of the last millennium, Blanchard et al. (1993), Siegel (1999) and Fama and French (2002) and others were suggesting a significantly lower market risk premium due to the observed lower equity returns. Falling interest rates against such backdrop together with ageing populations prompted calls for pension reform; see for example Davis (1998), Disney (2000), Blake and Mayhew (2006), Diamond (2006) and Whitehouse et al. (2009).

The long term falls in interest rates since the 1980s, however, are primarily due to reasons that are conducive for economic growth. As Carlstrom et al. (2009) and Wright (2011) show, monetary policies and economic developments in the recent decades have not only successfully controlled the inflation but also reduced its uncertainty. In the case of quantitative easing (QE), an extraordinary form of monetary policy, long-term risk free rates were deliberately kept low for continual economic growths, which in turn benefited equity markets.\footnote{Because of zero lower bound constraint and other considerations since the recent financial crisis, the role of long term interest rates in monetary policy has attracted considerable attention; see, for example, the discussions by Alex Cukierman and John Roberts, which are available respectively at https://voxeu.org/article/natural-rate-interest-its-measurement-monetary-policy-and-zero-lower-bound and https://www.federalreserve.gov/econres/notes/feds-notes/estimate-of-the-long-term-neutral-rate-of-interest-20180905.htm.} As Mishkin (2008) concludes, price stability and benign economic growth are mutually reinforcing.

Consistent with the above analysis, Ibbotson and Chen (2003) and Faugere and Erlach (2006) argue that long-term stock market returns are determined by the productivity of firms in the real economy. Using supply-side growth models, they estimate an equity premium that is not much lower than its historical average. Based on a more recent data from 1965 to 2017, this article finds that after the 1970s of high inflations, the average real returns on US and UK equities has stabilized at around 5% in the past three decades, thereby providing further evidence against the claim of low gilt yields mean low future returns on other asset classes. The empirical evidence established in this paper is consistent with Booth (2015) which estimates the risk premium of US and Canada equity markets to be around 5%.

In the above, the falls in interest rates are driven by general supply and demand factors affecting both safe and risky assets. As Caballero et al. (2017) points out, specific supply and demand factors with impacts largely on only the safe assets also explain the decline in risk-free rates, especially since the millennium. An important case is the rise in international reserve accumulation by China as well as the other emerging economies in the aftermath of the Asian financial crisis. This increased demand on US dollars drives up the US Treasury prices and in turn lowers gilt yields through international linkages. Another case is the Pensions Act 2004 that prompted many DB fund managers to purchase long-dated gilts irrespective of price in order to de-risk the scheme portfolios; see for example Joyce et al. (2009) and Greenwood and Vayanos (2010). In both cases, falling gilt yields are not indicative of weak economic growths.

Last but not least, regression analysis shows that gilt yields fit poorly the returns on the USS assets. The returns on the MSCI World Equity Index, on the other hand, explain as much as 94% of the past growths of the assets. The reason, in addition to those presented above, is the fact the assets held by
the USS are internationally well diversified. The small size of the UK economy as compared to the world is another reason why the gilt yield is poor choice as a discount rate.

Although this article considers specifically the case of the USS, its findings have several important implications for occupational pensions as well as the economy. First, an accurate estimate of discount rate is desirable because defined benefit pension plans are important for firm leverage; see Bartram (2016). Next, the undesirable economic consequences of deficits on private DB schemes could have been significantly smaller or even avoided if an appropriate discount rate were used for their valuation. Indeed, rising deficits on private DB schemes in recent years have been suspected as a possible reason for the observed subdued investment expenditure in UK as well as other OECD countries. In theory, Webb (2007) shows that pension deficits reduce the shareholder equity and increase the risk of the company’s long-term debt. Empirically, Bunn et al. (2018) find that firms with pension deficits did reduce investment and dividend payments. While the reduction in investment is small macro-economically compared to the stimulus offered by the Bank of England’s quantitative easing policy, the effects for some individual companies are large.

Also, Adrjan and Bell (2018) study UK firms that have been faced with large deficit recovery costs for their defined benefit pension plans. They show that firms share the burden of such costs when a significant portion of their workers are current or former members of the plan. Where there is closure of defined benefit plans to future benefit accrual, firms are able to reduce the total compensation of affected workers, implying a longer term costs for the firm as workers are now more likely to look for alternate jobs elsewhere.

The cost of closing a DB scheme is significant when the interest rate is low. To ensure sufficient funding for promised benefits despite possible market volatility, the scheme portfolio needs to hold considerably more risk free assets such as gilts which have been very expensive due to low, at times negative, real interest rates. The situation is very different across the Atlantic in the US where Treasury yields are not used as discount rates to evaluate the liability of DB schemes. Boubaker et al. (2017) find that recent unconventional monetary policy measures launched by the US Federal Reserve led to a substantial increase in pension funds’ allocation to equity assets, which is consistent with optimal asset allocation given the significantly lower returns on risk free assets.

To investigate the effect of holding more equities for the USS, Wong (2018) uses a model of representative pensioners to study the risk of underfunding for the defined benefit scheme. It is found that the risk of investing in more equities can be effectively diversified by long time-horizon holding. Moreover, because of current low interest rates, there is a high certainty of underfunding if the scheme portfolio holds only gilts. As more funds are allocated to equities, the probability of underfunding decreases to the point of self-sufficiency, where there is a small chance of ever requiring scheme sponsors to make additional contributions to pay for the promised benefits.

Finally, this article also highlights the need of continual research with respect to the economics of prudence and self-sufficiency as required by the Pensions Regulator for defined benefit plans. Day (2003) points out in an actuarial convention that many modes of actuarial thought are indefensible when examined against the latest findings of financial economics. Also, Clark and Monk (2006) highlights the shortcomings of actuarial and accounting practices as well as the issue of trustee competence in making optimal decisions for defined benefit schemes. For example, the current practice of liability-driven investment that buys gilts irrespective of price is highly suboptimal.

3 The 2017 USS Report and Accounts indicate that over 70% of the equities held by the USS are non-UK equities.
The paper is organized as follows. The next section introduces the relevant institutional background. Section 3 explains the reasons for the long term decline of interest rates and provides evidence that inflation related factors act as the key drivers for the past six decades of variation in the interest rates. After the study of expected long term equity returns in Section 4, the funding deficits of the USS are investigated in Section 5. Finally, Section 6 concludes.

2. Institutional background

2.1 USS

The Universities Superannuation Scheme (USS) is the largest defined benefit pension scheme in the United Kingdom with £63.6bn under management as at 31 March 2018. Its members include academic and academic-related staff from universities established mainly prior to 1992. The predecessor of the USS is the Federated Superannuation Scheme for Universities, which offered retirement benefits in annuity with no indexation to cost of living. The high inflations during late 1960s and 1970s rendered the retirement benefits insufficient for the rising costs of living. Consequently, the USS was introduced on 1 April 1975, offering members final salary retirement benefits indexed to inflation.

In January 1997, the USS joined other defined benefit schemes by taking part in contribution holiday, with its contributions reduced from 18.55% to 14% of salary. This contributed to the projected scheme deficit after USS experienced losses resulting from the 2007-2008 financial crisis. As a result, several changes were implemented in 2011, resulting in future scheme members losing 65% of their pension wealth while sponsors’ pension costs reduced by 26%; see Platanakis and Sutcliffe (2016). However, the ongoing weak economic performance after the financial crisis led the USS to identify continuing deficits, which culminated in further negotiations, industrial action, and eventually more changes being implemented in 2015. The final-salary scheme is now replaced with the hybrid of Career Average Revalued Earnings defined benefit plan on the first £55,000 of salary and defined contribution for salary over £55,000. Employee contributions rose to 8%, and employer contributions from 16% to 18% of salary. In 2017, USS reported the largest ever deficit of a defined benefit scheme in the UK. Overruling objections from University and College Union (UCU), the USS Joint Negotiating Committee announced to close the defined benefit part of the pension. In response, UCU balloted successfully for strike that began on 22 February 2018. The industrial action was suspended by both the Universities UK and UCU agreed to form a Joint Expert Panel (JEP) to re-examine the valuation of the USS 2017 valuation.

2.2 Industrial debate on discount rate

A crucial element in the projected deficits of the USS is the close association of gilt yields with the discount rates used in the valuation. Due to quantitative easing, riskless interest rates in world major economies have been in sharp decline. Since long-dated riskless interest rates are used to discount the promised pensions to obtain a present value of the liability, many defined benefits have changed from surplus into deficit as a result of falling interest rates; see for example Clark and Monk (2006) and Novy-Marx and Rauh (2009, 2011). However, questions arise as to whether low riskless interest rates are suitable discount rates to value liabilities of defined benefit schemes. As the Pensions

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4 Staff of the post-1992 universities are mostly members of the Teachers Pension Scheme.
5 The £55,000 threshold increases at CPI inflation annually.
Regulator (tPR) acknowledges in its 2017 Annual Funding Statement for Defined Benefit Pension Schemes,

The current debate on the approach to discount rates focuses on whether historical relationships between gilt yields and returns on other asset classes still hold true for the future. Proponents of a ‘gilts plus’ approach (typically meaning a fixed margin above gilts) argue that the historical relationship still holds and low gilt yields mean low returns on other asset classes. Opponents say that the gilt market is distorted and the historical relationship broken. (p. 6)

It is useful here to clarify that the aim of this article is to investigate whether the assets held by the USS are sufficient to pay for its promised pensions in the future. In this context, as described by tPR on funding defined benefit plans, an appropriate discount rate should be representative of ‘the yield on assets held by the scheme to fund future benefits and the anticipated future investment returns’.6

The approach to discount rates described above differs from much of the literature in which riskless interest rates are used to value the liabilities of defined benefit schemes. For example, Novy-Marx and Rauh (2011) calculate the liabilities of the US state employee defined benefit pensions using discount rates that reflect the risk of the payments from a taxpayer perspective. Assuming the promised benefits have the same default and recovery characteristics as the US federal republic, zero-coupon Treasury yields are used as discount rates to obtain a value of $4.43 trillion for the promised liabilities. Instead of considering a discount rate that reflect the risk of sponsors, the approach here follows that of Novy-Marx (2015) and use a discount rate that is representative of the returns on assets held by USS.

3. Interest rates

This section identifies the factors that explain the long term decline of interest rates, and investigates the impact of QE on the relationship between gilt yields and equity returns.

3.1 Long term decline of interest rates

Generally speaking, interest rates contain information indicative of economic wellbeing and hence future equity returns. Various studies such as Harvey (1988), Estrella and Mishkin (1996) and Estrella (2005) show, a steepening (or flattening) yield curve as a result of higher (or lower) yield on long-dated government bond is a sign of an improving (or worsening) economy, which tends to be associated with a better (or worse) outlook on equity returns. Slopes of yield curves associated with economic cycles, however, cannot explain the long term falls of 20-year gilt yield from over 17% during oil crisis in 1970s to the present level of less than 2%. Instead of the slope of yield curve, the level of inflation, its past variation and a trend starting in October 1992 when inflation targeting was adopted in UK are found to explain 92.7% variation of gilt yields from 1965 to 2017; see Table 1.7 Figure 1 below illustrates how the two models reported in Table 1, namely Eqn2 and Eqn3, fit the yields.

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6 See code of Practice No. 3 by tPR on funding defined benefits.
7 The same regression analyses are also applied to the real gilt yields instead of nominal gilt yields as reported in Table 1. Results remain the same qualitatively, with a slightly reduced adjusted R-squares of 0.461, 0.645 and 0.903 for Eqn1, Eqn2 and Eqn3 respectively.
The results in Table 1 show that the reason for the long term decline of interest rates is the reduction in the level and uncertainty of inflation, which has fallen from over 25% in 1970s to a current level that is close to the target of 2%. The achievement of price stability can be attributed to successful monetary policies that has been implemented in both UK and other economies as well as other developments. For example, Carlstrom et al. (2009) find that the inflation persistence in the United States has declined significantly since the early 1980s as a result of more aggressive central bank responses to inflation. Exchange rate pass-through to domestic prices brought by growing international trade is another contributing factor that helps lower the inflations; see Campa and Goldberg (2005) and Choudhria and Hakurab (2006). Technology can also help to reduce inflation as Dupor et al. (2009) find that a positive technology shock significantly and rapidly reduces inflation.

The trend coefficient in Equation 3 in Table 1 indicates that UK gilt yield, for reasons other than the level and variation of past inflations, has been falling by an average of 0.235% a year since the policy of inflation targeting was adopted. It accounts for about 5.9% of the 7.5% fall in gilt yield between October 1992 and December 2017. Three reasons are provided to explain the significant trend coefficient. The first reason is the reduction of inflation uncertainty and anchoring of inflation expectations, but such factors are not reflected in the level and variation of past inflations. In this regard, Wright (2011) finds that the term premiums have declined internationally during the 1990s and 2000s, especially in countries in which inflation uncertainty have been reduced due to substantial changes in the monetary policy frameworks. Hordahl and Tristani (2012) find that post 1999, the long-term inflation expectation in the United States and the euro area have remained well anchored, which is favourable to reducing long-term interest rates as a result of reduced inflation risk.

<table>
<thead>
<tr>
<th></th>
<th>Eqn 1</th>
<th>Eqn 2</th>
<th>Eqn 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>4.547**</td>
<td>3.206**</td>
<td>6.115**</td>
</tr>
<tr>
<td></td>
<td>[6.185]</td>
<td>[4.740]</td>
<td>[14.878]</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.566**</td>
<td>0.338**</td>
<td>0.249**</td>
</tr>
<tr>
<td></td>
<td>[7.988]</td>
<td>[4.711]</td>
<td>[7.265]</td>
</tr>
<tr>
<td>Variation of past inflation</td>
<td>1.053**</td>
<td>0.673**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[6.290]</td>
<td></td>
<td>[6.035]</td>
</tr>
<tr>
<td>Trend</td>
<td>-0.235**</td>
<td></td>
<td>[-13.536]</td>
</tr>
<tr>
<td>R-square</td>
<td>0.593</td>
<td>0.732</td>
<td>0.927</td>
</tr>
</tbody>
</table>

In the regressions, the dependent variable is monthly 20-year gilt yield whereas the independent variables are level of inflation, variation of inflation in past seven years and a trend starting in October 1992. The annual rate of change in RPI is used as the inflation whereas the trend first takes the value of zero and then increases by a twelfth after each month from October 1992 onwards. The t-statistics in brackets are obtained using the Newey-West procedure with 36 lags. ** indicates significance at 1% level.

The second reason is the unconventional monetary policy of QE in response to the 2007-2008 financial crisis. Despite the fact that policy rates of major economies were at near zero levels, prices continued to fall and the recurrence of great depression brought by debt deflation became a real possibility. Consequently, major central banks purchased huge quantities of long-dated government bonds. Joyce et al. (2011) and Gagnon et al. (2010) show that the large scale asset purchases operated through a portfolio-rebalancing channel, successfully lowered the term premiums and hence interest rates on longer term bonds.
Finally, the fall in interest rate was also driven by forces that cannot be attributed to a slowdown in the economy concerned. As Caballero et al. (2017) points out, the savings glut of China and the other emerging economies in the aftermath of the Asian financial crisis raised demand for US dollars and drove up the Treasury prices, which in turn lowered gilt yields through international linkages. On the other hand, the pension reforms in the United Kingdom in 1990s and 2000s have caused yields on long-dated gilts to fall; see Joyce et al. (2009) and Greenwood and Vayanos (2010). In particular, the implementation of the 2004 Pensions Act is such that many defined benefit schemes are required to hold a low volatility low return portfolio. Consequently, according to an investment report by Schroders in 2016, the private sector defined benefit schemes own an estimated 80% of the long-dated index-linked gilt market, with further potential demand that is almost five times the size of the market. Such structural imbalance prompts many pension fund managers to purchase long-dated gilts irrespective of price, causing yields to remain depressed relative to economic fundamentals.

3.2 Quantitative easing

In essence, the discount rate is an estimate of the return on the assets held by a defined benefit scheme. There should be a positive relationship between gilt yields and equity returns if the former are to be used as discount rates to value a defined benefit scheme. The analysis below investigates whether the positive relationship continues to hold after QE. For example, Wong et al. (2019) show that QE has significantly changed the transmission mechanism between credit and liquidity risks in the interbank markets. Specifically, credit risks were driven by liquidity risks during the crisis prior to QE. The transmission mechanism reversed after a large scale asset purchase program was started by the Bank of England.

The equation below shows that QE has effectively reversed the correlation between gilt yields and equity returns. In the equation, \( r_{t+1} \) and \( y_t \) are UK equity returns (with dividends reinvested) and 20-year gilt yields respectively, whereas \( I_t \) is an indicator function that takes on a value of one after August 2017, the month regarded by many as the beginning of the financial crisis. The estimate is based on a sample 636 monthly observations from 1965 to 2017, obtained from Thomson Reuters Datastream. Newey-West t-statistics are reported in square brackets. Prior to QE, high gilt yield is associated with high equity return; the correlation becomes negative post QE.

\[
\begin{align*}
  r_{t+1} &= -0.21 + 1.49y_t + I_t(25.80 - 7.20y_t) + e_t \\
  &\quad [\begin{array}{c}
  -0.03 \\
  2.53 \\
  2.55 \\
  -2.53 \\
  \end{array}] 
\end{align*}
\]

The reason for the negative relationship between gilt yields and equity returns is that long-dated interest rates were deliberately kept low by QE to stimulate the economy. Indeed, interest rates are often used as a monetary policy tool to fine tune the economy. Conventionally, short interest rates will be raised (lowered) if there are risks of overheating (recession) in the economy. In the process,

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9 Qualitatively similar results are obtained when other cut-off points (January of 2010, 2012 and 2014) in addition to August 2007 are considered.
interest rates tend to lag behind the economy, and thus are regarded by King and Watson (1996) as a lagging indicator.

QE also changes the relationship between gilt yields and dividend yields. For several decades, gilt yields are higher than dividend yields, which is sensible since equity returns comprise of capital gains as well as dividends. This makes the two assets close substitute for each other that gives rise to arbitrage activities, as studied by Clare et al. (1994) using a sample from 1968 to 1992. However, it is noticeable that since the late 1990s, gilt yields have been declining steadily. After QE, gilt yields are even lower than dividend yields, which are relatively stable throughout the period.

\[
DY_t = 1.84 + 0.28y_t + I_t (1.45 - 0.21y_t) + e_t
\]

\[2\] 

[4.18] [7.56] [2.92] [-2.09]

To illustrate the change in the relationship, the above equation is estimated where \(y_t\) and \(DY_t\) are respectively the gilt yield and dividend yield, and \(I_t\) is an indicator function that is defined in the same way as in equation (1). The coefficient 0.28 of \(y_t\) indicates a positive relationship prior to the financial crisis. Post QE, the level of dividend yield rises by 1.45 and the slope declines by 0.21, which implies that the correlation between gilt yield and dividend yield has effectively disappeared.

To sum up the above empirical evidence, QE has fundamentally altered the relationship between gilt yields and equity returns, rendering the former unsuitable as a discount rate for the valuation of defined benefit schemes.

### 4 Stock returns

This section builds on the preceding analysis to show that when prices are stable, long term expected equity return is driven by factors which are distinct from those that determine riskless interest rates.

#### 4.1 Long term expected returns

With Treasury yields at relatively high levels in 1990s and the US equity returns declining to their new lows, many papers were written on the decline of the equity risk premium and lower future returns; see for example Blanchard et al. (1993), Siegel (1999), Wadhwani (1999), Jagannathan et al. (2000) and Fama and French (2002). In contrast to such view, Ibbotson and Chen (2003) argue that the supply of stock market returns is generated by the productivity of the firms in the real economy. By decomposing the 1926–2000 historical equity returns into various supply factors such as inflation, earnings, dividends, the P/E, the dividend-payout ratio and so on, they estimated that the equity risk premium is only slightly lower than the pure historical return estimate. As the preceding section shows, the long term decline of interest rates is primarily due to reasons that are conducive for economic growth. If the theory put forward by Ibbotson and Chen were right, then the equity returns would stabilize as benign economic growth and price stability has been broadly achieved in the last two decades. To find out if this is the case, the following Gordon (1962) growth model is used to calculate the required equity returns for the UK and US using monthly data from January 1970 to December 2017.

\[
E(r) = \frac{D}{P} + g
\]

(3)
In (3), \( D, P \) and \( g \) are respectively the next period dividends, current price and growth of dividends. Table 2 reports for the various sub periods from 1970 to 2017 the equity returns (both nominal and real), average yields on government bonds and risk premium defined as the difference between equity returns and bond yields. During 1970s, interest rates and nominal equity returns were high as a result of high inflations caused by the oil crisis. Real equity returns, however, were low. The 1980s was an exceptional decade that witnessed the highest nominal and real equity returns as the inflation has been considerably reduced in both countries. From 1990 onwards, as discussed in the previous section, monetary policies together with increased international trade and technological advance have brought inflation successfully under control. While there exists a small difference between the two countries, the average of UK and US equity returns remain remarkably stable during the past three decades, at around 5.3% and 7.5% in real and nominal terms respectively.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>UK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity return</td>
<td>15.80</td>
<td>18.10</td>
<td>9.24</td>
<td>6.96</td>
<td>6.88</td>
</tr>
<tr>
<td>Gilt yield</td>
<td>11.94</td>
<td>11.14</td>
<td>7.96</td>
<td>4.64</td>
<td>3.23</td>
</tr>
<tr>
<td>Risk premium</td>
<td>3.86</td>
<td>6.96</td>
<td>1.28</td>
<td>2.32</td>
<td>3.65</td>
</tr>
<tr>
<td>Inflation</td>
<td>12.59</td>
<td>6.90</td>
<td>2.97</td>
<td>2.06</td>
<td>2.06</td>
</tr>
<tr>
<td>Real equity return</td>
<td>3.20</td>
<td>11.20</td>
<td>6.27</td>
<td>4.91</td>
<td>4.82</td>
</tr>
<tr>
<td>US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity return</td>
<td>9.99</td>
<td>11.15</td>
<td>6.64</td>
<td>8.15</td>
<td>7.96</td>
</tr>
<tr>
<td>Treasury yield</td>
<td>7.52</td>
<td>10.59</td>
<td>6.64</td>
<td>4.66</td>
<td>2.55</td>
</tr>
<tr>
<td>Risk premium</td>
<td>2.47</td>
<td>0.56</td>
<td>0.00</td>
<td>3.49</td>
<td>5.41</td>
</tr>
<tr>
<td>Inflation</td>
<td>7.36</td>
<td>5.10</td>
<td>2.93</td>
<td>2.81</td>
<td>1.61</td>
</tr>
<tr>
<td>Real equity return</td>
<td>2.63</td>
<td>6.05</td>
<td>3.71</td>
<td>5.34</td>
<td>6.35</td>
</tr>
</tbody>
</table>

Monthly data is used to obtain the figures reported in the Table. The UK sample is sourced from Thomson Reuters Datastream whereas the US from Robert Shiller online data. To obtain the equity returns \( \frac{D}{P} + g \), first calculate \( g \) as the geometric growth rate of dividends in each sub period. \( \frac{D}{P} \) is obtained as the arithmetic mean of dividend yields, which are the product of 'historical' dividend yield and \( (1 + g) \). The historical dividend yield is the ratio of the trailing twelve months' dividends to price. The Gilt and Treasury yields are arithmetic average of 20-year gilt yield and 20-year Treasury yield respectively. The risk premium is defined as equity return minus the respective risk-free interest rate. The real equity return is obtained by subtracting inflation from the equity return, where inflation is calculated as the geometric growth rate of price index. CPI and RPI are used for US and UK respectively; in the latter case, 0.8% is subtracted from the calculated inflation.

The expected return estimates presented in Table 2 are consistent with several papers that are supportive of Ibbotson and Chen (2003). Using data from early 1900s to 2013, Booth (2015) estimates the average equity market required return for the US as 8%; for Canada, it is 7.4%. On the other hand, Hassapis and Kalyvitis (2002) use a growth model to show that real stock price changes and output growth are strongly related in the G-7 economies. Mauro (2003) reports similar association between real output and stock returns in emerging economies as well as developed economies. Based on a supply-side growth model, Faugere and Erlach (2006) find that the stock market returns depend on GDP per capita growth.

To sum up, despite several recent financial crises in the last three decades, notably the burst of dot-com bubble and the recent financial crisis followed by the Great Recession, monetary policies have been successfully applied to stabilize the economy. Against such a backdrop, once the risk of high inflation has been evidently eliminated in 1990s, the equity returns remained broadly stable.
**Gilts plus prior to QE**

The basis upon which yields on long-dated government bonds can be used as discount rates must be supported by evidence not only in UK, but also in other similar financial markets such as the United States. The risk premium in Table 2, defined as equity return minus risk-free rate, corresponds to the ‘fixed margin’ that is added to the yield on government bond in the gilts plus approach. Therefore, the changing risk premiums from decade to decade in both US and UK is evidence against the validity of the approach for valuing defined pension plans, even prior to QE.

**4.2 High valuations and future equity returns**

It is common in actuarial practice to regard the current low dividend yields as signs of overvaluation. According to the Gordon growth model in (3), if dividend growth stays constant, the future return will be lower by an amount that the current dividend yield is below its long term average. Continuing with the assumption of constant growth, if the dividend yield is expected to revert to its long term average (for example, through a market correction), the expected return will be even lower. Such views, however, are inconsistent with the results presented in Table 3 below.

**Table 3**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D/P</td>
<td>4.98</td>
<td>4.87</td>
<td>3.92</td>
<td>3.09</td>
<td>3.52</td>
</tr>
<tr>
<td>g</td>
<td>10.81</td>
<td>13.23</td>
<td>5.32</td>
<td>3.87</td>
<td>3.36</td>
</tr>
<tr>
<td>Nominal return</td>
<td>15.80</td>
<td>18.10</td>
<td>9.24</td>
<td>6.96</td>
<td>6.88</td>
</tr>
<tr>
<td>Real return</td>
<td>3.20</td>
<td>11.20</td>
<td>6.27</td>
<td>4.91</td>
<td>4.82</td>
</tr>
<tr>
<td>US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D/P</td>
<td>4.00</td>
<td>4.20</td>
<td>2.44</td>
<td>1.60</td>
<td>2.12</td>
</tr>
<tr>
<td>g</td>
<td>5.98</td>
<td>6.95</td>
<td>4.20</td>
<td>6.55</td>
<td>5.84</td>
</tr>
<tr>
<td>Nominal return</td>
<td>9.99</td>
<td>11.15</td>
<td>6.64</td>
<td>8.15</td>
<td>7.96</td>
</tr>
<tr>
<td>Real return</td>
<td>2.63</td>
<td>6.05</td>
<td>3.71</td>
<td>5.34</td>
<td>6.35</td>
</tr>
</tbody>
</table>

The figures are reported using the same data as in Table 2. The dividend yield is calculated as the product of reported dividend yield and (1+g), where g is the geometric average annual growth rate of dividends. D/P is the average of monthly dividend yields in each sub period. Nominal return is obtained as D/P + g whereas real return is obtained by subtracting inflation from nominal return.

Table 3 reports for the various sub-periods from 1970 to 2017 the dividend yield (D/P), dividend growth (g) and nominal equity returns. As discussed previously, equity returns in both UK and US have stabilized from 1990s onwards. Although the dividend yields in US are lower than those in UK, the dividends in the former were growing at a faster rate, especially in the last two decade. This is consistent with the Miller and Modigliani (1961) theory, in which a low dividend yield implies a high growth rate of future dividends if markets are efficient. As pointed out by Ibbotson and Chen (2003), the prediction of a declining equity return by some literature is predicated on the violation of the Miller and Modigliani theory.

A couple of points should be noted here with regard to the high valuation of US equities. First, stock repurchases for tax purposes during recent decades in US are likely to have depressed the dividend yield; see Jagannathan et al. (2000). The resulted lower dividend yield, however, is not due to mispricing or change of fundamentals of the firms. As Miller and Modigliani show, stock repurchases would give rise to a lower dividend yield but higher growth, rendering the expected return unchanged. Therefore the valuation of US equities may not be as high as it appears to be.
The other point relates to the well documented findings that value stocks have a higher return than growth stocks. However, there are two reasons why such findings should not be translated into a lower discount rate for the valuation of defined benefit pensions. First, much of the research that leads to the value anomaly is based on short term, cross sectional returns. Whether the stock market in a faster growth economy (e.g. US) would have a lower long term return than one in a slower growth economy (e.g. UK) is an entirely open question. Second, the so-called value premium can be partly attributed to the value stocks being more risky (Zhang, 2005) and partly due to mispricing (Piotroski and So, 2012). The case of mispricing often has much larger impact on the returns and it occurs when, for example, low dividend yield stocks have low growth. There is no sign of mispricing between US and UK equities, as the lower dividend yield of the former is associated with a higher dividend growth rate.

Looking ahead

Table 4

<table>
<thead>
<tr>
<th></th>
<th>Dividend yield</th>
<th>Dividend growth</th>
<th>GDP 2017</th>
<th>GDP 2018-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>3.65</td>
<td>6.74</td>
<td>1.7</td>
<td>1.48</td>
</tr>
<tr>
<td>US</td>
<td>1.84</td>
<td>8.13</td>
<td>2.3</td>
<td>2.42</td>
</tr>
<tr>
<td>World</td>
<td>2.32</td>
<td>9.07</td>
<td>3.6</td>
<td>3.68</td>
</tr>
</tbody>
</table>

The figures in the second and third column are respectively the reported dividend yields as at 31 December 2017 and dividend growth forecast, which is obtained as the annual geometric growth rate of forecast dividends from December 2017 to December 2019. The GDP figures are growth rates. The dividend yields of UK and US stock markets are sourced from Thomson Reuters Datastream and Robert Shiller online database respectively. The other figures are from Bloomberg. All forecasts are obtained as at 8 April 2018.

Table 4 provides the reported dividend yields as at December 2017 of equity markets in UK, US and the world as represented by the MSCI World Equity Index. Consistent with the preceding value-versus-growth analysis, equity markets with low (high) dividend yield is expected to experience high (low) dividend growth, which in turn is proportional to the growth rate of the underlying economy. The expected returns according to the Gordon growth model is around 10%. Adjusting for possible bias in analysts’ forecast, the expected returns based on predicted dividend growths are consistent with the historical expected return of approximately 7.5% as reported in Table 2 and 3.

To sum up the above findings, the returns on equities depend on the profitability of firms which in turn is driven by the growth of the underlying economy. With benign economic growth and price stability, the rates of returns on both the US and UK equities have stabilized in the past three decades at a level similar to their long term historical average, despite falling long term interest rates.

5. Deficits of the USS

In recent years, the liabilities and deficits of the USS have been large and volatile; see Table 5 below. Although the USS assets have increased by 85% to £60bn between 2011 and 2017, its liabilities have more than doubled in the same period. The increase in liabilities cannot be explained by inflation, wage growth and rise in membership while the other factors such as life expectancy remains unchanged.
Table 5

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Liability</td>
<td>35.3</td>
<td>43.7</td>
<td>50.1</td>
<td>46.9</td>
<td>57.3</td>
<td>59.8</td>
<td>72.6</td>
</tr>
<tr>
<td>Assets</td>
<td>32.4</td>
<td>33.9</td>
<td>38.6</td>
<td>41.5</td>
<td>49.1</td>
<td>49.8</td>
<td>60.0</td>
</tr>
<tr>
<td>Deficit</td>
<td>2.9</td>
<td>9.8</td>
<td>11.5</td>
<td>5.4</td>
<td>8.2</td>
<td>10.0</td>
<td>12.6</td>
</tr>
<tr>
<td>IL20</td>
<td>0.71</td>
<td>-0.01</td>
<td>-0.27</td>
<td>-0.04</td>
<td>-0.90</td>
<td>-0.96</td>
<td>-1.68</td>
</tr>
<tr>
<td>Inflation</td>
<td>4.1</td>
<td>3.5</td>
<td>2.8</td>
<td>1.7</td>
<td>0.1</td>
<td>0.3</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The liability and assets are in unit of £bn from the annual reports of USS. The deficit is obtained as the difference between the values of liability and assets. IL20 and inflation refers to yield on 20-year index-linked gilt and the annual rate of change in CPI respectively. Both IL20 and inflation are obtained from Bloomberg.

5.1 A simple model

The valuation process of the USS is described by both tPR and JEP as ‘complex’.\(^{10}\) Here, a simple model is used to investigate the reason for the substantial increase in the size of the liabilities of USS. Let \(B\) be the benefits in real term to be paid over \(T\) years, and \(r\) the discount rate. Using binomial expansion for approximation, the liability can be written as

\[
L = \sum_{t=1}^{T} \frac{B}{(1 + r)^t} \approx BT \left[1 - \frac{T + 1}{2} r\right]. \tag{4}
\]

Taking the log, (4) becomes

\[
\ln(L) \approx \ln(BT) - \frac{T + 1}{2} r. \tag{5}
\]

Let \(r = y + m\) where \(y\) and \(m\) are gilt yield and fixed margin respectively. To fit the model to the real data, annual variations need to be taken into account. Let \(j\) denote the year. Then from (5) we have

\[
\ln(L_j) = \left\{\ln(BT) - \frac{(T + 1)m}{2}\right\} - \frac{T + 1}{2} y_j + \epsilon_j \tag{6}
\]

In the above, \(\epsilon_j\) captures the ‘errors’ due to the following annual changes: (i) Increase in membership of USS; (ii) Increase in accrued pensions as a result of wage growth; and (iii) Inflation. Assume these errors add an average of \(\alpha\) to the log of liability each year, then the model would become

\[
\ln(L_j) = j\alpha + \left\{\ln(BT) - \frac{(T + 1)m}{2}\right\} - \frac{T + 1}{2} y_j + \epsilon_j, \tag{7}
\]

and its first difference will have a constant term \(\alpha\) as shown below.

\[
\Delta \ln(L_j) = \alpha - \frac{T + 1}{2} \Delta y_j + \Delta \epsilon_j \tag{8}
\]

\(^{10}\) See page 9 in the JEP report and the FT article published on 11 October 2017 for the comment by tPR. The JEP report can be obtained from http://www.ussjep.org.uk/ whereas the latter is available at https://www.ft.com/content/210b1d6c-adbd-11e7-beba-5521c713abf4.
Regression results

To estimate the models (6) to (8), the liabilities in Table 5 are transformed into March 2017 prices according to the CPI inflation reported in the same table. Taking the log of the liabilities at March 2017 price gives us the dependent variable \( \ln(L_j) \). Yields on conventional and index-linked gilts of various terms are used as regressor. It is found that the 20-year index-linked gilt yield provides the best 'fit' of the liabilities and Table 6 below reports the estimated regression models.

**Table 6**

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>( \ln(L_j) )</th>
<th>( \ln(L_j) )</th>
<th>( \Delta \ln(L_j) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.856**</td>
<td>3.844**</td>
<td>0.007</td>
</tr>
<tr>
<td>t-statistic</td>
<td>[587.96]</td>
<td>[148.48]</td>
<td>[0.53]</td>
</tr>
<tr>
<td>95% confidence bounds</td>
<td>(3.84, 3.88)</td>
<td>(3.75, 3.94)</td>
<td>(−0.040, 0.054)</td>
</tr>
<tr>
<td>Slope</td>
<td>−0.258**</td>
<td>−0.247**</td>
<td>−0.242**</td>
</tr>
<tr>
<td>t-statistic</td>
<td>[−33.68]</td>
<td>[−10.12]</td>
<td>[−9.87]</td>
</tr>
<tr>
<td>95% confidence bounds</td>
<td>(−0.281, −0.234)</td>
<td>(−0.336, −0.157)</td>
<td>(−0.325, −0.158)</td>
</tr>
<tr>
<td>Trend</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t-statistic</td>
<td>[0.49]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% confidence bounds</td>
<td>(−0.028, 0.037)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R-square</td>
<td>0.993</td>
<td>0.991</td>
<td>0.927</td>
</tr>
</tbody>
</table>

The OLS regression results reported in 2nd, 3rd and 4th column correspond to equations (6), (7) and (8) respectively. Seven observations are used in the first two regressions and six in the last. ** denotes significance at 1% level.

It can be seen from the regression results that the gilt yields explain as much as 99.3% of the variation of liabilities of the USS between 2011 and 2017. It will be useful to check the validity of the model by comparing the theoretical value of intercept and slope coefficients with their estimated counterparts. \( T = 50, m = 0.017 \) and \( B = 1.47 \) are used to obtain a theoretical intercept value of 3.86 for (6) and a slope of −0.255.\(^{11}\) It can be seen that both theoretical values are within all the 95% confidence bounds of the estimation.

The regression results find that \( \alpha \) is insignificantly different from zero, which may be explained as follow. As mentioned above, there are three factors affecting \( \alpha \). First, the increase to liability is considerably smaller than the rise in membership may suggest, as most new members start with zero accrued benefit. Second, wage growth does not affect the benefits of deferred and pension members. Finally, adjusting the liabilities to 2017 price actually has a negative impact on \( \alpha \), for the inflation-linked benefit increase applies mainly to members on pension. It is likely that the negative impact of the last factor offsets the effect of the other two components, giving rise to a zero or very small \( \alpha \).

Large and volatile deficits

The UUK recently remarked in the Employers Pension Forum that ‘as well as being sizeable, the deficit is volatile and this volatility poses additional risks to the security of the USS.’ However, the reason for the large and volatile deficits is due to the fact that low interest rates have been used as the discount rates. Since the liability is valued in a way similar to bonds, the slope of the relationship between the value of liability and interest rate steepens as the latter declines. We differentiate the expectation of (6) to obtain the following derivative to understand the nonlinear relationship known as bond convexity

$$\frac{\partial L}{\partial y} = -\tau \cdot e^{\ln(BT)-\tau m-\tau y} = -\frac{(T + 1)}{2} L(y)$$

(9)

where $\tau = (T + 1)/2$. As can be seen from the derivative in (9), the sensitivity of the value of liability to changes in the interest rate depends on the level of liability, which becomes large as yield falls. For example, $\partial L/\partial y = -10.2$ when the yield in March 2011 was 0.71%. This means that a 10 basis point fall in yield would increase the liability by £1.02bn. On the other hand, when the yield is as low as -1.68% in 2017, $\partial L/\partial y = -18.8$ implying that the same 10 basis point fall in yield would result in £1.88bn rise in the value of liability.

**2017 Valuation**

There is further evidence that supports the validity of the model. The 2017 liability of £72.6bn in Table 5 is known as the monitoring liability. The 2017 valuation revises it to £67.5bn, based on 50 years of varying discount rates which average to 3.27%. The index-linked gilt yields in the estimated models assume an inflation rate of 3%, which implies the nominal yield in 2017 is 3% - 1.68% = 1.32%. Adding a margin of 1.7% gives us a discount rate of 3.02%. The required rise in discount rate that reduces the liability by £5.1bn can be obtained using $\partial L/\partial y$ derived from model (6) as 3.02 + 5.1/18.8 = 3.29%, which is close to the average of discount rates used by USS.

Various 2017 valuation documents also show that the USS adopts an interest rate approach to discount rates. First, note that its first ten years of discount rates in the 2017 valuation average only 0.93%; see Figure 2 below. The reason for the low discount rates is because the USS reckon it would take ten years for the interest rate to revert back to the 2014 level; see the USS September 2017 consultation document, p.6. Also, for valuations on monitoring basis, the USS assumes that all assets continue to provide the same level of outperformance above gilts. As the USS Chief Risk Officer explained, ‘there is a reasonable empirical and theoretical basis for using this metric.’

< Figure 2 >

**5.2 An alternate approach to discount rate**

Since the portfolio of the USS is internationally well-diversified, the well-established capital asset pricing theory by Sharpe (1964), Lintner (1965) and Mossin (1966) suggests that the world equity index can be the basis upon which an appropriate discount rate is constructed. To illustrate this empirically,
returns on USS assets are regressed on various sets of regressors which include return on the MSCI World Equity Index denominated in pound sterling (\(W_E_t\)), lagged long-dated index-linked gilt yields (\(Y_t\)) and changes in the yields (\(\Delta Y_t = Y_t - Y_{t-1}\)).

**Table 7**

<table>
<thead>
<tr>
<th>Eqn 1</th>
<th>Eqn 2</th>
<th>Eqn 3</th>
<th>Eqn 4</th>
<th>Eqn 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.033</td>
<td>0.105*</td>
<td>0.072</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>[2.510]</td>
<td>[2.818]</td>
<td>[1.752]</td>
<td>[3.017]</td>
</tr>
<tr>
<td>(W_E_t)</td>
<td>0.601**</td>
<td>0.640**</td>
<td>0.559**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[7.930]</td>
<td>[9.422]</td>
<td>[6.946]</td>
<td></td>
</tr>
<tr>
<td>(Y_{t-1})</td>
<td>-0.023</td>
<td>0.022</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-0.376]</td>
<td>[1.638]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Delta Y_t)</td>
<td>-0.096</td>
<td>-0.027</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-1.316]</td>
<td>[-1.179]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj Rsq</td>
<td>0.940</td>
<td>-0.207</td>
<td>0.128</td>
<td>0.947</td>
</tr>
</tbody>
</table>

In the regressions, the dependent variable is the rate of changes in the USS assets from 2011 to 2017. \(W_E_t\), \(Y_{t-1}\) and \(\Delta Y_t\) are annual returns in terms of pound sterling on MSCI World Equity Index, lagged long-dated index-linked gilt yields and annual changes of gilt yields respectively. The required yearly asset values are obtained from the annual reports of the USS whereas the other data are sourced from Bloomberg. * and ** indicate significance at 5% and 1% levels respectively.

The regression results in Table 7 clearly show returns on the USS assets are well explained by returns on world equities, with an adjusted R-square of over 94%. On the other hand, the other two regressors based on gilt yield are insignificant in the regressions, thereby confirming the inappropriateness of the gilts plus approach. One application of the results in Table 7 is to use expected long term equity return to construct the required discount rate as presented below.

**Is the USS in surplus?**

The assets held by USS may be classified into three categories, namely 60% equities, 20% alternate investments and 20% bonds. The analysis in Section 4 suggests the expected rate of return on equities can be taken as 7.5%. Assuming the expected rate of return on alternate investments and bonds are 4% and 2% respectively, the expected rate of long term return on USS portfolio is 0.6x7.5 + 0.2x4 + 0.2x2 = 5.7%. Following the USS method of prudence, 1.2% is taken away from the expected return to arrive at a discount rate of 4.5%. Using model (6), this translates into a yield of 4.5% – 3% – 1.7% = – 0.2% and a technical provision of £49.9bn, giving a surplus of £10.1bn for USS.

The plausibility of a large surplus for the USS can be appreciated by looking at the time series changes of its discount rates. For the reported liabilities between 2011 and 2017, model (6) can be used to obtain the corresponding discount rates. Figure 3 plots the constructed USS discount rates, the average return realised by the its assets over the period and the average discount rate of the state employees’ defined benefit schemes (NASRA) in the US.\(^\text{14}\) The difference between the two discount rates could be due to the fact that more low-risk low-return assets are held by the USS. More importantly, the fall in the NASRA discount rate is gentle and small, possibly due to the small weighting of government bonds in the portfolio. In contrast, the USS discount rate declines by 2.40% during the past seven years, reflecting the view that riskless interest rate plus a fixed margin represents returns

on other asset classes. Such a view is certainly unjustified as more than 60% of the USS portfolio comprises of international equities and property assets, the rates of return of which are shown to have little correlation with gilt yields.

6. Conclusion

The past pension reforms were mostly concerned with ageing population as a result of lower fertility rates and greater longevity. The last two decades witnessed a different kind of crisis for privately funded defined benefit pensions as interest rates fell and remained low for a protracted long period. However, much of the anxiety is unwarranted if it can be recognised that gilts are no longer representative of other asset classes for the valuation of defined benefit schemes.

Because of high inflation, the returns on riskless assets and equities are comparable during 1970s and 1980s. Hence it was reasonable to use gilt yields to value the liabilities of defined benefit pensions. Successful monetary policies and other economic developments, however, have brought stability to prices, resulting in long term decline of riskless interest rates. With zero lower bound on policy rates, the long-dated interest rates fall further due to quantitative easing as central banks try to stimulate the economies. Other factors such as the savings glut and liability-driven investment of pension funds also contributed to the decline, rendering the riskless yield depressed relative to the economic fundamentals. As Krishnamurthy and Vissing-Jorgensen (2012) remark, the low yield due to their safety and liquidity suggests that risk-free assets in important respects are similar to money. In this regard, yields on riskless assets clearly do not reflect returns on other asset classes.

On the other hand, the returns on equities are driven by entirely different factors. In particular, both theory and empirical evidence indicate that long term stock market returns are the result of the productivity of firms in the real economy. As Mishkin (2008) remarks, price stability and economic growth are mutually reinforcing, long term nominal stock market returns have stabilized at about 7% to 8% in the past three decades. Also, high valuations are not predictor of low future returns but are underpinned by high growths. Otherwise, arbitrageurs will short sell high valuation stocks and buy value stocks if both have similar growth prospect.

In the past decade, the financial sustainability of the USS has been greatly enhanced by increased contributions, cheaper benefit accruals (as a result of switching from final salary to career-average-revalued-earnings) and huge growth in its assets. Therefore, the so-called funding crisis faced by the USS is emblematic of the counterfactual problems faced by privately funded defined benefit schemes in the UK as well as in other OECD countries. The economic costs are unnecessary and huge: reduced dividend payments and investments by firms, industrial actions over scheme closures, less favourable financial settlement and retirement plan for workers, higher employee turnover rate and suboptimal use of pension funds in investments.

Finally, in view of the findings presented in this article, many actuarial practices should be reviewed. In particular, given current low interest rate environment, there is a need to examine the cost-benefit of the so-called liability-driven investment versus the more traditional approach of long-horizon holding diversification and risk sharing between age cohorts in pension funds.
Reference


Figure 1

Inflation and gilt yield

Discount rates in 2017 valuation

Figure 2

20
Figure 3

Discount rates and realised return


NASRA  USS  Realized return