

What reform directions for USS?¹

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Summary

This note discusses reform of USS as simply as possible (see glossary at end). Sections 1 and 2 concern areas currently under consultation; sections 3-6 are about wider aspects which should inform discussion. The main arguments are:

- There are different ways of measuring the deficit of a pension scheme, each appropriate in a particular context. The method being used to produce the current estimate of the deficit in USS places heavy emphasis on de-risking, mostly by using a low-risk return (e.g. the rate of return on government bonds). This note argues (section 1) that that approach is the wrong one and that, as a result, the deficit is overstated.
- There are different timescales for filling a deficit, the appropriate choice depending on the type of pension arrangement. The time scale chosen for USS is faster than necessary, given the characteristics of the scheme, in particular the longevity of higher education, the powerful drivers of rising demand for skills, and the fact that USS is a mutual scheme in that universities all guarantee each other (known as a ‘last man standing’ guarantee) (section 2).
- There are soundly-based principles of good pension design, an important one being risk sharing (section 3).
- Within those principles there are multiple ways of adjusting a pension scheme to changing economic and demographic circumstances, and multiple ways of sharing risk (section 4). This note argues that de-risking (a) has been too narrowly focussed and (b) has failed to build in automatic adjustment to changing circumstances. It also explains why and how a wider view of de-risking is both feasible and desirable.
- Some of the reforms of USS in 2011 and some of those currently under discussion fail to comply with the principles of good design and share risk too narrowly (section 5).
- An unsuitable reform of USS, should it occur, raises a series of strategic questions (section 6).

1. Consultation about reform of USS has focussed mainly on the size of the deficit and the speed with which it should be filled. These topics are the subject of sections 1 and 2. The remaining sections are about wider aspects which should be part of discussion of reform, so as to (a) address any deficit, (b) put in place a mechanism for addressing any future deficit, and (c) comply with the principles of good pension design. The purpose of this note is not to provide a blueprint but to set out the questions which should be considered.

1 How large is the deficit?

2. Assessing the financial health of a pension scheme raises two central questions:

- How large is the deficit?
- If there is a deficit, how quickly should it be filled (section 2)?

The answer to each depends on whether the scheme is sensibly regarded as short lived or long lived.

¹ The analysis in this note draws on Barr and Diamond (2008). I am grateful to Michael Bromwich, Michael Otsuka, Hilary Parker and Fran Tonkiss for helpful comments on earlier versions. Remaining errors are my responsibility.

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3. **DIFFERENT WAYS OF EVALUATING THE FINANCIAL HEALTH OF A PENSION SCHEME.** The financial health of a scheme is assessed by comparing the value of the scheme's assets with the value of assets necessary to pay projected future benefits. The complication is that there are different methods of valuation. In particular, (a) should the scheme's assets be valued at today's prices or on the basis of an average over a period of time, and (b) should the expected rate of return on the scheme's assets be today's return or some sort of average?

4. Two methods of evaluation are particularly relevant to the discussion of USS.

- A *solvency valuation*, at its simplest, assumes that a pension scheme will stop collecting new contributions and considers whether the scheme's current assets are enough to pay all pension promises made to date.
- An *ongoing valuation* assumes that a scheme will continue to collect contributions and considers whether the scheme's current and future assets are enough to pay all current and future pension promises.

5. **SHORT-LIVED SCHEMES.** Examples include a single person with a funded defined-contribution individual account (see glossary), or a single firm, which could go bankrupt.

6. The shorter a scheme's expected time-scale the more it is vulnerable to the risk of varying asset prices. For such schemes it makes sense to use a solvency valuation, i.e.:

- To measure the value of the fund using the current market price of its assets (referred to as 'mark to market');
- To use a low-risk rate of return, for example the long-run return on government bonds, in assessing the financial state of the scheme.

Other things equal, this approach projects a larger USS deficit than one based on (generally higher) stock-market returns.

7. In a system with fully-funded individual accounts, younger people generally hold stock-market assets, but move into less risky assets such as government bonds as they approach retirement. Well-designed individual accounts include such 'life cycle profiling' as part of their design.

8. **LONG-LIVED SCHEMES.** An example is a multi-person, multi-generation, multi-enterprise pension system. An arrangement like this is very different from individual accounts or schemes run by single firms.

9. A long-lived pension scheme with overlapping generations can invest in stock-market assets but, in sharp contrast with individual schemes, does not have to de-risk by moving from equities into (generally lower-yielding) bonds as a person approaches retirement. Instead, it can hold a portfolio of assets which maximises the return for the scheme's chosen degree of risk, thus enabling a larger pension for a given contribution.

10. For such schemes it makes sense to use an ongoing valuation, i.e.:

- To measure the value of a fund on the basis of asset prices averaged over a period, rather than prices today;
- To use a rate of return based on the average over a period.

Other things equal, this approach projects a smaller USS deficit than one based on the low-risk rate of return.

11. **MISTAKE TO AVOID.** Consider a college with an endowment, the income from which contributes to the cost of maintaining the college buildings. Good financial management suggests a portfolio aimed at long-term growth, using the resulting income for building maintenance. The error in converting equities into bonds in the run up to a repair is obvious.

12. The question of whether to measure a deficit in terms of the low-risk rate of return or the usually-higher stock-market return hinges on a judgement about the longevity of the system. The longer-lived the scheme, the smaller the risk in holding a mainly stock-market portfolio. It is a mistake in a long-lived scheme to use the valuation methodology appropriate for a shorter-lived scheme.³

13. **IN SUM.** The financial health of USS should be measured on the basis of an ongoing valuation, given the past longevity of higher education, the powerful drivers of rising demand for skills (i.e. the implausibility that higher education will become a ‘rust belt’ industry), and the strength of the ‘last man standing’ guarantee. Using a solvency valuation for USS is misplaced.

2 How quickly should any deficit be filled?

14. Single private firms can go bankrupt, and should therefore always have sufficient assets to pay promised benefits. Thus any deficit should be filled quickly

15. But if the entity is long lived (a multi-person, multi-generation, multi-enterprise pension scheme or a long-lived college) it is not imprudent to allow time to make up a deficit.

16. Mistake to avoid: a requirement to fill a deficit in a long-lived scheme quickly is mistaken. It would be like requiring someone with 20 remaining years of mortgage who runs into negative equity to accelerate repayments to eliminate the negative equity quickly. Such a policy is unnecessary given the remaining duration of the mortgage and the likely trajectory of house prices.⁴

17. Evaluating USS on an ongoing basis avoids this mistake.

3 Risk sharing: Why

18. **OBJECTIVES OF REFORM.** Reform of USS should balance a range of objectives, including:

- Adequacy of benefits on average (measure: the average replacement rate (see glossary));
- Fairness of the benefit structure across differing careers (measure: the replacement rate for different careers paths);
- Sustainability, including robustness in the face of potential economic and demographic developments (necessary to protect both members and employers);
- Risk sharing: the future is an uncertain business, so pension systems face unavoidable risk. Considerations of sustainability should include explicit consideration of how risks should be shared. Risk sharing is important for efficiency, for fairness and for the political viability of the system, and hence merits more detailed discussion.

³ In another note (Barr, 2015a), I argue that the structure of pension regulation is biased towards de-risking, hence this error is no accident. The argument is important because it indicates that a good reform of USS involves rowing against the regulatory tide.

⁴ I have stolen this example from Dennis Leech.

19. **RISK SHARING.** Many people value security, and therefore choose a lower but more certain benefit (e.g. a pension based on career-average salary) over a benefit with a higher average but also higher risk, such as defined-contribution individual accounts.

20. For exactly that reason many people buy insurance. Insurance does not make risks disappear, but shares them; if my house catches fire, the cost is shared with everyone else with fire insurance. A central conclusion of economic theory is that ‘corner solutions’ are generally suboptimal. Too much fat in a diet is bad, but so is too little; the amount of fat should be optimised, not maximised or minimised.⁵ Analogously, placing all the risks of a pension scheme on employers (as in a final-salary scheme) is generally suboptimal; so is placing all the risks on workers (as with defined-contribution individual accounts).

21. Instead, it is generally better if risks are shared widely. There are multiple ways of responding to a deficit, and multiple ways of sharing risk. They include:

- Higher contributions (temporary or permanent) by workers, employers or both;
- Lower benefits in the future (e.g. adjusting the accrual rate (see glossary) or currently (e.g. adjusting the way benefits in payment are indexed); and/or
- A higher pension age.

Reform will not necessarily make use of all these mechanisms (the option to increase contributions is often limited) but a process that does not consider all of them is flawed. Discussion of reforming USS illustrates the problem.⁶

4 Risk sharing: How

22. This section is not about specific reforms of USS about which wide consultation is clearly necessary. The aim is simpler: to list the right questions. The section discusses in turn contributions, building up benefits, benefits in payment, and pension age, in each case discussing (a) good design of the basic system and (b) how to share risk.

4.1 Contributions

23. **INCREASED CONTRIBUTIONS.** What scope, if any, is there for

- Raising employer contributions, on either a temporary or permanent basis?
- Raising contributions by members of USS, either temporarily or permanently?

4.2 Building up benefits

4.2.1 Basic design

24. **FINAL SALARY OR CAREER AVERAGE?** There are good reasons for moving from final-salary to career average.

- Wider risk sharing: in a final-salary scheme the employer faces the entire risk. With career average, the risk is shared between worker and employer: if earnings are lower for a period (e.g. after the 2008 economic crisis), career-average earnings are lower, hence some of the risk falls on the worker.

⁵ Such optimisation is sometimes referred to colloquially as the ‘Goldilocks principle’.

⁶ For discussion of a system deliberately designed to share risks widely, see Munnell and Sass 2013.

- Greater predictability for employers: when projecting future liabilities in a final-salary scheme employers have to make guesses about late-career increases in salary, which can be influenced by external events such as offers from other universities. With career-average benefits, in contrast, the size of a person's pension will already be largely determined by the individual's past earnings.
- Less regressive: in a final-salary scheme, benefits are based on final salary but contributions are broadly on the basis of career average. Thus there is a cross-subsidy from people whose earnings grow more slowly to those whose earnings grow rapidly later in their career. The former group tends to be those with lower earnings, the latter the high flyers. Thus on average, final-salary schemes redistribute from lower to higher earners. Many regard this as unfair.
- Weaker impediments to labour mobility: except in national schemes, final-salary pensions excessively lock a worker into his or her current job. Career average benefits do better on this score, the precise effect depending on design details.

25. **WHAT ACCRUAL RATE WHEN MOVING FROM FINAL SALARY TO CAREER AVERAGE?** A critical element in determining the size of a person's pension is how the translation from final salary to career-average is calibrated. Consider someone with 40 years' service, whose final salary is 200 and career-average earnings 150, with an accrual rate of 1/80 per year of service. His final-salary pension would be 40/80 of 200, i.e. 100.

- If the accrual rate remains unchanged, his career-average pension would be 40/80 of 150, i.e. 75, or three-quarters of his final-salary pension. Though only illustrative, the example is informative: fuller estimates suggest that the move from final salary to career average with a constant 1/80 accrual rate reduces benefits by about 25%.
- If the accrual rate were raised to 1/60 of career-average earnings per year of service, the person's pension would be 40/60 of 150, i.e. 100, fully protecting his pension. It is noteworthy that this example comes close to illustrating the Teachers' Pension Scheme, which is career average with an accrual rate of 1/57.

26. The calibration question – how to adjust the accrual rate in a move from final-salary to career-average – is an important element in any such move and, as discussed in section 5, one that received insufficient attention in the 2011 reforms.

27. **HOW SHOULD A PERSON'S EARNING RECORD BE INDEXED?** The choice of (a) how earnings records are indexed and (b) the interaction with accrual rates raises a series of issues. Those discussed here are the most important but not the only ones.

28. *Indexing earnings records.* In a final-salary scheme what enters the pension formula is a person's final salary; earlier years are irrelevant. In a career-average scheme a person's entire earnings record is relevant, raising the question of how to measure each year's earnings. Failure to index a person's earnings record largely discounts early years (my first academic salary was £2,000), and thus reduces measured career average earnings and thus, other things equal, reduces pensions. It is therefore necessary to index a person's earnings record by adjusting earnings each year in line with changes in wages, or in prices, or a mix.

29. To illustrate, suppose a person's earnings in her first year equals the national average, and that in that year average earnings were 100 and the price index 100. Suppose that by the time she retires 40 years later, the price index has risen to 400 and the average wage to 1000.

- With wage indexation, the calculation of career average would include a value of 1000 for her first year of earnings, and analogously for her earnings in years 2-40.
- With price indexation, the comparable figure for her first year would be 400, and analogously for subsequent earnings.

30. What is the difference?⁷

- With wage indexation the pension a worker gets when he or she retires bears a clear relation to earlier earnings. The Hutton Report (Independent Public Service Pensions Commission 2011) recommended earnings indexation during working years, both for active and deferred members.
- Wage indexation leads to higher measured career-average earnings than price indexation. As discussed below, that may or may not increase the cost of the system, depending on the choice of accrual rate.
- Wage indexation gives greater weight than price indexation to earnings earlier in a career and to that extent, other things equal, benefits people whose earnings rise more slowly (on average, lower earners) relative to those whose earnings rise faster later in their careers.

31. *Considering indexation and the accrual rate together.* The indexation of earnings records and the accrual rate should be considered together. It is possible to keep the cost of a pension system constant with a higher accrual rate and price indexation of earnings or with a lower accrual rate and wage indexation of earnings. There are good arguments for either approach; the point being made here is that both should be part of discussion of reform.

32. Under the 2011 reforms, earnings are indexed to prices and the accrual rate remained 1/80th. Compared with wage indexation, the effect is to reduce the value of a person's career average earnings and hence his or her pension.

33. **SHOULD THERE BE A CAP ON CAREER AVERAGE BENEFITS?** It has been proposed that a person should earn career-average benefits on earnings up to some limit (the figure currently under discussion is £55,000), with defined-contribution benefits above that. There are good arguments for a cap – the question is where it should be set. As noted, many people would choose lower but more certain benefits over a benefit that is higher on average but more risky. As discussed below, a higher cap would be compatible with sustainability if incorporated in an explicit strategy for risk sharing.

4.2.2 Risk sharing: Adjusting the buildup of benefits

34. The discussion in section 4.2.1 sets out the main questions to consider in designing the basic system. This section considers how that system might adjust to changing economic and demographic circumstances.

35. **HOW SHOULD THE ACCRUAL RATE ADJUST IF A DEFICIT ARISES?** An accrual rate that includes some adjustment to the financial position of USS, would shift some risk from employers to workers. This is not the place to discuss such mechanisms, but they exist in practice and, if well-designed, are a useful way to share risk.⁸

⁷ For fuller discussion, see Barr and Diamond (2008, pp. 72-74).

⁸ Barr (2013) includes detailed discussion of the system in Sweden; see also Munnell and Sass 2013 who discuss a system of risk sharing in a Canadian Province.

36. **HOW SHOULD ANY CAP ON CAREER AVERAGE BENEFITS ADJUST OVER TIME?** To promote consumption smoothing (see glossary), the cap on career-average benefits should rise with earnings. At a minimum, the cap should rise in line with prices. Again, the formula for any such increase could include an element related to the medium-term financial position of USS.

4.3 Benefits in payment

4.3.1 Basic design

37. **HOW SHOULD BENEFITS CHANGE FOR A DELAYED START?** There are strong arguments for giving people choice about whether to draw their pension at the earliest permitted age or to postpone the start of benefit. To that end, it is important that a person's initial pension should increase for a delayed start.⁹

38. **HOW SHOULD BENEFITS IN PAYMENT BE INDEXED?** In a well-designed system, benefits in payment should be indexed to price change or to a weighted average of price change and wage change.¹⁰ As explained in section 5, the 2011 arrangements do not comply with this principle.

4.3.2 Risk sharing: Adjusting benefits in payment

39. **HOW SHOULD BENEFITS IN PAYMENT ADJUST IF A DEFICIT ARISES?** An important principle of pension design is that protection against risk should rise with age. Pensioners have less time and ability to adjust, and older workers have less time to adjust than younger ones. Thus the design of pensions should avoid sudden shocks, particularly for pensioners and workers near retirement. That does not mean that pensioners should necessarily be protected from all risk, but that risk should be limited and, if possible, temporary.

4.4 Pension age

40. **WHAT EARLIEST PENSION AGE?** A pension system should have an earliest eligibility age below which it is not possible to claim old-age pension.¹¹ That age should reflect (a) social norms, (b) any industry-specific features (e.g. where work is particularly physically demanding), and (c) long-term sustainability of the pension system.

41. **HOW SHOULD EARLIEST PENSION AGE ADJUST TO CHANGING LIFE EXPECTANCY?** If we were designing a pension system for a newly discovered planet and were told that its dominant native life form was living longer and longer we would not choose a fixed pension age but, instead, design a system in which pension age bore a sensible relationship to life expectancy. Had that been done when pension systems were introduced from the late 19th century onwards there would be little discussion today of a 'pensions crisis'. There are different ways in which pension age can adjust automatically to changing life expectancy and a number of countries, including Denmark, have built automatic adjustment into legislation.

⁹ In a well-designed scheme, the increase should be approximately actuarial (see glossary and, for fuller discussion, Barr and Diamond 2008, pp. 77-79).

¹⁰ See Barr and Diamond (2008, pp. 74-77).

¹¹ Disability pension for genuine long-term disability should not be subject to an age restriction.

5 Bad design in current or proposed USS arrangements

42. Several elements in the arrangements introduced in 2011 or reforms currently being considered violate the principles of good pension design.

5.1 Building up benefits

43. **INADEQUATE DISCUSSION OF CHOICE OF ACCRUAL RATE.** There has been little discussion of how to calibrate the accrual rate in the move from final-salary to career-average. Section 4.2.1 explained how moving from final salary to career average with a constant accrual rate of 1/80 was a reduction in benefits. The current proposal to increase the accrual rate to 1/75th increases benefits slightly, but the cut relative to the pre-2011 final-salary formula remains significant.¹² That reduction has not had the detailed discussion it merits.

44. **FAILURE TO CONSIDER INTERACTIONS.** Alongside the accrual rate of 1/80th, the 2011 arrangements included price indexation of a person's earnings record.

- Price indexation plus a constant accrual rate reduces the cost of the system by reducing benefits without considering wider aspects such as the adequacy of benefits and the potential effect on recruitment and retention.
- Wage indexation of earnings records provides more effective consumption smoothing, so it can be argued that the Hutton Commission was right to advocate wage indexation of earnings records. It is possible to combine wage indexation of earnings records with cost containment by choosing an appropriate accrual rate.¹³
- To share risks, indexation could be combined with a default accrual rate which could adjust as one response to a deterioration in the financial position of USS.
- Again, this is an issue to which insufficient attention has been paid.

45. **INADEQUATE DISCUSSION OF ANY CAP ON CAREER AVERAGE BENEFITS.** The figure currently being considered (£55,000) is unsupported by analysis. As noted, analysis should consider (a) the level of any cap, (b) how it should rise in line with earnings or prices and (c) how adjustment could be linked to the medium-term financial health of USS.

46. **INDEXATION OF A PERSON'S EARNINGS RECORD IN THE FINAL-SALARY ELEMENT.** In principle, the rights a member has accrued under the pre-2011 final-salary arrangements will be protected. The method proposed is that accrued benefits will be (a) calculated using pensionable salary and years of service at the time of change, and thereafter (b) revalued in line with price inflation measured by the CPI up to the point of retirement.

47. Two points are noteworthy. First, revaluation in line with prices rather than wages is a reduction in benefit, i.e. it can be argued that accrued rights are protected only parsimoniously. Second, this is another topic which has not had the discussion it merits.

5.2 Benefits in payment

48. **FAULTY INDEXATION.** For rights accrued up to 2011 pensions in payment rise by the full amount of price inflation measured by the consumer price index (CPI). Pensions in payment

¹² The numerical example in section 4.2.1 considered someone with 40 years' service, whose final salary is 200 and career average 150. Her final-salary pension would be 40/80 of 200, i.e. 100. With an accrual rate of 1/80th, her pension would be 40/80 of 150, i.e. 75; with an accrual rate of 1/75th, it would be 40/75 of 150, i.e.80.

¹³ On the other hand, price indexation of earnings records creates less impediment to labour mobility (i.e. more neutrality between active and deferred) assuming that deferred benefits are indexed only to price change.

accrued since 2011 rise by the full amount of price inflation up to 5% per year, by half of inflation between 5% and 15%, with no indexation for inflation above 15%. Thus if inflation in a year is 10%, a pension of 100 will rise to 107.5, not to 110 (i.e. 100% of inflation up to 5% plus 50% of inflation between 5% and 10%). As a result, the person's real pension falls by 2½% in that year and all subsequent years.

49. The 2011 arrangement is bad design.

- Inflation above 5% in any one year leads to a *permanent* reduction in real pension, interfering with consumption smoothing and thus imposing excessive risk on pensioners.
- The earlier during retirement inflation above 5% occurs, the larger the loss of pension in present value terms (see glossary). Since the timing of high inflation is arbitrary the resulting effects are arbitrary, affecting younger pensioners most, and hence unfair.
- From an employer perspective (see next para.), this design is not necessary for sustainability, particularly with well-designed arrangements for risk sharing.

50. There are good reasons why pensioners might share some of the pain during bad times, but that loss need not be permanent. A solution would be to apply partial indexation during bad times, but with catch-up when economic conditions allow.¹⁴ Thus pensioners share some of the risk of turbulent times but the effect is not permanent. As discussed earlier, it is right to give pensioners more protection from risk than younger people, but it does not follow that pensioners should necessarily receive complete protection.

5.3 Pension age

51. **LACK OF ADJUSTMENT OF PENSION AGE TO CHANGES IN LIFE EXPECTANCY.** The absence of any serious discussion of pension age and how it should adjust to changes in life expectancy is a glaring lacuna, given the power of such adjustment to share risk.

6 Strategic questions

52. These issues prompt a series of questions.

- Given the diversification of higher education is it any longer optimal to have a single pension system for the entire sector?
- If not, should there be a pension system for the sector as a whole, to which individual institutions or groups of institutions could add a top up?
- Or should some institutions run their own pension system?

Glossary

ACCRUAL RATE. The rate at which a person's contributions build up entitlement to a pension, e.g. 1/80th of a person's earnings (final salary or career average) per year of service.

ACTUARIAL BENEFITS. Suppose that by the time a person retires, she has accumulated £X in retirement savings. An actuarial benefit is the monthly pension that £X will finance for the rest of her life, and will depend on two factors: the return on her retirement savings over the course of her retirement, and the expected length of her retirement. Thus an actuarial benefit will be higher for someone who retires at (say) 67 rather than 65 because she will be drawing pension for a shorter time. More formally, if a person's pension is fully actuarial, the expected **PRESENT VALUE** of his or her monthly benefit is equal to his or her pension accumulation at the time the pension starts.

¹⁴ The system in Sweden has a 'brake' mechanism which reduces indexation in the face of a deficit but with catch-up when the deficit has been eliminated; see Barr (2013, section 7.4).

ANNUITY. A monthly benefit for the rest of a person's life. In a **DEFINED-BENEFIT** system the annuity is determined by the benefit formula, e.g. career average or final salary. In a **DEFINED-CONTRIBUTION** system the individual exchanges his or her pension accumulation for a monthly benefit.

CAREER AVERAGE PENSIONS. See **DEFINED-BENEFIT PENSION.**

CONSUMPTION SMOOTHING. Behaviour that enables a person (or household) to shift consumption from his/her younger to his/her older self, e.g. from years when earning to years when retired.

DEFINED-BENEFIT PENSION. A pension where benefit is based on (a) a worker's length of service and (b) his/her earnings history (e.g. final salary or career average). In a pure defined-benefit system resources adjust to match pension promises; thus the risk of financial market turbulence falls on the scheme's sponsor, i.e. the employer or the government.

DEFINED-CONTRIBUTION PENSION. A pension where benefit is determined by the value of assets accumulated in the worker's name over his or her career. Benefits may be taken as a lump sum, as a sequence of withdrawals, or by purchase of an **ANNUITY**. In a pure defined-contribution system, the pension adjusts to match available resources; thus the risk of financial market turbulence falls on the individual worker.

PRESENT VALUE. Consider a stream of pension income of £1,000 per year starting today for someone with an expected remaining life expectancy of 20 years. The present value of that income stream is the amount of money needed today to pay those future benefits. If there is no inflation and the interest rate is zero, the present value of £1,000 per year for 20 years is £20,000. If the interest rate is 5%, it is possible to finance a pension of £1,000 per year with a capital sum less than £20,000 because, after paying the first year's pension, the annuity provider can earn 5% interest on the remaining balance of the person's pension accumulation.¹⁵

REPLACEMENT RATE. The term can have different meanings. For the purposes of this note, the replacement rate is defined as an individual's pension benefit as a percentage of his or her previous earnings. In broad terms, a person needs about 65-70% of his or her previous earnings to maintain a given standard of income in retirement (the figure is less than 100% because he/she no longer faces costs such as pension contributions and travel to work), suggesting a target replacement rate from all sources of income (national insurance pension, USS pension, other pension income, other income from saving) of about two-thirds.

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¹⁵ Excel has a built-in present-value formula. For Excel 2010, see <https://support.office.microsoft.com/en-gb/article/PV-function-3d25f140-634f-4974-b13b-5249ff823415?CorrelationId=f15a856c-5aca-4c28-8fc7-251d662bf7b4&ui=en-US&rs=en-GB&ad=GB>