Comments[1] on the paper "How much risk is the USS taking?" by David Miles and James Sefton[2]

The paper addresses the question posed in the title using stochastic simulations to model the likelihood of the scheme's capital assets becoming exhausted. In this note I argue that the method they adopt, in particular their specific chosen stochastic model, is not a reliable basis for making such a judgment because it exaggerates risk.

It is crucial to understanding whether a pension scheme has "enough money", to be clear about what that would mean in practice, what assumptions are being made about the progress of the scheme over time, and what kind of money is needed anyway. Thus any stochastic modelling that tries to answer that question should distinguish between, on the one hand, the *market value* of the investment assets and, on the other, the *investment income* those investments bring in. These are not equivalent[3] and which is more relevant depends on the framing of the question.

If the scheme is being considered for possible closure, the former view is important, since one must have regard to runoff, where assets are sold to pay pensions as the beneficiaries dwindle. But if it is being seen as possibly able to continue open indefinitely, with the support of a strong employer covenant and a steady influx of new members, then the latter perspective is required since asset sale is not the primary concern. It is important that trustees carry out analyses from both points of view, which are not equivalent.

Miles and Sefton fail to make this distinction. Instead their approach is simply to model the time path of total returns, running together investment income and capital gains/losses - whether realised or not. This means that, from the point of view of answering the question whether the scheme can remain open sustainably, their simulations overstate risk and their conclusions are overly pessimistic. Their stochastic model allows in, and bakes in, too much variation coming from excessively volatile asset markets, whether stock, bond, real estate markets.

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[1] 3rd draft, January 2023.

[2] NIESR Policy Paper no. 29, 29 September 2021 (also "Updating Miles and Sefton results on the current position of the USS and ways forward from it", by the same authors, 22 December 2021)
https://www.niesr.ac.uk/wp-content/uploads/2021/10/NIESR-Policy-Paper-029_0-5.pdf

[3] Financial economists often simply assume efficient markets whereby asset prices are explained as the discounted present value of expected future earnings. But that is a strong theoretical assumption which fails to hold in reality, as shown by many empirical studies, most notably by Robert Shiller and his co-authors, who have demonstrated that market prices of assets, whether bonds, stocks, or real estate are far too variable, this excess volatility often found to be an order of magnitude or more. See for example, Robert J. Shiller: "The Volatility of Stock Market Prices, *Science*, 2 January 1987; "Do stock prices move too much to be justified by subsequent changes in dividends?", *NBER* 0456, 1980; *Market Volatility*, MIT Press, 1992; *Irrational Exuberance*, Princeton University Press, 2nd ed. 2015; also George A Akerlof and Robert J Shiller, *Animal Spirits: How Human Psychology Drives the Economy and Why it Matters for Global Capitalism,* Princeton University Press 2009.

Risk will also be overstated as a result of using *percentage yields (%)* instead of *cash income (£)* as the random element. Yield expressed as a percentage is inherently excessively volatile because market prices appear in the denominator. On the other hand, absolute investment income in money terms is driven by real economic factors and much less susceptible to this volatility.[4]

The paper's basic idea is that the investment portfolio can be seen as comprising two classes of assets: 'risky' equities, which produce a high return on average but one that is also highly variable, and 'safe' bonds, with a low but fairly constant return. The question is essentially whether the equity returns, on average, are sufficiently high to outweigh the combined effects of the low bond yield and that the likelihood of the equity returns underperforming by too much.

It uses a simple model applied to actual USS data starting from the assets at the 2020 valuation, £66.5 billion. and the projected cash flow of pension payments each year up to 2102 by when all accrued benefits will have been paid.

Their conclusion is that, while on average the scheme is well enough funded that it will be able to pay all the pensions promises, there is still a significant probability that the money will run out and the scheme will be unable to pay the promised pension benefits without needing to ask the employers for further contributions. This probability is of the order of over 30 percent for a portfolio with a majority of growth assets. These findings are worrying.

The paper addresses a straightforward empirical question that turns mainly on the relative risk and return parameters of the two asset classes. However there are a number of major issues with this study that may well point to different conclusions emerging if addressed. Most importantly there is an important, basic, methodological issue unaddressed: the relation between asset prices and pensions funding for the USS, with its unique characteristics as a very large, open, immature, multi-employer scheme.

Detailed Comments

1. The methodology employed is questionable because it focuses solely on asset values rather than specifically on pension funding, which is likely to lead to an overstatement of risk and therefore biased findings. It examines the likelihood (as a probability estimated in a Monte-Carlo simulation) that the assets will become exhausted - not the likelihood that not all the projected pensions will be paid, without further funding. These two questions are not the same and the difference is crucially important to the stochastic modelling: the former methodology focuses on the market value of the investment portfolio where the randomness mainly comes from the stock market through prices. For the latter methodology, asset values are not of primary concern, since the scheme will only need to sell capital to pay pensions whenever there is a shortfall in income. The study should therefore model the probability of such a shortfall separately.

By ignoring this distinction Miles and Sefton are implicitly making an unreal assumption that is actually key to their results. They end up using an inappropriate risk metric for determining funding - in all circumstances whether the scheme needs to sell assets to pay pensions or not - related to the excess volatility of stock market prices. It would surely be more relevant to use a measure of variation in investment income, that is cash flow, which is known to be much less volatile, since it is mostly independent of the animal spirits, irrational exuberance, booms

and busts, etc to which the stock market is prone. When talking about risk it is necessary to study the second moments of the probability distributions but also to be clear about the metric: are we looking at randomness of capital values or income?

Miles and Sefton's model has two classes of assets: equities and bonds. From the alternative, cash-flow-funding-focused point of view, there are three classes of investment income, which have different stochastic parameters: (1) dividends from equities[4], (2) capital gains (and losses) due to changes in equity prices and (3) bond income. Dividend income from equities behaves very differently from stock market equity price movements because they belong to different markets with different volatilities: on the one hand goods markets (the real economy) drive profits and therefore dividend yield, while on the other hand, financial markets such as the London Stock Exchange, with a large speculative component unrelated to fundamental earnings, drive asset prices.[5]

An example might be, say, Pfizer, in which the USS has a sizable investment (£67.89 million[6]), which yields a relatively steady dividend each year (£2.21 million last year), whereas its shares on the LSE are traded and its price is volatile to reflect market sentiment and other factors than expected yield. These are two separate markets and whereas the market price of the Pfizer shares might well fairly closely reflect the fundamentals of the dividends, and expectations of dividends, on the average over a suitable time period, the observed variance in market price from year to year will be much greater than the variation in dividends earnings that is supposed, in theory, to underlie it, because of the many other factors that drive the market than a mechanistic DCF calculation.

This point can be seen clearly from the USS Annual Reports. The diagram below (Figure 3 from my January 2001 paper "Pension Scheme Valuation versus Pension Funding and the Cost of Prudence (with reference to the Universities Superannuation Scheme)"[7]) shows the annual investment returns for the 20 years 2001-20.

[4] This needs to be qualified somewhat because not all equities pay a dividend, notably some tech stocks such as Apple Computing (the largest holding in the USS portfolio). The investment return from them must come from realized sales where the asset price is what matters.

[5] I am not discussing bonds here, following Miles and Sefton, who treat them as if they are not a source of risk. Although bonds are fixed income assets their market prices are volatile and therefore they are treated as a source of risk for the valuation despite their income yield - which is what actually pays for pensions in normal times - being fixed.

[6] At 30 September 2021.

[7] **"**Pension Scheme Valuation versus Pension Funding and the Cost of Prudence (with reference to the Universities Superannuation Scheme)", Dennis Leech, Department of Economics, University of Warwick, January 2021, downloadable at **https://blogs.warwick.ac.uk/dennisleech/entry/pension_scheme_valuation)** or available by email from me at d.leech@warwick.ac.uk.

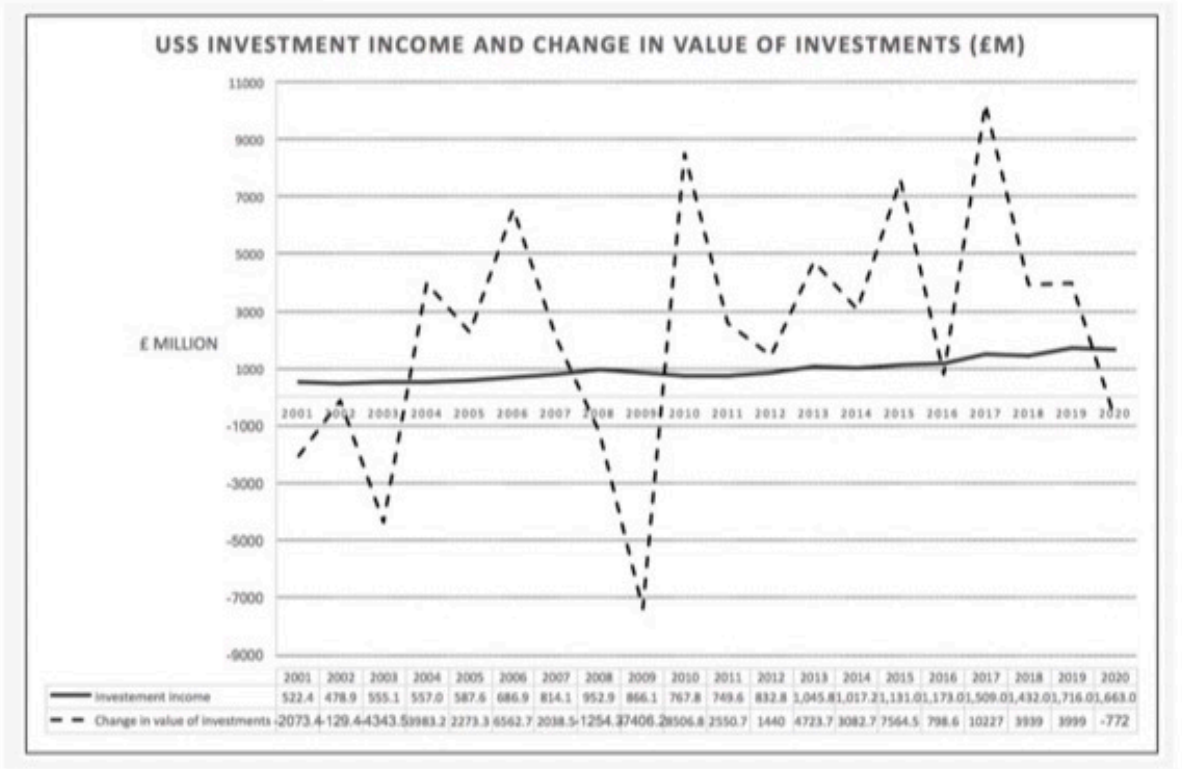

Figure 3: USS investment income and change in value of portfolio investments, 2001-2020 (Data source: USS Annual Reports and Accounts for all years 2001-20, Fund Accounts and Notes to the Financial Statements: see Note 9, for years until 2015, Note 10 thereafter.)

The figures are unadjusted for inflation and growth but the message is pretty clear: investment income shows a fairly steady trend without a lot of volatility whereas the value of the investments exhibits considerable volatility[8]. This corresponds with what we know

[8] A simple measure of volatility is the coefficient of variation, defined as the standard deviation divided by the mean. The respective coefficients of variation for the two series shown in the chart are 0.39 for investment income and 1.83 for the change in value of investments, suggesting that the latter is 4.7 times more volatile than the former. The figures are in the paper. Interestingly the coefficient of variation of benefits paid over the same period is 0.38, which suggests that, at least in terms of volatility, there could be a good match if pensions were paid from investment income given the right investment strategy.

intuitively from the regular FMP monitoring reports: that the assets vary by a lot for what seem like short term reasons.[9] [10]

The stochastic variable driving Miles and Sefton's simulations is the rate of total return, which is the sum of the dividend yield and the rate of change of the capital value. This includes unrealised capital gains and losses, and is the reason for the very high standard deviation they use. This is the wrong variable because, as can be seen from the chart, capital values can be very low without there being any drop in the dividend income.

Thus it is wrong to model pension funding simplistically as following the market value of capital assets. In 2008/9 for example the scheme suffered a massive loss due to the financial crash: its investments fell by more than £9.5 billion in two years; but since it was not relying on selling any of those assets to pay pensions just then, it did not greatly matter for funding. Investment income was much the same after the crash than previously (actually £52m greater in 2009 than in 2007). And the stock market recovered quickly: the whole loss had been more than regained in the next two years; the value of investments were up by £11.5 billion by 2011. So it is misleading to treat this asset-prices volatility as a risk to pension funding in all circumstance.

The rate of dividend yield of course will always be excessively volatile since it is a rate of change whose denominator is much more volatile than its denominator. Therefore more realistic stochastic modelling would need to avoid this source of irrelevant risk. What is needed is a simulation that separates the risk metric used with respect to investment income cash flow from that used with respect to financial markets that are exclusively concerned with trading assets. A new simulation is required.

2. The assumptions about interest rates seem out of date after the structural break that happened following the Truss/Kwarteng budget and the ensuing leveraged LDI scandal in September 2022 (that still seems to be with us judging from evidence given last month to the parliamentary enquiry by the Work and Pensions Committee). It is no longer relevant to assume the low levels of interest rates that Miles and Sefton did as gilt rates have returned to and are expected to remain at higher, more historically normal levels. So, if nothing else, the simulations need to be redone with the new parameters.

3. The model ignores contributions. There seems to be an implicit assumption that past accrual must only be funded from investment returns. Yet many of the members who have built up this accrual are still going to be in employment for many more years after 2020 and

[9] Unadjusted for inflation. Investment income includes: dividends from UK equities, net property income, income from pooled investment vehicles, dividends from overseas equities, income from UK fixed interest securities, income from overseas fixed interest securities, interest on cash deposits, interest from money purchase AVCs. Change in the value of investments is the change in market value of the investments over the year, comprising both realised gains/losses on purchases/sales and unrealised gains/losses due to market price changes on in- vestments held at the year end. The assets include pooled investment vehicles, derivatives, property, money purchase AVC investments, cash deposits.

still paying contributions. Perhaps it would be more realistic to allow for this in the model. This would not mean cross-subsidisation.

4. The model ignores the monitoring role of the trustee board. The model takes the assets at the valuation date in 2020 and runs it on the assumption that there are no changes to the rules or investment strategy whatever happens to assets and funding. (It is in some way like firing an unguided missile at a target a long way distant.) Yet the trustees actually meet regularly to monitor progress, and there is a triennial valuation, with modifications always being available if judged to be prudently required. This factor should be built into the modelling to allow endogenous trustee mitigation, adjustments, rule changes, etc.

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The Returns on Investments includes a large item 'Change in market value of net investments' which combines the effect of changes in market prices of assets, equities, bonds, etc, which are notional, and realised changes due to asset sales and purchases. It is important to separate the two items, since the former is not part of income for the purposes of funding the scheme as an open scheme, while the latter is. Here the two are separated using the reconciliation figures from the notes to the financial statements (variously notes 9 or 10).

It is obvious that the change in market value of investments is dominated by the effect of changes to market values and that the net purchases/sales is of minor importance relatively.

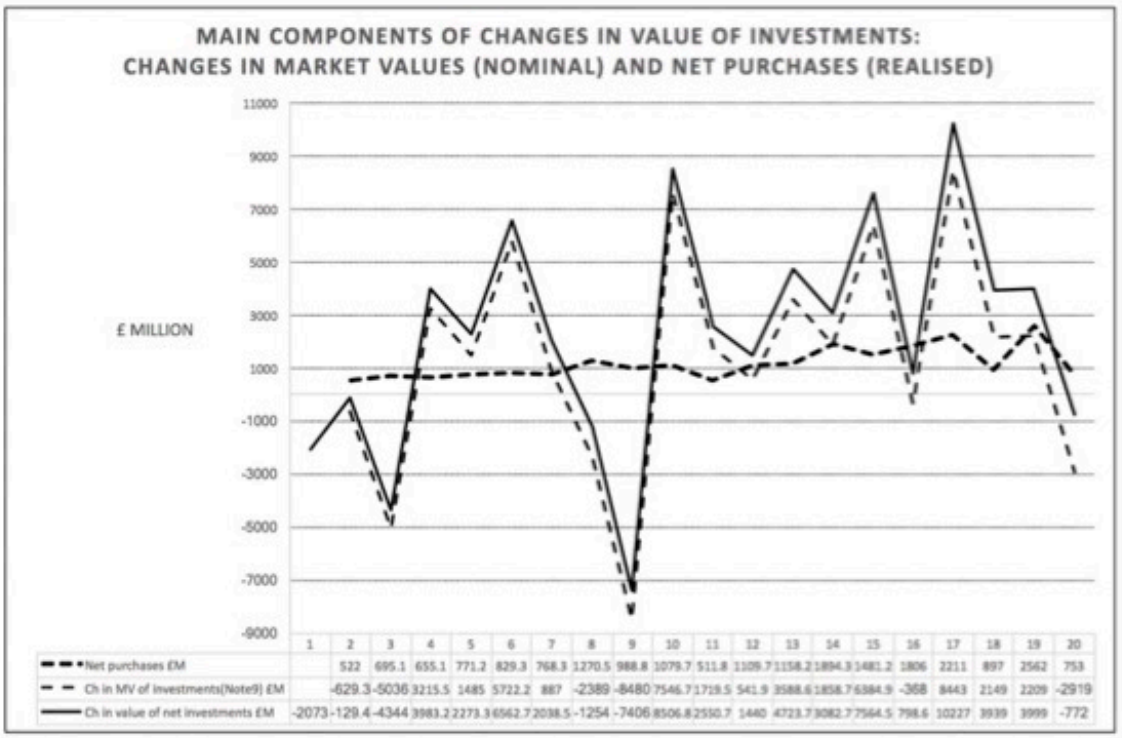

Figure 5: USS investment income and change in value of portfolio investments, 2001-2020 (Data source: USS Annual Reports and Accounts 2001-20, Fund Accounts and Notes to the Financial Statements: see Note 9, for years until 2015, Note 10 thereafter.)

5. There are many technical questions to be asked about the model specification and parameterisation.
For example the assumption of lognormally distributed returns owes more to analytical convenience and convention among modellers than to any sound empirical basis.
Why assume fixed alpha (the share of equities)?
The model with mean reversion via a negative MA(q) process seems too slow if q=9; why not try others such as q=2 or 3.

6. The Miles and Sefton analysis is analytically too narrow in its focus on one approach to the exclusion of alternatives. The valuation according to the Statutory Funding Objective - comparison of asset market values with liabilities calculated on a discounted present value formula with a 'prudently' chosen discount rate - is not the only way of checking funding adequacy or even a particularly relevant one for the USS. Others should be used as well.

It would be far better, and make just as much sense, for trustees to use the same discount rate for the projected income and outgo going forward. That would provide an alternative picture of scheme health and could be done easily. This is an important matter for an open, potentially long-lived DB scheme in a sector with a strong covenant like the USS.

Dennis Leech, University of Warwick, January 2023