THE CARDANO LINCOLN WORRY INDEX (THE "WORRY INDEX")

SUMMARY OF METHODOLOGY

1 AN INTRODUCTION

The Worry Index captures in an integrated single measure the major risks facing a defined benefit ("DB") pension scheme – funding risk, investment risk, and sponsor risk – the three fundamental risks highlighted by Integrated Risk Management (IRM) guidance of the Pensions Regulator.

2 THE WORRY INDEX FAMILY

The Worry Index family currently comprises:

WORRY INDEX – ALL SHARES INDEX, which is an equal-weighted composite measuring the pension risk of the biggest UK companies. Constituents are FTSE 100 companies that sponsor UK DB scheme(s).

WORRY INDEX – INDUSTRY SPECIFIC SUB-INDEX, which breaks down the All Share Index into 10 industries – Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrials, Oil & Gas, Technology, Telecommunications, and Utilities.

For each constituent of the index, the Worry Score calculated as:

$$\text{Worry score} = \frac{\text{Liability}_{\text{Stress}} - \text{Asset}_{\text{Stress}}}{\text{Ev}_{\text{Stress}}} \times 100$$

A Worry Score of 30 indicates that pension-related risks represent 30% of the enterprise value of the sponsor. Currently a Worry Score of 30 or above is calibrated to our Worry Zone. Similarly, we believe that a Worry Score below five indicates a Safe Zone with little current cause for concern. Each of the three components is first measured as in the "business as usual" scenario and then stress tested in a risk scenario.

3 APPLYING THE STRESS TEST

A stress scenario test is applied to all constituents, on liabilities, assets, and sponsor strength, to assess risks in a holistic manner.

SPONSOR STRESS TEST The major components of enterprise value (EV), namely total equity (including market capitalisation and other equity) and debt, are stressed according to the stress table[1]. Cash and cash equivalents are not stressed.

ASSET STRESS TEST Assets are subject to stress to various degrees depending on their asset class, region, and maturity. The riskiest assets such as equities and commodities fall by as much as 22%; investment-grade bonds and annuities benefit from the lower interest rate and increase in value in the range of 2% - 22%.

LIABILITY STRESS TEST Liability increases due to a reduction of interest rate and an increase in inflation. The stress scenario is calibrated as a 61-basis points reduction in interest rate and a 34-basis points increase in inflation. The liability in this scenario is calculated as.

$$\text{Liability}_{\text{Stress}} = \text{Liability}_{\text{Low Risk}}$$
$$\times \left(\frac{1 + \text{NominalSwapRate}}{1 + \text{NominalSwapRate}_{\text{Stress}}}\right)^{\text{MacauleyDuration}}$$
$$\times \left(\frac{1 + \text{RPISwapRate}}{1 + \text{RPISwapRate}_{\text{Stress}}}\right)^{\text{MacauleyDuration} \times \text{InflationSensitivity}}$$

where $\text{Liability}_{\text{Low Risk}}$ denotes the value of pension liability on a low-risk basis using nominal and RPI swap rates.

[1] *Stress to total equity is adjusted by long-term equity beta. For banks and insurance companies where EV is not well defined, EV is replaced by the sum of total equity and debt.*

4 INFORMATION SOURCES

Constituents of FTSE 100 Index and their FTSE Russell industry classification are obtained from Bloomberg[2].

For each constituent, **scheme liability and asset data** such as pension liability value, assumptions, sensitivities, and asset allocation are taken from company annual report and accounts. **Sponsor data** such as market capitalisation, enterprise value, and beta are collected from Bloomberg. Where applicable, reporting currency is converted to pound sterling using the Bank of England exchange rate. **Swap curves** are constructed based on swap data from Bloomberg. All data are as of the reporting date of the company annual report and accounts.

Stress test data are based on the Pension Protection Fund (PPF) Guidance for Bespoke Stress Calculation for Assessing Investment Risk, for levy calculation purpose, 2015-2017.

5 THE LIMITATIONS

The Worry Index considers, on an integrated risk basis, the overall DB pensions risk relative to the scale of the supporting covenant. The quality of the Index relies on the quality of disclosure of the company report and accounts and hence it has several limitations. The demographic component of funding risk is currently not captured by the Worry Index due to the lack of data. Investment risk, on the one hand, might be understated as a result of benefit of doubts when the reported asset classification is ambiguous; on the other hand, it might be overstated when the notional value of hedging assets is not fully disclosed. As for the sponsor risk, quite often the supporting covenant is not equal to that of the group as a whole (i.e. the legal sponsor can be stronger or weaker than the listed entity). We also note that a more detailed covenant assessment would consider profitability, cash flows, the business nature and capital structure of the employer should also be taken into consideration to form a complete picture. This detailed analysis is usually carried out by a covenant consultant. When interpreting the Sub-indices, it should be noted that some sectors have very few constituents and hence the Sub-indices could be very sensitive to the constituents. As such the Worry Index is a high-level indicator whose primary use is to calibrate on a consistent basis the systemic pension risk facing the FTSE 100 companies.

[2] The two share classes of Royal Dutch Shell PLC are combined and treated as one constituent.