

IOPS Working Papers on Effective Pensions Supervision, No.35

SUPERVISION OF SOLVENCY OF OCCUPATIONAL DB PENSION FUNDS

Taejin Han
Dariusz Stańko
December 2021

IOPS WORKING PAPERS ON EFFECTIVE PENSIONS SUPERVISION

As the proportion of retirement income provided by private pensions becomes increasingly important, the quality and effectiveness of their supervision becomes more and more crucial. The IOPS Working Paper Series, launched in August 2007, highlights a range of challenges to be met in the development of national pension supervisory systems. The papers review the nature and effectiveness of new and established pensions supervisory systems, providing examples, experiences and lessons learnt for the benefit of IOPS members and the broader pensions community.

IOPS Working Papers are not formal publications. They present preliminary results and analysis and are circulated to encourage discussion and comment. Any usage or citation should take into account this provisional character. The findings and conclusions of the papers reflect the views of the authors and may not represent the opinions of the IOPS membership as a whole.

**IOPS WORKING PAPERS
ON EFFECTIVE PENSIONS SUPERVISION**
are published on www.iopsweb.org

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The views expressed herein are those of the authors and do not necessarily reflect those of the IOPS or the governments of IOPS Members. The authors are solely responsible for any errors.

SUPERVISION OF SOLVENCY OF OCCUPATIONAL DB PENSION FUNDS

Taejin Han
Dariusz Stańko*

ABSTRACT

This report reviews approaches to supervision of the solvency of DB pension schemes and develops recommendations on supervision under the current environment. Its focus is on the DB occupational pension plans (with or without guarantees) in IOPS jurisdictions in line with the OECD definitions.

The report looks into the types of DB pension funds in IOPS jurisdictions. The report provides a detailed analysis of 12 jurisdictions that provided comprehensive data on DB occupational pension schemes – it reviews valuation of their assets and liabilities, and examines how schemes' solvency is defined and monitored.

Finally, it discusses possible measures to address solvency concerns under the current financial environment and offers relevant good practices.

Keywords: solvency, pension supervision, defined-benefit (DB), private pensions, occupational pension schemes

JEL codes: G-23, G-28, G-32.

* International Organisation of Pension Supervisors (IOPS).

Contents

| | |
|---|----|
| Executive Summary | 5 |
| Project Background | 7 |
| Goal, scope, and structure | 7 |
| 1. DB pension schemes in various IOPS jurisdictions | 7 |
| 1.1. DB pension landscape in IOPS jurisdictions | 7 |
| 1.2. Recent changes in DB occupational pension landscape | 10 |
| 1.3. Main factors influencing the recent changes in proportion of DB pension funds | 12 |
| 2. Valuation of DB pension schemes in IOPS jurisdictions | 12 |
| 2.1. Valuation methods of pension assets | 12 |
| 2.2. Valuation methods of pension liabilities..... | 13 |
| 3. Supervising solvency of DB pension schemes in selected IOPS jurisdictions: survey of supervisors | 22 |
| 3.1. Solvency: definition and criteria used for supervision | 22 |
| 3.2. Policy and regulatory measures in place to supervise solvency of DB pension schemes..... | 26 |
| 3.3. What should be policy and regulatory measures necessary to meet solvency requirements? | 30 |
| 3.4. Supervisory approaches to deal with COVID-19 | 31 |
| 4. Other supervisory measures to manage solvency positions | 34 |
| 4.1. Asset-liability management | 34 |
| 4.2. Funding buffer | 35 |
| 4.3. Risk monitoring | 36 |
| 5. Conclusions | 38 |
| Related publications | 40 |

Tables

| | |
|--|----|
| Table 1 DB pension landscape in IOPS jurisdictions | 10 |
| Table 2 Recent changes in proportion of DB occupational pension funds (as % of AuM of all occupational pension plans)..... | 11 |
| Table 3 Valuation methods of pension assets | 13 |
| Table 4 Approaches used to calculate pension obligations..... | 15 |
| Table 5 Methods to calculate life expectancy in the valuation of liabilities | 17 |
| Table 6 Methods for discounting liabilities | 21 |
| Table 7 Criteria used to supervise solvency of DB pension funds | 24 |
| Table 8 Trends of funding ratios* of DB pension schemes in selected IOPS jurisdictions 2014-2018 | 25 |
| Table 9 Policy/regulatory measures to supervise solvency of DB pension schemes..... | 26 |
| Table 10 Policy/regulatory measures necessary to meet solvency requirements for DB pension schemes | 30 |

Boxes

| | |
|--|----|
| Box 1 Methods on continuity test performed in Belgium..... | 37 |
|--|----|

Figures

| | |
|---|----|
| Figure 1 Funding ratio of DB plans in selected jurisdictions, 2010 (or first year available), 2019 and 2020 (in per cent) | 32 |
|---|----|

SUPERVISION OF SOLVENCY OF OCCUPATIONAL DB PENSION FUNDS

Executive Summary

The paper reviews approaches to supervise solvency of DB occupational pension and develops recommendations for best practices related to the funding of DB plans. The paper offers a “deep dive” into 12 jurisdictions that provided detailed response to the IOPS questionnaire. Of the 28 IOPS members who supervise DB pension arrangements, twelve (Australia, Austria, Belgium, Canada, Colombia, Ireland, Mauritius, the Netherlands, Portugal, Russia, South Africa, Switzerland) provided detailed answers and their responses are the basis for this paper.

In seventy percent of DB jurisdictions, the employer is responsible for covering the deficit in a DB pension scheme with employees also sharing some of the responsibility in a few cases through methods such as benefit cuts. Most jurisdictions, however, do not have any backstop that would be provided in the event that the sponsor of a plan (i.e. the employer) goes bankrupt. Therefore, it is critical that solvency is closely supervised, particularly in the current environment.

The valuation of pension assets and liabilities is the starting point to supervise solvency of DB pension funds, as it gives the basic information on whether the pension fund has enough assets to make the future pay-outs. All of the 12 jurisdictions that responded to this question evaluate investment assets with a “mark-to-market” method and pension liabilities (technical provisions) using a “market-consistent” method. The use of approaches to calculate pension obligations (PBO, ABO, and VBO) varies; some countries where pension obligations are calculated for different purposes use two different approaches.

A discount rate is one of the most important factors¹ in estimating a pension plan’s liabilities, as it is used in converting projected future benefits into present value. The paper finds that amongst the reviewed IOPS jurisdictions, a single discount rate is used more commonly than a yield curve.

The paper also found that most pension funds in the surveyed jurisdictions use the assumed-return approach, which uses a discount rate based on a long-term assumed average rate of return on the pension plan’s assets. Most of the surveyed jurisdictions use mortality tables with an adjustment to include recent improvements in life expectancy.

As there are no international regulatory standards globally (beyond regional standards such as EU) on the assumptions and methodologies used to supervise the solvency of pension funds, IOPS jurisdictions use their own criteria.

Regarding supervisory practices, a ‘funding ratio’ is mainly used as a regulatory criterion to supervise solvency of DB pension funds in most jurisdictions. However, there are differences in assumptions and methodologies used to calculate assets and liabilities. Also, a pension arrangement where benefits are fully guaranteed and one in which benefits can be adjusted should not necessarily be subject to the same solvency rules.

Regarding measures actually in place for supervision, all ten of the IOPS jurisdictions that responded to this specific issue, set recovery periods as a policy/regulatory measure to supervise solvency of DB pension schemes. Seven jurisdictions allow a reduction of benefits, and six allow risk sharing solutions. One jurisdiction created a guarantee scheme.

¹ In some cases, the mortality rates may have even more impact than the discount rate (e.g., in closed, highly mature pension funds).

The vast majority of responding supervisors agreed on the policy of flexibility when satisfying regulatory criteria for solvency. Half of them suggest that longer recovery periods are necessary for meeting solvency requirements, and three agreed on introducing risk sharing solutions. Two jurisdictions supported the idea of introducing legislation that would allow for reduction of benefits. No jurisdiction identified the introduction of guarantee schemes as necessary for meeting solvency requirements.

The report has also identified the following additional good practices which complement the related IOPS and WPPP (OECD Working Party on Private Pensions) principles. These practices could help manage or improve the solvency positions of occupational DB pension schemes:

- Encouraging pension funds to use asset-liability management to reduce unexpected volatility caused by, amongst the other factors, a rapid change in interest rates.
- Encouraging or stipulating that pension funds set up a “funding buffer”, which could be used to sustain financial stability in case of unexpected losses.
- Encouraging or stipulating that pension funds use various techniques to monitor risks affecting their solvency position, such as risk modelling (including the continuity test) or stress testing. Risk modelling should induce pension funds to adopt the most appropriate, i.e., not necessarily the most conservative, asset allocation, depending on the liability profile and the strength of the sponsor.

Project Background

This paper is part of the solvency and adequacy project accepted by the IOPS Members for the Programme of Work for 2017-2018. However, given other priorities, the project had to be postponed and was realised in 2019-2020. The members of the project team included: Brazil (co-leader), Canada, South Africa, Switzerland (co-leader) and Turkey (Pension Monitoring Center).

Goal, scope, and structure

The goal of this paper is to review approaches to supervising the solvency of DB pension schemes in different IOPS jurisdictions and offer advice on supervision of funding of DB plans in the current environment. The paper focuses on DB occupational pension plans (with or without guarantees) in IOPS jurisdictions in line with OECD definitions². The aim is to investigate DB pension schemes that are: 1) funded (as opposed to PAYG) **and** that are 2) either sponsored **or** organised by employers.

Section 1 explores the types of DB pension funds in various IOPS jurisdictions to investigate whether it is important to supervise solvency of DB pension funds. The rest of the paper offers a “deep dive” into 12 jurisdictions that provided detailed response to the IOPS questionnaire. Section 2 reviews the valuation of occupational DB pension schemes’ assets and liabilities, approaches used to calculate pension obligations, as well as demographic and economic assumptions. Section 3 examines how the solvency of occupational DB pension schemes is defined and monitored in different IOPS jurisdictions. Section 4 discusses possible measures to address solvency concerns in the current financial environment. Section 5 concludes.

1. DB pension schemes in various IOPS jurisdictions

1.1. DB pension landscape in IOPS jurisdictions

Before the outbreak of COVID-19, we surveyed the IOPS Members in 2019 and early 2020 to investigate 1) whether they have any DB pension arrangements, 2) who supervises them, and 3) how such pension arrangements are addressed in case of deficit. Responses were received from 53 jurisdictions³, i.e., 70% of all 76 IOPS member jurisdictions at that time. The questionnaire revealed that **33 respondents (62%) have DB pension arrangements in their jurisdictions**⁴. Some of them (e.g., Chile, Iceland, Israel, Namibia, and Nigeria) have already closed DB schemes to new members, but ensuring that these arrangements are solvent is still critical.

DB funded arrangements are sponsored or organised by employers in 30 jurisdictions⁵. Ten jurisdictions indicated that they also have DB arrangements that are either unfunded or are not sponsored or organised by employers. These arrangements include public pension schemes (Jamaica,

² Private Pensions OECD Classification and Glossary (2005), pages 12-14, <http://www.oecd.org/finance/private-pensions/38356329.pdf>

³ Albania, Armenia, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czech Republic, Ghana, Gibraltar, Hong Kong, Hungary, Iceland, India, Ireland, Isle of Man, Israel, Jamaica, Kazakhstan, Korea, Lesotho, Liechtenstein, Lithuania, Macedonia, Malawi, Maldives, Malta, Mauritius, Mexico, Morocco, Namibia, the Netherlands, Nigeria, Peru, Poland, Portugal, Romania, Russia, Rwanda, Serbia, Seychelles, Slovakia, South Africa, Spain, Switzerland, Trinidad & Tobago, Turkey, the UK.

⁴ Australia, Austria, Belgium, Brazil, Canada, Chile, Ghana, Gibraltar, Iceland, Ireland, Isle of Man, Israel, Korea, Lesotho, Liechtenstein, Malawi, Mauritius, Mexico, Morocco, Namibia, the Netherlands, Nigeria, Portugal, Russia, Rwanda, Seychelles, South Africa, Spain, Switzerland, Trinidad & Tobago, Turkey, the UK.

⁵ The exceptions are Chile and Rwanda, which have DB pension funds sponsored by the government/state.

Mexico, Morocco, Rwanda, Turkey), multi-employer plans (MEPs) sponsored and organized by unions (Canada), pension plans for self-employed (Belgium), non-autonomous funds (Spain), hybrid pension schemes (UK), and others (Liechtenstein).

In the case of a deficit, employers are responsible for providing additional funding in most of the DB jurisdictions. Out of 30 jurisdictions with employer DB pension schemes, **twenty (70%) stated that the employer is responsible for covering the deficit**. Among these jurisdictions, in four (Brazil, Canada, Liechtenstein, and Switzerland) **employees share the deficit with employers** through methods such as benefit cuts. In Portugal, if employers do not cover the deficit, the pension fund or collective adhesion would have to be wound up, which might lead to benefit cuts for the employees.

With regard to ten jurisdictions where employers are not responsible for covering the deficit, three (Ireland, the Netherlands, Trinidad & Tobago) stated that there is no legal obligation for employers to fund a plan deficit. Another two (Russia, Turkey) indicated that deficit rules may differ depending on the rules of pension plans, while in one (Gibraltar, where DB arrangements are run only for government-owned businesses) the government is responsible for putting up resources in case of deficits. In the Netherlands, a strict responsibility of employers to guarantee any shortfall exists only in a small fraction of the total technical provisions⁶ (some 6% to date). Four other respondents (Colombia, Malawi, Mexico, and Seychelles) did not specify who covers a deficit.

Most countries do not have any backstop (guarantee) that would be provided in the event that the sponsor of a plan goes bankrupt. Guarantee funds for the DB system function in only four jurisdictions (Canada⁷, Korea⁸, Switzerland⁹, the UK¹⁰). In Morocco, DB schemes are guaranteed by the State, as all current DB pension arrangements are funded and sponsored by public bodies.

⁶ In all the other cases, there can be a hike in premiums to make up for the short fall, and/or ultimately a benefit cut.

⁷ There is a guarantee fund to which employers must contribute in the province of Ontario (Ontario Pension Benefits Guarantee Fund, PBGF)

⁸ If a company goes bankrupt, an employee can ask for a maximum of 3-year retirement benefit (within upper limit) from the Wage Claim Guarantee Fund run by the government. After the employee receives the benefit, the government has the right to seek redress from the company.

⁹ The pension fund is generally liable for the contributions of the employer. However, in case of a fund's illiquidity, the LOB Guarantee Fund guarantees the benefits. (LOB refers to Federal law on the occupational old-age survivors and disability benefit plan of 25 June 1982; SR 83140).

¹⁰ The Pension Protection Fund (PPF) was set up in April 2005 to protect people who belong to defined benefit, e.g. final salary, pension schemes in the United Kingdom. If their employers fail, and their pension schemes cannot afford to deliver what they promised, the PPF will pay some compensation for their lost pensions.

IOPS members were also asked who supervises the DB pension arrangements in their jurisdictions. **Twenty-eight authorities¹¹ supervise them**, while five (Mexico¹², Korea¹³, Lesotho¹⁴, Seychelles¹⁵, Turkey¹⁶) are not involved in the supervision. Among the 28 respondents that supervise DB arrangements, 25 supervisors¹⁷ have at least some of the relevant data on the funding level of the pension funds indicated below Table 1).

¹¹ In Switzerland, the Occupational Pension Supervisory Commission (OPSC) is on the top of the supervision pyramid responsible for the regional supervisory authorities. These regional authorities are responsible for the supervision of the pension funds.

¹² Supervision of the public DB arrangements is carried out by the social security institutes (IMSS & ISSSTE), and the Ministry of Finance reviews each year the budget applied to the pension expenditure of these institutions.

¹³ The Ministry of Employment and Labour has the authority to supervise the entire retirement pension system. The Financial Supervisory Service has the authority to supervise the institutions that operate retirement pensions.

¹⁴ The Central Bank of Lesotho is to be assigned the supervisory mandate by the Pension Funds Bill, 2019. Previously, pension arrangements were supervised.

¹⁵ Following the Cabinet approval for the Financial Services Authority (FSA) to supervise the Seychelles Pension Fund (SPF), the first drafts of the amendments to the FSA and SPF Acts have been developed by the Office of the Auditor General and currently await presentation to the National Assembly.

¹⁶ The Ministry of Treasury and Finance does the actuarial supervision for some of the DB arrangements, but other entities such as the Directorate General of Foundations, the Ministry of Interior, and the Ministry of National Defence supervise the DB funds.

¹⁷ Gibraltar, Malawi, Russia are the countries with limited access to the relevant data on DB arrangements.

Table 1 DB pension landscape in IOPS jurisdictions

| Country | (1) DB pension arrangements (funded plans sponsored or organised by employer?) | | (2) Any other DB pension arrangements? (Y/N) | Backstop provided for (1) or (2)? (Y/N) | Supervises DB pension arrangements? | |
|----------------------|--|---|---|--|---|-------------|
| | Y/N | Who funds a plan deficit? | | | Y/N | Data? (Y/N) |
| Australia | Y | Employer | N | N | Y | Y |
| Austria | Y | Employer | N | N | Y | Y |
| Belgium | Y | Employer | Y | N | Y | Y |
| Brazil | Y | Employer and employees | N | N | Y | Y |
| Canada | Y | Employer (in some plans, the deficit is shared between the employer and the members) | Y | Y ^{a)} | Y | Y |
| Chile | N | - | Y | N ^{b)} | Y | Y |
| Colombia | N | - | Y | N | Y | Y |
| Ghana | Y | Employer (limited to the rate of contributions) | N | N | Y | Y |
| Gibraltar | Y | Government | N | N | Y | N |
| Iceland | Y | Employer | N | N | Y | Y |
| Ireland | Y | No obligation to fund any deficits | N | N | Y | Y |
| Isle of Man | Y | Employer | N | N | Y | Y |
| Jamaica | Y | Employer | Y | N | Y | Y |
| Korea | Y | Employer | N | Y | N | N |
| Lesotho | Y | Usually employers | N | N | N | N |
| Liechtenstein | Y | Employer or employees | Y | N | Y | Y |
| Malawi | Y | N/A | N | N | Y | N |
| Mauritius | Y | Employer | N | N | Y | Y |
| Mexico | Y | N/A | Y | N | N | Y |
| Morocco | Y | Employer | Y | N | Y | Y |
| Namibia | Y | Employer | N | N | Y | Y |
| The Netherlands | Y | Employees | N | N | Y | Y |
| Nigeria | Y | Employer | N | N | Y | Y |
| Portugal | Y | Employer (if the fund winds-up, employees may bear the loss) | N | N | Y | Y |
| Russia | Y | May differ according to the rules of pension plans | N | N | Y | N |
| Rwanda | N | - | Y | N | Y | Y |
| Seychelles | Y | N/A | N | N | N | Y |
| South Africa | Y | Employer | Y | N | Y | Y |
| Spain | Y | Employer | Y | N | Y | Y |
| Switzerland | Y | Employer and/or employees | N | Y | Y | Y |
| Trinidad & Tobago | Y | The legislation does not mandate that anyone needs to fund a plan deficit | N | N | Y | Y |
| Turkey | Y | May differ on the rules of the pension plans | Y | N | N | N |
| UK | Y | Employer | Y | Y | Y | Y |

a) In the province of Ontario (Ontario Pension Benefits Guarantee Fund, PBGF)

b) Backstop is not provided but inasmuch as the state is the “sponsor”, pension payments are fully guaranteed
Source: IOPS.

1.2. Recent changes in DB occupational pension landscape

The proportion of DB occupational pension funds has declined over the past ten years in many jurisdictions. According to the OECD Global Pension Statistics, the assets in DC pension arrangements have grown more than the assets in DB pension arrangements in most of the selected countries.

Comparing assets of occupational DB plans and occupational DC plans in periods between 2008 (or first year available) and 2020 (or latest year available) among 22 selected jurisdictions (Table 2), the proportion of DB pension funds has declined in 15 countries. The exceptions are Korea (an increase from 20.9% to 25.4%), New Zealand (from 38.3% to 43.2%), Canada (a slight increase from 59.8% to 60.1%), Namibia (an increase from 70.8% to 72.7%), Costa Rica (from 84.4% to 87.5%), Switzerland (from 89.0% to 90.3%) and Finland (from 89.1% to 91.9%). Four jurisdictions (Finland, Israel¹⁸, Nigeria, and Switzerland) did not report any occupational DC pension funds. They either may not have such arrangements or shifts may have occurred from occupational DB plans to personal DC plans, which cannot be verified in this table.

**Table 2 Recent changes in proportion of DB occupational pension funds
(as % of AuM of all occupational pension plans)**

| Country | First year of comparison | | | Latest year of comparison | | |
|--------------------|--------------------------|--------------|--------|---------------------------|--------------|--------|
| | year | DB (%) | DC (%) | year | DB (%) | DC (%) |
| Denmark | 2008 | 1.6% | 98,4% | 2020 | 1.3% | 98,7% |
| Italy | 2008 | 11.8% | 88,2% | 2020 | 3.2% | 96,8% |
| Dominican Republic | 2014 | 16.5% | 83,5% | 2020 | 6.0% | 94,0% |
| Iceland | 2009 | 23.8% | 76,2% | 2020 | 6.6% | 93,4% |
| Mexico | 2008 | 21.7% | 78,3% | 2019 | 11.3% | 88,7% |
| Liechtenstein | 2008 | 37.0% | 63,0% | 2020 | 11.5% | 88,5% |
| Nigeria | 2009 | 45.2% | 54,8% | 2020 | 12.5% | 87,5% |
| France | 2009 | 28.5% | 71,5% | 2018 | 22.6% | 77,4% |
| Australia | 2008 | 32.4% | 67,6% | 2013 | 24.0% | 76,0% |
| Korea | 2008 | 20.9% | 79,1% | 2020 | 25.4% | 74,6% |
| United States | 2008 | 36.5% | 63,5% | 2020 | 29.9% | 70,1% |
| Spain | 2008 | 49.7% | 50,3% | 2020 | 35.9% | 64,1% |
| Brazil | 2014 | 54.9% | 45,1% | 2020 | 42.1% | 57,9% |
| New Zealand | 2008 | 38.3% | 61,7% | 2013 | 43.2% | 56,8% |
| Turkey | 2011 | 54.4% | 45,6% | 2016 | 47.9% | 52,1% |
| Israel | 2008 | 77.4% | 22,6% | 2020 | 50.9% | 49,1% |
| Canada | 2008 | 59.8% | 40,2% | 2015 | 60.1% | 39,9% |
| Namibia | 2010 | 70.8% | 29,2% | 2020 | 72.7% | 27,3% |
| Guyana | 2015 | 88.4% | 11,6% | 2020 | 86.7% | 13,3% |
| Costa Rica | 2015 | 84.4% | 15,6% | 2018 | 87.5% | 12,5% |
| Switzerland | 2013 | 89.0% | 11,0% | 2019 | 90.3% | 9,7% |
| Finland | 2011 | 89.1% | 10,9% | 2020 | 91.9% | 8,1% |

Source: OECD Global Pension Statistics (Figure 1.19, page 38, <https://www.oecd.org/pensions/private-pensions/pensionmarketsinfocus.htm>), and IOPS.

However, as shown in section 1.1., notwithstanding the observed tendency towards decline in DB arrangements, the solvency of DB pension funds remains an important subject to supervise in many jurisdictions.

¹⁸ In Israel, DB plans have been closed to new members since 1995, and since 2008 it has been mandatory for workers who are not covered by a pension plan to choose and open a personal DC plan with a new pension fund, a provident fund or a life insurance company. This plan is not set up by the employer, and the employer is not responsible for providing any benefit or return guarantee.

1.3. Main factors influencing the recent changes in proportion of DB pension funds

The respondents indicated the following reasons for the recent decline of DB pension funds in their jurisdictions:

- Employers cannot bear financial risks (due to low interest rates) and/or biometrical (longevity) risks (Austria, Belgium, Ireland, Mauritius, the Netherlands, South Africa)
- A growing governance and regulatory burden adds to the incentive for employers to cease offering DB pension benefits (Ireland)
- DB pension plans' lack of flexibility coupled with declining investment performance is making restructuring more difficult (Switzerland)
- The general increase in wages has driven up the cost of DB pension scheme liabilities (Ireland, Mauritius)
- Operational costs associated with maintaining the sustainability of the DB schemes induce sponsoring employers to set up DC plans instead of DB plans (Mauritius)
- The average age of the DB members is increasing, resulting in a greater proportion of DB members reaching the age at which they exit the pension system (Australia, Ireland).

Because of the above reasons, members of DB funds are encouraged to transfer their benefit entitlements to DC schemes (Australia, South Africa) and the majority of DB pension funds are closed to new members (Australia, Ireland).

2. Valuation of DB pension schemes in IOPS jurisdictions

Subsequently, to focus the discussion on IOPS members who have occupational DB pension arrangements and who supervise them, a questionnaire was distributed to the relevant 28 members. Among these jurisdictions, twelve¹⁹ provided detailed answers. This gives a somewhat representative and evidence-based view on the current practices and recommendations regarding the supervision of DB pension schemes.

2.1. Valuation methods of pension assets

The valuation of pension assets and liabilities is the starting point to supervise solvency of DB pension funds. This gives the basic information on whether the pension fund has enough assets to make the required future pay-outs.

There are basically two different methods to evaluate pension assets - **“fair value” valuation** and **“historical cost” valuation**.²⁰ Fair value valuation measures the current market value. Assets are measured at estimates of the prices that pension plans would receive if they were to sell the assets. In contrast, historical cost valuation measures the value at the original cost. The price reflected on the balance sheet is either the purchase price or a value reduced by depreciation.

¹⁹ Australia, Austria, Belgium, Canada, Colombia, Ireland, Mauritius, the Netherlands, Portugal, Russia, South Africa, Switzerland.

²⁰ See IMF (2011) for more detailed information.

There has been a general trend to adopt “fair value” as a valuation method of pension assets, but there is considerable debate as to whether fair value is a better measure for supervising the solvency of pension funds. Fair value valuation provides a more accurate value as it is based on the current market price. It also enhances transparency and provides timely information, especially when valuation is necessary for liquidation purposes. However, fair value valuation increases volatility during financial crises and may enhance pro-cyclicality of the financial system if a crisis leads to fire sales of the assets²¹.

Jurisdictions were asked which methods pension funds use to evaluate their investment assets. The question was directed at investment assets (not total assets), because these assets should be the main source for making future pay-outs. All 12 selected jurisdictions responded that they evaluated investment assets using the mark-to-market method²² (Table 3). Two jurisdictions (Australia and Russia) responded that they value assets based on the relevant accounting standard.

Table 3 Valuation methods of pension assets

| Country | Investment assets |
|--------------|---|
| Australia | Mark to market (in accordance with Australia Accounting Standard AASB 1056) |
| Austria | Mark to market |
| Belgium | Mark to market |
| Canada | Mark to market |
| Colombia | Mark to market |
| Ireland | Mark to market |
| Mauritius | Mark to market |
| Netherlands | Mark to market |
| Portugal | Mark to market |
| Russia | Mark to market (in accordance with IFRS9) |
| South Africa | Mark to market |
| Switzerland | Mark to market |

Source: IOPS.

2.2. Valuation methods of pension liabilities

Pension liabilities (technical provisions), unlike the case of asset valuation, usually cannot be traded in the market. However, it is reasonable to conclude that pension liabilities are valued in a “market consistent” method, given that most jurisdictions calculate pension liabilities as the present value of the future pension obligations discounted by appropriate market related interest rate.

Some jurisdictions apply two or more liability calculation methods for different purposes. For example, Canada calculates liabilities on a “going concern” basis and a “solvency” basis. A going concern valuation assumes that the fund continues to exist in the future with members accruing future benefits and the plan accruing future income, whereas a solvency valuation assumes that the plan is closed on the day of the valuation and neither benefits nor income are accrued. Belgian pension funds

²¹ Pension funds tend to have a counter-cyclical investment behaviour rather than a pro-cyclical one if they follow strategic asset allocation policies and refrain from fire sales of assets (See IOPS, 2019).

²² “Mark-to-market method” ‘refers to accounting for the “fair value” of an asset or liability based on the current market price, the prices of similar assets and liabilities, or based on another objectively assessed “fair” value’ (https://en.wikipedia.org/wiki/Mark-to-market_accounting). If market prices for the same or similar positions are not available, then firms must estimate fair values using valuation models. International Financial Reporting Standards (IFRS) generally require these models to be applied using observable market inputs such as interest rates and yield curves available at commonly quoted intervals. Otherwise, unobservable firm-supplied inputs such as expected cash flows developed using the firm’s own data should be used. When fair values are estimated with the use of valuation models, they are referred to as using the “mark-to-model method”.

must calculate “Long term technical provisions (LTP)” and “Short term technical provisions (STP)”. LTP is the provision on which the funding policy is based, calculated to guarantee the sustainability of its commitments. STP is the minimum vested reserves determined by the social and labour legislation. Similarly, Portuguese pension funds calculate liabilities under two different scenarios. DB plans are usually funded using the “funding scenario” but a “minimum funding scenario” is established as a minimum safety net.

2.2.1. Approaches to define the scope of pension obligations

There are three approaches to define the scope of pension obligations of defined benefit schemes: PBO, ABO, and VBO. A **projected benefit obligation (PBO)** “is an actuarial measurement of what a company will need at the present time to cover future pension liabilities. It is used to determine how much must be paid into a defined benefit pension plan to satisfy all pension entitlements that have been earned by employees up to that date, adjusted for expected future salary increases.”²³ The method assumes that the pension plan will not be terminated in the foreseeable future, so the projection is adjusted to reflect expected compensation in the years ahead and takes into account:

- estimated remaining service life of employees
- assumed salary rises
- forecast of employee mortality rates.

Unlike PBO, the **accumulated benefit obligations (ABO)** method “refers to the present value of retirement benefits earned by employees using current compensation levels”²⁴. ABO is estimated based on the assumption that the pension plan is to be terminated immediately; it does not consider any future salary increases. The **vested benefit obligation (VBO)** method refers to the present value of pension benefits that have already accrued to the employee, based on current salary levels²⁵.

Up to two of these approaches were used to calculate pension obligations in 12 responding jurisdictions (Table 4). This was particularly the case for countries where two pension calculation methods were used for different purposes (Australia and Portugal).

In Australia, pension obligations are calculated according to both the PBO and VBO methods, depending on the purpose for which they are being used. The PBO is required when determining the funding requirements and setting the required contribution rates, whereas the VBO is required when determining whether a fund is in a satisfactory financial position. Portuguese DB pension funds calculate pension obligations using the PBO and ABO methods for two different scenarios. The PBO method is used for the ‘funding scenario’, which uses the actuarial measure of liabilities compliant with the international accounting standards; the ABO method is used for the ‘minimum funding scenario’, which is calculated to establish a minimum safety net.

²³ <https://www.investopedia.com/terms/p/pbo.asp>

²⁴ <https://www.investopedia.com/terms/a/accumulated-benefit-obligation.asp>

²⁵ <https://www.investopedia.com/terms/v/vested-benefit-obligation.asp>

Table 4 Approaches used to calculate pension obligations

| Country | Approach |
|-----------------|--|
| Australia | PBO: for determining the funding requirements and setting the required contribution rates VBO: for determining whether the fund is in a satisfactory financial position |
| Austria | Entry age normal method |
| Belgium | ABO: Short term technical provisions ABO + Margin: Long term technical provisions |
| Canada | ABO, PBO (vary across the provinces) |
| Colombia | PBO |
| Ireland | ABO |
| Mauritius | PBO |
| The Netherlands | PBO |
| Portugal | PBO: for the 'funding scenario' ABO: for the 'minimum funding scenario' |
| Russia | PBO (employer's liabilities are calculated according to IAS 9, pension fund's liabilities are evaluated according to IFRS 4, both most likely similar to PBO) |
| South Africa | PBO |
| Switzerland | VBO |

Source: IOPS.

In Belgium, the prudential law does not specify a particular method to calculate pension obligations. The most common method to evaluate the Short-term technical provisions (STP) is the ABO method using assumptions defined in the regulation methods. For the Long-term technical provision (LTP), most Belgian funds use the ABO plus a buffer to take into account the margin for adverse deviation. The buffer is determined via a continuity test done every three years. Belgian IORPs should describe and justify the methodology used for calculating the technical provisions in the financing plan.

In Canada, the ABO and PBO methods are both used depending on the province. In Colombia, Mauritius, South Africa, and the Netherlands, the PBO method is used, while Irish pension funds use ABO methods. In Switzerland, pension liabilities for the active insured are calculated using the VBO method.

In Austria, the “entry age normal method” is used to calculate pension obligations. The method is similar to PBO but differs in consideration of the remaining years of service. Therefore, technical provisions calculated with PBO are often lower than those calculated with the entry age normal method during the accumulation phase. The future increase in salaries is also considered in the entry age method.

2.2.2. Demographic assumptions: mortality rate

The actuarial assumptions required in the valuation of pension liabilities can be grouped into two main categories: demographic and economic. As was indicated previously, because liabilities usually cannot be traded in the market, pension funds need to estimate future retirement benefits and convert them into present value to derive a fair value. Various demographic and economic assumptions are used to generate cash flows for future retirement benefits, after which economic assumptions (discount rate) are used to convert future retirement benefits into present value.

Demographic assumptions are used to project the development of the population of a pension scheme and the moment when the benefits to be provided will begin to be paid. There may be various lists of demographic assumptions (e.g., mortality rate, disability rate, recovery rate, withdrawal rate). Among these, the most important assumption is the mortality rate. Jurisdictions were asked how they compute life expectancy in the value of liabilities (e.g. is it a constant level, is it an up-to-date estimate, is it a best-estimate projection for future paths of potential mortality developments, etc.?)

Most jurisdictions responded that they use a mortality table (also known as life table) with an adjustment to include future improvements in life expectancy. The mortality table shows for each age

what the probability is that a person of that age will die in the next year ("probability of death"). It represents the survivorship of people from a certain population and can be explained as a long-term mathematical way to measure a population's longevity. Table 5 provides a summary.

In Australia, a fund's actuary sets the expected mortality assumptions as part of the actuarial valuation. There are no legal requirements as to how these assumptions are to be set; however, under Professional Standard 400²⁶ as set out by the Institute of Actuaries of Australia, all assumptions including mortality rates are required to be set either from the best-estimate range of assumptions or a more conservative range, provided the circumstances justify the use of more conservative assumptions. In doing this, some funds do allow for the impact of improving mortality rates.

In Austria, the actuary of a pension company calculates life expectancy under consideration of mortality table, sex, age, date of birth, status (e.g. active member or pensioner), retirement age, and spouse.

In Belgium, life expectancy is calculated based on mortality tables MR/FR²⁷, which are the standard tables, mostly used by the pension funds (IORPs). If funds decide to use other mortality tables, they must justify this use, and if necessary, adapt the other assumptions to guarantee the sustainability of the fund. Many Belgian funds use MR/FR mortality tables with a correction of the age (minus 3 or 5 years) to take into consideration the improvement in life expectancy.

In Canada, the actuary typically assumes mortality rates in accordance with a mortality table and adjustments for future improvements in longevity. The mortality table and projection scale are typically the ones promulgated from time to time by the Canadian Actuarial Standards Board.

In Ireland, the mortality tables to be used in the valuation of benefits of non-retired members are specified in Statutory Guidance issued by the supervisor²⁸. The mortality assumptions used in the valuation of pensioner benefits reflect those used by insurance companies in the Irish marketplace for the purposes of pricing annuities.

In Mauritius, the Private Pension Schemes (Technical Funding Requirement) Rules specify that in determining the prudent (actuarial) assumptions, the DB scheme shall ensure that the mortality and demographic assumptions are based on prudent principles, having regard to the current and expected characteristics of the beneficiaries of the scheme. Licensees use English life tables and for larger funds, they would carry out a mortality investigation to see if any adjustment is required.

In the Netherlands, pension funds use a best-estimate projection for future paths of potential mortality developments, updated once every two years by the Royal Actuarial Association.

In Portugal, pension funds tend to use static mortality tables for the valuation of liabilities. For the funding scenario, the most common mortality table applied by pension funds is the TV 88/90 (in some cases with an adjustment). However, for the minimum funding scenario²⁹, the regulation establishes the use of the mortality table TV 73/77.

²⁶ <https://www.actuaries.asn.au/Library/Standards/SuperannuationEmployeeBenefits/2020/PS4002020mar.pdf>

²⁷ The method to determine the mortality tables MR/FR is explained in the annex of the royal decree dated 14 November 2003 on the implementation of the law of 28 April 2003 on "pensions and the tax system of these and some advantages complementary in terms of social security system".

²⁸ https://www.pensionsauthority.ie/en/trustees_registered_administrators/statutory_guidance/

²⁹ The main purpose of minimum funding scenario is to establish a minimum safety net. It does not prejudice the use of more appropriate assumptions in the 'funding scenario'.

In Russia, actuaries should use a pension fund's data on its member's death rates and take expected mortality improvements into account. If such data are insufficient, then other statistics may be used, for example official countrywide mortality tables.

In South Africa, the regulation does not prescribe the mortality assumptions to be applied. It requires demographic assumptions to be determined in a manner that is relevant to the membership of the fund for which the liabilities are calculated. The choice and relevance of the assumptions must be selected and justified by the valuator (actuary).

In Switzerland, about half of the pension funds use periodic tables to calculate the technical provisions, while the others use generational tables. The difference is that generational tables include future improvements in life expectancy whereas periodic tables do not. Pension funds using periodic tables need to reserve each year additional provisions for improving life expectancy. The tables themselves might be considered a best estimate of mortality and disability for Swiss pension funds. They are constructed using data from the biggest Swiss pension funds.

Table 5 Methods to calculate life expectancy in the valuation of liabilities

| Country | Methods (mostly used) | Rules set by |
|-----------------|--|---|
| Australia | Best estimate or more conservative assumptions* * some funds allow for the impact of improving mortality rates | Fund's Actuary |
| Austria | Mortality tables* * depends on sex, age, date of birth, retirement age, etc. | Fund's Actuary |
| Belgium | Mortality tables MR/FR (standard) + correction* * life expectancy improvement (-3 or -5 years) | Royal decree |
| Canada | Mostly* Mortality tables + adjustment * May vary across the provinces | Canadian Actuarial Standards Board |
| Ireland | Mortality tables* * Which insurance companies use in the Irish marketplace | Statutory Guidance |
| Mauritius | English life tables + adjustment* * Larger funds would carry out a mortality investigation to see if any adjustment is required | Fund's Actuary |
| The Netherlands | Best-estimate projection for future paths of potential mortality developments | Royal actuarial association |
| Portugal | Funding scenario: mortality tables* * mostly table TV 88/90 (with or without adjustments) | Fund's Actuary |
| | Minimum funding scenario: table TV 73/77 | Regulation |
| Russia | Fund's data (life expectancy improvement considered) | Fund's Actuary |
| South Africa | Manner that is relevant to the membership of the fund | Fund's Actuary |
| Switzerland | Periodic tables + additional provisions or Generational table (includes life expectancy improvement) | Data from the biggest Swiss pension funds |

Source: IOPS.

2.2.3. Economic assumptions: discount rate

Economic assumptions used in valuing retirement benefits typically include an interest rate for discounting future cash flows (i.e., discount rate), a price inflation rate, a rate of increase in salaries, a pension benefits increase rate, etc. Their inclusion and level depend upon the actual benefits provided, the economic factors affecting a country/employer, and the specific restrictions placed when making calculations. Among these factors, the most important assumption concerns the discount rate.

Methods many pension funds use to determine the discount rate can be categorized into two primary approaches – “the assumed-return approach” and “the bond-based approach”.³⁰

The assumed-return approach uses a discount rate based on a long-term assumed average rate of return on the pension plan’s assets, which includes an allowance for expected returns from the stock market when plan assets are invested in equities. This approach is based on the premise that pension plans are long-term enterprises, so the estimated long-term average cost of financing plan benefits, based on the plan’s asset allocation, provides the most relevant measure of the plan costs. Selecting a discount rate based on the expected rate-of-return approach may be subjective. Under this approach, the discount rate depends on the plan’s asset allocation, so allowing riskier assets such as stocks can increase the discount rate. Also, the estimation of future investment returns may affect the discount rate, as more optimistic estimates produce higher discount rates. Therefore, pension funds who use this method need to be carefully supervised to avoid any temptation to invest in riskier assets or assume optimistic views on the future economic conditions to derive a higher discount rate.

In contrast to the assumed-return approach, the bond-based approach uses a discount rate based on market prices for bonds, annuities, or other alternatives that are deemed to have certain characteristics similar to pension promises, rather than estimates of future returns. The bond-based approach is premised on the theory that defined pension benefits are “bond-like,” in that they constitute promises to make specific payments in the future and accordingly should be similarly valued. The relevant bond “quality” (e.g., AAA-rated, AA-rated, etc.) can depend on the specific purpose of the liability measurement, which can result in rates that vary considerably. The “risk-free interest rates approach”, using government bonds or interest rate swaps, could be considered as a specific type of this approach. A liability based on risk-free interest rates can be interpreted as an approximation of the amount of money that would be needed to come close to protecting the payment of future benefits from all risks.

Theoretically, a bond-based discount rate should be applied differently for each maturity on account of the risks associated with time. A longer maturity bears higher risk owing to an inherent increase in uncertainty of outcomes, so the discount rate should gradually increase as maturity increases. This upward sloping curve of interest rates across different maturity dates is called the ‘yield curve’. To capture discount rates for each maturity a yield curve should be used but for practical reasons, many pension funds convert the yield curve into a single rate and apply a flat discount rate to all future benefits regardless of their maturity. Using a single rate discount rate could be considered a less accurate method, but it is a much more convenient method compared to applying a yield curve as a discount rate.

Jurisdictions were asked how they set the discount rate to convert future payments into present value. In many jurisdictions, the rule is decided by the actuaries in the pension funds, but most use the assumed-return approach, using an expected rate of return based on the asset allocation. Also, a single discount rate is generally preferred to a yield curve (see Table 6).

In Australia, the expected rate of return on the fund’s assets is used as a discount rate. However, the fund’s actuary may allow for short-term variations if deemed appropriate. The expected rate of return is usually set using the DB fund’s actual asset allocation and is based on best-estimate returns over the long term. A single discount rate approach is usually applied for discounting. The rate is set by the DB fund itself (under actuarial advice) and not as required by the supervisor. The Institute of Actuaries of Australia has set out Professional Standards to which all of its members must comply. Under Professional Standard 400, all assumptions, including a DB fund’s discount rate, are required to be set either from the best-estimate range of assumptions or a more conservative range, provided the circumstances justify the use of more conservative assumptions. Law/supervision does not set the maximum values that the expected return of assets can take.

³⁰ See “GAO-14-264 Pension Plan Valuation” for more details (<https://www.gao.gov/assets/670/666287.pdf>)

In Austria, the expected rate of return is used as a discount rate in a single discount rate formula. The asset classes to be included depend on the investment strategy. Law/supervision does not set the maximum values that the expected return can take, but the pension supervisory authority (FMA) defines by regulation the maximum interest rate for new active members and new contracts. Usually, the rate is agreed by the pension company and by the employer.

In Belgium, following the prudential law, technical provisions shall be calculated by means of a sufficiently prudent actuarial assessment. To calculate The Long-Term Technical Provisions, pension funds (IORPs) can choose between the following two methods to define the discount rate:

- a) return on covering assets as well as future returns, and/or
- b) return on bonds of a Member State or on other high-quality bonds.

Belgian funds determine their discount rate themselves in compliance with the “prudent person” principle. The value of the rate and the way to determine it should be described in the financing plan. As the prudent person principle applies, the prudential assessment of the technical provisions is not focused solely on the discount rate, but examines the parameters and methods used as a whole (via a continuity test). The consistency between the assumptions and the methods used, but also with risk policy and the investment policy of a fund is paramount. In most cases, an expected return on assets in a single discount rate formula is used, but very few funds apply a yield curve for discounting. Law/supervision does not set the maximum values that the expected return of assets can take. However, a fund needs to justify the methods and bases it uses for calculating the technical provisions, which must be of such a nature that they guarantee the sustainability of its commitments. Therefore, depending on the level of the discount rate and, hence, the level of risk included in that rate, a buffer must be included in the Long-Term Technical Provisions to compensate for the negative deviations. The Short-Term Provisions, which correspond at minimum to the level of vested rights, must be calculated with minimal assumptions defined in the applicable social and labour law (for Belgian pension plans a discount rate of 6%, for cross-border pension plans determined on the basis of the local social and labour law).

In Canada, pension plans use a single discount rate for going-concern valuations selected by the actuary. Canadian actuaries can choose to use either the expected return on assets, or the yields on bonds, considering the expected future benefit payments of the pension plan. For the solvency valuation, the rates are prescribed: for benefits expected to be settled by a commuted value transfer, the value of the pension is discounted by a medium-term government bond rate for the first 10 years and by a long-term government bond rate after 10 years. The discount rate for benefits expected to be settled by purchase of an annuity are based on the duration of the liabilities that is provided by the Canadian Institute of Actuaries (CIA), which is a proxy for the discount rate being used by insurance companies to value life annuity purchases.

In Ireland, the discount rates to be used in the valuation of non-pensioner liabilities are set out in Statutory Guidance issued by the Pensions Authority. The approach could be described as a single rate using the expected return on assets with an element of blending of the pre- and post-retirement discount rates. For members with ten or more years to normal retirement age, the standard basis reflects an assumed long-term interest rate; for members within ten years of normal retirement age, the standard basis tends towards a reflection of current interest rates. The standard basis allows for investment in equities until ten years before normal retirement age and, thereafter, a mix of equity and fixed-interest investments, with the proportion of fixed-interest investments gradually increasing to 100% by normal retirement age. The pre-retirement discount rate used to value active members’ liabilities and the long-term post retirement discount rate used to value deferred members’ liabilities are currently 6% and 4.25%, respectively. Pensions in payment (i.e. the benefits which are already being received) are valued on the actuarial basis consistent with the cost of buying annuities in the Irish marketplace.

In Mauritius, the law does not specify how to set the rate used to discount future payments into present value. In most cases, pension funds use a weighted expected return on assets based on strategic asset allocation, in a single discount rate formula. They take the risk-free rate (government bond of appropriate term) as a base and then add an equity risk premium and a liquidity premium and reduce the calculated rate to include a prudence margin. Pension funds set their own discount rate, but the rate should be based on prudent assumptions as expressly specified in the FSC Rules; Subject to section 11 of the Private Pension Schemes (Technical Funding Requirement) Rules 2013, the defined benefit scheme shall ensure that the rates of interest used to discount future payments of pension benefits have been prudently chosen and are consistent with the manner in which the assets are valued.

In the Netherlands, pension funds use a yield curve, including an ultimate forward rate (UFR) as a discount rate. The curve is published monthly on the pension supervisor's (DNB) website. An interest rate swap is used as a risk-free rate and the UFR level is the 10-year moving average of the 20-year interest rate.³¹ By law, pension funds must use the interest rate curve that the DNB publishes.

In Portugal, under the funding scenario, pension funds typically use a single discount rate based on the AA corporate bond yield of appropriate maturity taking into account the average duration of liabilities. The minimum funding scenario sets a discount rate of 4.5%.

In Russia, there are no specific requirements to use a single discount rate or a yield curve during the actuarial assessment of pension funds. Under prevailing legislation, pension funds may use single discount rate for all future periods. One of the common approaches to choose this single rate is to determine the average period of future cash flows and use the rate that would apply to government bond with similar maturity at the time of valuation.

In South Africa, usual practice is to use a single rate based on the average duration of the liabilities. In order to arrive at a discount rate, two generally accepted approaches are recognised: a "bond-based approach" (applying the risk-free rate) and a "risk premium approach" (applying the risk-free rate + a risk premium based on the proportion of assets invested in growth assets, with a maximum limit of 3% for the risk premium). Pension funds can choose their own approach for the financial soundness basis, the bond-based approach, risk-premium approach or anything in between. However, the approach may not be less prudent than the risk-premium approach. If the financial soundness approach that the fund decides to apply is not the bond-based approach, the difference between the chosen approach and the bond-based approach effectively needs to be held as a solvency reserve. Regulation requires the discount rate to reflect market yields on appropriate bonds commensurate with the duration and the nature and currency of the liabilities at the valuation date. Given the absence of a deep and liquid market in corporate bonds, government bonds should be and have been used. Pension funds set the discount rate themselves, within the bounds of the limits set by the supervisor.

In Switzerland, setting the discount rate is done individually by each pension fund. Single discount rates based on the expected return on assets, calculated for the medium-term for each fund individually depending on its asset allocation, are usually used. For the pension funds that use a risk-free rate, the yield on 10-year government bonds in Switzerland is used as a reference.

³¹ The first smoothing point is 20 years, and the convergence factor is 0.1. NB: the 'Parameter committee' (a committee of experts, installed and mandated by the minister of social affairs to advise on key parameters once every 5 years) has advised recently to change the level of the UFR to the 10-year moving average of the 30-year interest rate, make 30 the first smoothing point and set the convergence factor at 0.02. This advice is intended to be implemented in 2021.

Table 6 Methods for discounting liabilities

| Country | | Discount rate (mostly used) | | | | |
|-----------------|---------------|-----------------------------|---|--|--|--|
| | | Formula | Structure | Reference | Rules set by | Average nominal value in 2018 |
| Australia | | Single rate | Expected rate of return | Asset allocation | DB funds | 5.9% |
| Austria | | Single rate | Expected rate of return depending on the investment strategy | Asset allocation | DB funds (FMA sets limits for the new members) | up to 6.5% |
| Belgium | | Single rate | Expected rate of return | Asset allocation | DB funds | 2.7% |
| Canada | Going concern | Single rate | Expected rate of return or Yields on bonds considering future payments | Asset allocation | DB funds | 5.19% ^{a)} |
| | Solvency | Single rate | [Commuted value transfer] Risk free rate (medium government bond rate for first 10 years, long-term government bonds after 10 years) | Government bonds | Regulation | Non indexed 3.2% ^{b)} / 3.4% ^{c)} Fully indexed 1.7% ^{b)} / 1.8% ^{c)} |
| | | | [Purchase of an annuity] Proxy of discount rate used by insurers | Insurance company | Canadian Institute of Actuaries | Non indexed 3.03% Fully indexed -0.02% |
| Ireland | | Single rate | Expected rate of return (Pre-retirement discount rate: equity, 6%) (Long term post-retirement discount rate: bonds, 4.25%) | Asset allocation | Regulation | approximately 3% (a crude estimate) |
| Mauritius | | Single rate | Expected rate of return | Asset allocation | DB funds (following FSC rules) | N.A. |
| The Netherlands | | Yield curve | Risk free rate + UFR ^{d)} | Interest rate swap | Supervisor | 2.34% |
| Portugal | Funding | Single rate | Risk free rate + premium ^{e)} | AA corporate bond yield (Average duration) | DB funds | 2% |
| | Minimum | Single rate | 4.5% | - | Supervisor | - |
| Russia | | Single rate | Risk free rate | Government bonds | DB funds | 7.1% ^{f)} |
| South Africa | | Single rate | Risk free rate + premium | Government bonds | DB funds (following FSCA rules) | 9.8% |
| Switzerland | | Single rate | (most often) Expected rate of return | Asset allocation | DB funds | 2.1% |

a) The average discount rate used in actuarial valuations of DB plans in British Columbia. The discount rate is selected by the plan's actuary and is not prescribed.

b) For the first 10 years, c) after 10 years.

d) The UFR level is the 10-year moving average of the 20-year interest rate. The first smoothing point is 20 years and the convergence factor is 0.1.

e) AA corporate bond yield of appropriate maturity taking into account the average duration of liabilities.

f) Simple average discount rate for 10 biggest pension funds in 2018.

Source: IOPS.

3. Supervising solvency of DB pension schemes in selected IOPS jurisdictions³²: survey of supervisors

3.1. Solvency: definition and criteria used for supervision

Solvency is the ability of a pension plan to pay all the benefits owed to the members and beneficiaries as they fall due.

As there are no international regulatory standards on the assumptions and methodologies used to supervise the solvency of pension funds, IOPS jurisdictions use their own criteria. Nonetheless, many jurisdictions set their solvency rules in line with the definition above to ensure that pension funds have sufficient assets to meet their liabilities (Table 7).

Also, it is worthwhile to note that pension arrangements in which benefits are fully guaranteed and could potentially be adjusted are not the same type of plan, and indeed should not necessarily be subject to the same solvency rules.

In Australia, the main criterion used to measure solvency is the DB fund's financial position, determined as the ratio of the net assets available to pay members' benefits to the value of the members' vested benefits. The latter corresponds to the benefits that would be paid if a member voluntarily left the fund. If this ratio is greater than or equal to 100% then the DB fund is deemed to be in a satisfactory financial position. If the ratio is less than 100%, then the DB fund is deemed to be in an unsatisfactory financial position.

In Austria, as a general solvency requirement, pension funds need to hold own funds (capital) that are more than 1% of technical provisions, as well as 3% of technical provisions with guarantees. Own funds include the paid-up share capital, the capital reserves, the revenue reserves, the net profit for the year not dedicated to distribution, the untaxed reserves, and supplementary capital. The paid-up share capital of a multi-employer *Pensionskasse* shall amount to at least EUR 5 million (for single-employer *Pensionskasse* at least EUR 70,000). Apart from the minimum requirements for the paid-up share capital, there are no further solvency requirements for DB plans.

In Belgium, the prudential law requires that every pension fund (IORP) should always maintain sufficient and appropriate assets to cover the technical provisions in respect of the total range of pension schemes operated, the solvability margin, and the other liabilities of the fund. IORPs should mainly calculate two funding ratios, which must be higher than 100%:

- minimum funding ratio: Assets / Short Term Technical provisions (+ solvency margin)
- funding ratio: Assets / Long Term Technical provisions (+ solvency margin).

The ratios need to be calculated and explained in the annual reporting of the pension fund and in the report of the person responsible for the actuarial function. The level of technical provisions must be certified by an accredited auditor. The reports are subject to an annual review by the pension supervisory authority (FSMA).

³² Colombian DB funds are similar to a pay-as-you-go system. As they have no solvency requirements, Colombia did not provide answers to section 3.

In Canada, pension funds are supervised in two ways:

- (1) On a solvency basis: This is the ratio of solvency assets divided by solvency liabilities, as if the plan were to be terminated on a given date;
- (2) On a going concern basis: The ratio of going concern assets divided by going concern liabilities, as if the plan is to continue indefinitely.

Solvency assets and going concern assets are valued in a similar way. However, the liabilities are valued very differently. Lately, many provinces have reduced the requirements for funding a solvency deficit. As this decreases the amount of benefit security, additional risk-mitigation measures have been added, such as margin requirements on a going concern basis.

In Ireland, a DB pension fund is considered to meet the minimum solvency requirement if the ratio: Assets/ (Funding Standard liabilities + Funding Standard Reserve³³) is above 100%.

In Mauritius, the main criterion used to supervise solvency requirements is the funding ratio. The funding ratio uses the actuarial value of the assets of the scheme as the numerator relative to the technical provisions (calculated in accordance with the accrued benefits funding method based on prudent assumptions) as the denominator. A DB scheme shall meet the technical funding requirement if its funding ratio is at least 100%³⁴.

In the Netherlands, using a standard model, each fund has its own risk-based required funding ratio. The standard model and its parameters are laid down in second-tier law; the parameters are reconsidered once every five years by a committee of independent experts. The funding ratio is calculated using the investment assets valued at market prices as the numerator, and technical provisions valued at the risk-free rate and UFR as the denominator. On average for the Dutch pension sector, the required funding ratio is about 125%.

In Portugal, the funding ratio is determined as the ratio of the amount of assets to the amount of liabilities. According to certain sectorial regulation, only the following value needs to be totally funded (if higher than the one calculated under the minimum funding scenario):

- 100% of the present expected value of pensions in payment
- 95% of the present expected value of liabilities related to past service.

In Russia, there are two main indicators: the fund should not have an actuarial deficit and it should pass the obligatory stress-test. An actuarial deficit exists if a fund's total liabilities exceed its total assets. Since 2018, pension funds have to conduct internal stress tests according to scenarios prepared by the Bank of Russia and fund themselves. The basic principle is to forecast values of assets and liabilities quarterly, taking into account all cash flows and payments. The stress test measures the ability of a pension fund to meet its obligations and to satisfy prudential requirements during a 5-year forecast

³³ A pension scheme's Funding Standard Reserve is calculated as the aggregate of:

- 15% of Funding Standard Liabilities (technical provisions) less 15% of EU sovereign bonds and cash held by the scheme, and
- the increase in Funding Standard Liabilities (technical provisions) if the interest rate assumption was 0.5 percentage point less than that assumed for the purposes of calculating the Funding Standard Liabilities

³⁴ If a funding ratio is at least 90% and the rates of contributions to the scheme are such that the funding ratio of 100% can be expected to be met for the period for which the schedule of contributions is in force, and it meets all the requirements provided in any FSC Rules issued by the Commission under section 18 of the Act, it shall be deemed to meet the technical funding requirement.

horizon. The methodology utilizes Monte Carlo simulations to forecast losses from credit risk. This considered, pension funds must remain solvent in 75% of the simulations to comply with regulations.

In South Africa, the funding level is defined as the ratio, expressed as a percentage, calculated in terms of the following formula:

$$\frac{(A - \text{ESA} - \text{MSA})}{(L + \text{CRA})}$$

Where:

A – is the value that the valuator has placed on the assets

ESA – is the credit balance in the employer surplus account

MSA – is the credit balance in the member surplus account

L – is the value that the valuator has placed on the liabilities

CRA – is the amounts standing to the credit of those contingency reserve accounts that are established or that the board deems prudent to establish on the advice of the valuator.

In Switzerland, the coverage ratio is defined as investment assets divided by technical provisions. The main criteria used to supervise the funding level of the pension fund is the expert's report. If underfunded, the expert must report annually.

According to OECD (2021a: 220; 2021b: 40), Finland, Iceland and Luxembourg use fixed discount rates (at 3%, 3.5% and 5% respectively), whereas the United Kingdom and the United States use market rates as a discount rate (the gilt yields and high-quality corporate bonds, respectively).

Table 7 Criteria used to supervise solvency of DB pension funds

| Country | Criteria for supervising pension funds | | | Regulatory standard |
|-----------------|--|---|---|------------------------|
| | Regulatory criteria | Numerator | Denominator | |
| Australia | Funding ratio | Net assets available to pay member's benefits | Value of the member's vested benefits | 100% |
| Austria | Capital requirement | Own funds | Technical provisions | 1% |
| | | | (in addition) Technical provision with guarantee | 3% |
| Belgium | Minimum funding ratio | Assets | Short Term Technical provisions + solvency margin | 100% |
| | Funding ratio | | Long Term Technical provisions + solvency margin | |
| Canada | Solvency ratio | Solvency assets | Solvency liabilities | 85%-100% ^{a)} |
| Ireland | Funding ratio | Assets | Funding Standard liabilities + Funding Standard Reserve | 100% |
| Mauritius | Funding ratio | Actuarial value of the assets | Technical provisions | 100% |
| The Netherlands | Funding ratio | Investment assets | Technical provisions | 125% ^{b)} |
| Portugal | Funding ratio | Assets | Liabilities | 100% ^{c)} |
| Russia | Actuarial deficit obligatory stress-test | Assets | Actuarial value of liabilities | 100% |
| South Africa | Funding ratio | Assets – (MSA + ESA) | Liabilities + CRA | 100% |
| Switzerland | Coverage ratio | Investment assets | Technical provisions | 100% |

- a) Vary across the provinces (Ontario: 85%, New Brunswick: 90%, Alberta, British Columbia, Saskatchewan: 100%).
b) This is not the regulatory standard but the crude sector average when the regulatory calculation is done.
c) For the banking (78% of DB market) and insurance (6% of DB market) sectors only the following value needs to be totally funded:

- 100% of the present expected value of pensions in payment
- 95% of the present expected value of liabilities related to past service.

Source: IOPS.

Among selected jurisdictions, five provided data on the movements of funding ratios for the recent five years. Over this period, the funding ratio has declined in three jurisdictions.

Table 8 Trends of funding ratios* of DB pension schemes in selected IOPS jurisdictions 2014-2018

| Country | | 2014 | 2015 | 2016 | 2017 | 2018 |
|-------------------|---------|--------|--------|--------|--------|--------|
| Belgium | | 130.8% | 130.3% | 126.6% | 124.7% | 116.6% |
| Canada | Alberta | 87% | 100% | 109% | 88% | 87% |
| | Ontario | 88% | 83% | 91% | 94% | 94% |
| Ireland** | | 98.6% | 103.2% | 98.2% | 101.6% | 105.0% |
| The Netherlands** | | 107.7% | 102.2% | 102.2% | 108.8% | 103.3% |
| South Africa | | 104.7% | 105.7% | 107.8% | 103.8% | 99.1% |

*as defined by jurisdictions (see Section 3.1)

** Ireland 136% and 116% (2019, 2020); Netherlands 105% and 101% (2019, 2020) – see Figure 1.

Source: IOPS.

As shown in Table 7 and Table 8, a ‘funding ratio’ is used as a regulatory criterion for supervising pension funds in most jurisdictions. But even though supervisors use the same ratio, the implications are quite diverse across jurisdictions owing to the different assumptions and methodologies used to calculate assets and liabilities, as discussed in Section 2. For example, the expected liability cash flows are based on current salaries in some countries (Belgium, Ireland), while in other countries they are based on salaries projected to the normal retirement age (Colombia, Mauritius, Netherlands, Russia, South Africa). Alternatively, some countries demand regulatory funding levels to be calculated using a market discount rate (Canada, Netherlands, Russia, South Africa), while others require a fixed discount rate (Ireland) or a rate equal to the future expected return on assets (Australia, Austria, Belgium³⁵, Mauritius, Switzerland). These different provisions will produce different levels of liabilities.

To measure the impact of the economic events (financial crisis, low interest rates, increased life expectancy), one would have to measure solvency in the same way for each country. Funding ratios calculated with the use of the discount rates based on the expected rate of return and the market-based rate are incomparable. For example, in Canada, pension funds’ funding ratios are around 100-125%, whereas their solvency ratios are around 85%-100%.

³⁵ However, supplemented with a buffer.

3.2. Policy and regulatory measures in place to supervise solvency of DB pension schemes

Supervisors were asked whether they use any of the following general policy and regulatory measures to supervise the solvency of DB pension schemes:

- Recovery periods
- Allowing risk sharing solutions (i.e. changing the design of the existing DB schemes to let sponsors transfer risk to members)
- Legislation that would allow for reduction of benefits
- Guarantee schemes

All ten IOPS jurisdictions that responded to this question set recovery periods as a policy/regulatory measure to supervise solvency of DB pension schemes (Table 9). Seven jurisdictions allow a reduction of benefits, and six allow risk sharing solutions. One jurisdiction (Ontario, Canada) created a guarantee scheme³⁶.

Table 9 Policy/regulatory measures to supervise solvency of DB pension schemes

| Country | Recovery periods | Risk sharing solutions | Reduction of benefits | Guarantee schemes |
|-----------------|--|---|---|---|
| Australia | Yes (3 years) | No | Yes | No |
| Austria | Yes (upon approval) | No | No | No |
| Belgium | Yes (5 years) | Yes | No | No |
| Canada | Yes (up to 10 years) | Yes^{a)} in some provinces | Yes^{b)} in some provinces | Yes^{c)} in some provinces |
| Ireland | Yes (3 years) | No | Yes | No |
| Mauritius | Yes (upon approval) | Yes | Yes | No |
| The Netherlands | Yes (10 years – roll over) | Yes | Yes | No |
| Portugal | Yes (case by case) | Yes | No | No |
| South Africa | Yes (3 years, up to 9 years) | No | Yes | No |
| Switzerland | Yes (7-10 years) | Yes | Yes | No |

a) British Columbia (for jointly sponsored plans), New Brunswick, Ontario, Saskatchewan

b) New Brunswick, Ontario, Saskatchewan

c) Ontario (Ontario Pension Benefits Guarantee Fund, PBGF)

Source: IOPS.

³⁶ In Ontario, if an employer of a DB plan becomes insolvent or bankrupt and there is not enough money in the pension fund to pay all the pension benefits to the members that were promised, the Ontario Pension Benefits Guarantee Fund (PBGF) may then apply a guarantee payment of certain benefits with a specified limit from the PBGF eligible pension plan.

3.2.1. Recovery periods

Setting recovery periods is a common regulatory measure amongst the ten jurisdictions that responded to this question. It works as a supplementary measure to the funding ratio, as it is often applied when the funding ratio is below the regulatory standard.

In Australia, if a fund registers an unsatisfactory financial position, Prudential Standard SPS 160³⁷ requires the fund to put in place a rectification plan, which is expected to restore the plan to a satisfactory financial position within three years. A longer period can be allowed with the agreement of the supervisor. When a DB fund's actuary acknowledges that the fund is in an unsatisfactory financial position, they must provide a statement to the fund's Trustee within 15 business days describing the actions to be taken to address the financial position. The statement must either contain a recommendation or set a date by which time a recommendation will be made in respect of contribution rates or levels that will, on reasonable expectations, restore the fund to a satisfactory financial position within three years.

In Austria, if a pension fund does not fulfil the solvency requirement described in section 3.1., it shall submit to the pension supervisory authority (FMA) a plan on how to restore its sound financial position (solvency plan). If the FMA has legitimate reason to assume that the fund will no longer be able to maintain the solvency requirement in the foreseeable future, the FMA shall demand the submission of a solvency plan. In the solvency plan, the pension fund shall outline how it will make sure that its own funds reach the required amount or do not drop below it. The solvency plan requires the authorisation of the FMA. The plan shall be authorised if its implementation is likely to result in the restoration of a sound financial position. If, owing to a deterioration of the financial situation of the pension fund, the FMA has legitimate reason to assume that the sufficient capital resource base of the fund will presumably no longer be guaranteed in the long run, the FMA may request the submission of a reorganisation plan. If the reorganisation plan suggests the risk of an insufficient capital resource base, the FMA shall be entitled to require the provision of additional own funds. A reorganisation plan may also be required in addition to a solvency plan.

In Belgium, if the minimum funding ratio is below 100%, the sponsor should immediately pay an extra contribution to cover the entire gap. If the funding ratio is below 100%, pension funds (IORPs) must propose recovery measures with a recovery period of a maximum of 5 years. The fund should take account of its specific situation, in particular its asset/liability structure, risk profile, liquidity plan, age profile of its members and start-up schemes in drawing up the recovery measures. Those measures must be approved *a priori* by the National Competent Authority (NCA). When recovery measures are in place, FSMA expects from the IORP an annual follow-up until the end of the recovery period. FSMA verifies that the recovery path (for each fund with recovery measures) is correctly applied. In case of additional underfunding, new or additional measures can be requested. In addition, FSMA recommends that all recovery measures provide for a 'recovery path' setting maximum nominal shortfalls or minimum cover rates per financial year (in relation to the amount of the technical provisions for that financial year, increased by the solvency margin where appropriate). The FSMA further requests that, as long as there is a shortfall in funding, the sponsor must undertake to pay a minimum recovery allocation each year, even if favourable stock market conditions do not require it and the recovery path is followed without this allocation. The aim is to establish a system of recurrent refinancing by the sponsor so that the recovery can be achieved more quickly in the event of favourable stock market conditions.

In Canada, recovery (amortisation) periods vary by provinces (5-10 years). At the federal level, the recovery period is 5 years to fund solvency deficiencies and 15 years to fund going concern unfunded liabilities. Pension plans must file actuarial reports on an annual basis (or every three years if

³⁷ <https://www.legislation.gov.au/Details/F2013L01247>

the solvency ratio in the previous actuarial report is greater than 1.2) setting out the special payments required to amortise the unfunded liability and/or solvency deficiency.

In Ireland, if a pension fund does not meet the minimum solvency requirement, they need to submit a ‘funding proposal’ to the Pensions Authority. The funding proposal must be designed to ensure that the scheme could reasonably be expected to satisfy the minimum solvency requirement at the effective date of the next actuarial funding certificate, or any later date specified by the Pensions Authority. If the intended recovery plan term is longer than 3 years, schemes must provide actuarial documentation around the current funding position of the scheme, set out their intended investment strategy over the proposed recovery plan term, while committing to match pensioner liabilities with appropriate bonds.

In Mauritius, if a DB scheme does not meet the technical funding requirement, its governing body after consultation with the actuary, shall in conjunction with the sponsoring employer develop a contingency plan to restore the funding ratio to 100% within a predetermined timeframe approved by the pension supervisory authority (FSC). The governing body and the actuary may consult with the supervisor on an appropriate timeframe for the restoration of the funding ratio to 100%, prior to the submission of the contingency plan. The plan shall include the timeframe within which the funding ratio of the DB scheme shall be restored to 100% in accordance with the FSC Rules.

In the Netherlands, funds with coverage ratios below the required funding ratio must fill in a recovery plan, demonstrating sufficient recovery strength to recover to the required funding ratio in at most 10 years’ time, or apply benefit cuts in the size needed to recover within 10 years. The recovery plan rolls over time; funds have to demonstrate their recovery capacity over a 10-year window every year anew as long as they are below their required funding ratio. As a back-stop, funds with coverage ratios below about 104% (defined by the IORP Directive) for five consecutive years have to apply unconditional benefit cuts to immediately bring them back to the minimum funding ratio (the cuts may be spread over time but must be applied unconditionally to the pension liabilities immediately).

In Portugal, in case of under-funding, the DB pension fund management entity is responsible for proposing to the sponsor(s) the regularisation of the situation. The regularisation could occur in the short term (e.g., one-off contribution within 1 year) or via the establishment of a recovery plan. The recovery plan and the length of the recovery period are established on a case-by-case basis. If a suitable recovery plan is not established within a certain period of time, the pension fund management entity should wind up the pension fund or collective adhesion in the case of open pension funds. In case of non-compliance with the recovery plan, the pension fund or collective adhesion should be wound up.

In South Africa, the scheme to restore financial soundness must aim to do so within three years. The pension supervisory authority may extend the three-year period provided that the extension may not exceed nine years.

In Switzerland, pension funds may be underfunded for a certain time. If underfunded, they must take action to reach the 100% funding level (coverage ratio). Recovery periods are set usually from 7 to 10 years.

3.2.2. Risk sharing solutions

Six jurisdictions (Belgium, Canada, Mauritius, the Netherlands, Portugal, and Switzerland) allow risk sharing solutions.

Mauritius and Portugal permit the conversion of DB plans into DC plans. In Switzerland, the pension fund might change the design of its existing DB schemes if the board (consisting of employees and employer) agrees.

The Netherlands allow risk sharing solutions subject to fair treatment restriction.

In Canada (Ontario), some examples of risk sharing solutions are as follows:

- Legislation allows employers and members to increase contribution amounts/rates
- Allow plan sponsors to change plan provision as long as no reduction of benefits with respect of past service (e.g., DC conversion, freezing DB pension with future DC benefit accrual)
- Most of the jointly sponsored pension plan (JSPP)³⁸ are generally exempt from solvency requirements
- Multi-employer pension plans (MEPP) may provide defined benefits but, in most MEPPs, the required contributions are negotiated and fixed through collective bargaining. Reduction of benefits (with respect of both accrued and prospective service) is permitted under Ontario Regulations if there are insufficient plan assets. MEPPs are generally exempt from solvency requirements.
- Employers may shift a portion of the pension benefit obligations to insurance companies under group annuity contracts in exchange for a premium.

3.2.3. Reduction of benefits

Seven jurisdictions (Australia, Canada, Ireland, Mauritius, the Netherlands, South Africa, and Switzerland) have legislation that allows for reduction of benefits.

In Australia, the Superannuation Industry (Supervision) Regulations do allow for the reduction of benefits, but only in very limited circumstances. If a fund is being wound up while in an unsatisfactory financial position or technically insolvent, the regulations specify the priority that must be given to the liabilities of the fund. If the fund will remain on an ongoing basis, the regulations do allow for benefits to be reduced, but this can only be done with the consent of the members or with the approval of the regulator. In both cases, various other conditions relating to member disclosure amongst other things must be met.

In Canada (New Brunswick), under the Shared Risk regulation³⁹, if the open group funded ratio falls below 100% in two successive actuarial valuation reports, a funding deficit recovery plan is implemented within 12 months after the review date of the second of those reports. This may result in pension benefit reductions.

In Ireland, ongoing DB private pension schemes may apply to the regulator to reduce members' benefits in accordance with legislation and statutory guidance. This requires the pension scheme to follow a defined process which includes consultation with the affected members and is subject to approval by the regulator. It is normally considered as part of a funding proposal to achieve the minimum funding level over an agreed recovery period.

In Mauritius, a private pension scheme may reduce or alter the pension benefits already accrued to a beneficiary or alter the pension benefits that are not yet accrued subject to the approval of the Commission.

The legislation in the Netherlands allows for reduction of benefits as a measure of last resort. In South Africa, future benefit accrual may be reduced; however, communication to members is vital when

³⁸ A special type of pension plan in which decision making and contributions are shared by both employers and members.

³⁹ On 1 July 2012, the Shared Risk Pension Plan model was introduced in the legislation. Under this type of pension plan, the plan sponsor and members jointly share the financial risk.

considering reduction of benefits. In Switzerland, the pension fund may reduce its benefits if the board (employees and employer) agrees.

3.3. What should be policy and regulatory measures necessary to meet solvency requirements?

Supervisors were asked which of the following five general policy and regulatory measures are, in their view, necessary to meet the solvency requirements (

Table 10):

- Introducing or maintaining flexibility in satisfying regulatory criteria for solvency
- Introducing longer recovery periods
- Introducing risk sharing solutions
- Introducing legislation that allows for reduction of benefits
- Introducing guarantee schemes.

Seven out of eight responding jurisdictions agreed on the policy of flexibility when satisfying regulatory criteria for solvency. Four jurisdictions (Australia, Canada, Mauritius, and Portugal) agreed that the introduction of longer recovery periods is necessary for meeting solvency requirements, and three others (Australia, Canada, Mauritius) agreed on introducing risk sharing solutions. Two jurisdictions (Australia, Canada) supported introducing legislation that allows for reduction of benefits. No jurisdiction found introducing guarantee schemes necessary for meeting solvency requirements.

Table 10 Policy/regulatory measures necessary to meet solvency requirements for DB pension schemes

| Country | Flexibility in regulatory criteria | Longer recovery periods | Introducing Risk sharing solutions | Introducing Reduction of benefits | Introducing Guarantee schemes |
|------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------|
| Australia | Yes | Yes | Yes | Yes | No |
| Austria | No | No | No | No | No |
| Belgium | Yes | No | No | No | No |
| Canada | Yes ^{a)} in some provinces | Yes ^{b)} in some provinces | Yes ^{c)} in some provinces | Yes ^{d)} in some provinces | No |
| Mauritius | Yes | Yes | Yes | No | N/A |
| Portugal ^{e)} | Yes | Yes | No | No | No |
| South Africa | Yes | No | No | No | No |
| Switzerland | Yes | No | Already in place | Already in place | N/A |

a) Alberta, British Columbia, New Brunswick, Saskatchewan

b) Alberta, New Brunswick, Ontario, Saskatchewan

c) New Brunswick, Saskatchewan

d) New Brunswick, Saskatchewan

e) Portuguese supervisor noted that the answer to this question is highly dependent on the design and features of the pension plans and the system itself, namely the applicable solvency model, role played by the sponsor, etc.

Source: IOPS.

The Australian Prudential Regulation Authority (APRA) commented that introducing or maintaining flexibility in satisfying regulatory criteria for solvency is necessary, as there can be times when the financial position of a fund can become unsatisfactory simply because of short-term negative fluctuations in investment markets and will then revert to a satisfactory financial position after market

corrections. Australia recently introduced the concept of a ‘Shortfall Limit’ to allow flexibility for DB plans suffering unsatisfactory financial positions owing to short-term negative fluctuations. The Shortfall Limit is set by the trustee for each DB fund and is set as being equal to the extent to which the trustee considers that a fund can be in an unsatisfactory financial position and still be reasonably expected to return to a satisfactory financial position within one year after corrections to temporary negative market fluctuations. While the trustee will be required to implement the recovery plan if the fund is found to be in an unsatisfactory financial position while conducting the initial or regular actuarial investigation, they will only be required to implement the recovery plan in between actuarial valuations if the fund is found to have breached the Shortfall Limit.

The Financial Services Commission of Mauritius noted that flexibility may be given to those schemes that are able to comply with most of the solvency requirements as per the law but with a slightly lower solvency ratio than expected. This is subject to the condition that the scheme provides a contingency plan that details the actions to be taken to restore the solvency level to what is required by law.

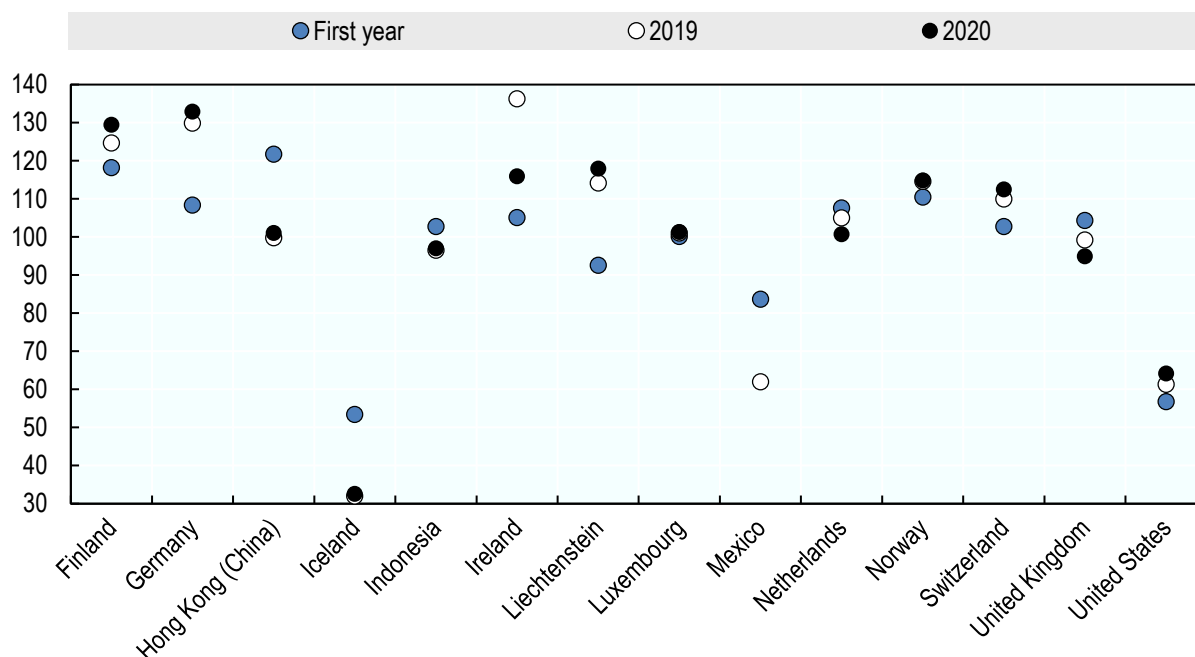
The Occupational Pension Supervisory Commission of Switzerland also agreed on introducing or maintaining flexibility in satisfying regulatory criteria for solvency as each pension fund has individual characteristics.

3.4. Supervisory approaches to deal with COVID-19

After the outbreak of the COVID-19 pandemic, many jurisdictions have carefully monitored the impact of current market conditions on funding ratios. The crisis has worsened the funding positions of defined benefit pension schemes owing to the reduced value of pension investments and increased value of pension liabilities. It has also reduced the ability of some employers and employees to continue paying their pension contributions and, where relevant, weakened employers’ covenants. Finally, it gave room for potential disruption of operational activities amongst employers and pension providers, given the need to substantially move to working remotely.

Even though IOPS has yet to fully analyse the impact of the COVID-19 pandemic on pension schemes, some early evidence implied more worrisome levels of underfunding than before. Even the Dutch pension plans, previously among the best funded in the world, fell from a 105% funding rate in the aggregate prior to the COVID-19 shock, to below 70% (Mitchell, 2020). As OECD (2021) asserts, however, “the recovery of financial markets after Q1 2020 supported the improvement of the funding ratios during the rest of 2020, with assets increasing faster than liabilities at the end in most of the jurisdictions covered in the cited study (see Figure 1).

Figure 1 Funding ratio of DB plans in selected jurisdictions, 2010 (or first year available), 2019 and 2020 (in per cent)



Source: OECD Global Pension Statistics 2021 (Figure 1.20, page 41, <https://www.oecd.org/pensions/private-pensions/pensionmarketsinfocus.htm>).

Pension supervisors supported operations and business continuity of pension DB and DC arrangements by reducing some regulatory constraints and providing relief from certain requirements for trustees, employers, or providers to allow them to continue their priority operational activities. Such measures included, amongst others,

- allowing more flexible deadlines or postponement of submissions of statutory returns, certified financial and accounting statements, actuarial reports and annual statements, and simplification of procedures (e.g., accepting submission of documents with only one electronic signature)
- applying more flexible approaches in respect of breaches of administrative and legal requirements (e.g., reporting requirements, payment of contributions by employers) by extending reporting deadlines and allowing more time to pay contributions without triggering enforcement actions or allowing self-correction actions within a certain time for non-payment.

Specifically, for defined benefit schemes, pension supervisors also introduced transitional measures such as, for example, valuation of technical provisions, minimum reserve requirements, extended deadlines for submission of recovery plans, temporary relief or moratorium on solvency payment requirements, the possibility for suspension of value transfers for a particular period in case of the risk members could be victims of scams or unsound advice.

At the same time, supervisors required that supervised entities continue to strictly comply with the regulations beyond these temporary/exceptional measures, and ensure their business continuity and provision of services, and report to the supervisory authority on contingency plans and other measures taken to ensure business continuity, proper functioning of IT systems, new work procedures and systems adapted to the new circumstances. Pension schemes were also expected to be ready to assess the impact

on their operations owing to the Covid-19 pandemic and communicate in a timely manner with pension funds/scheme members on any significant changes to their services and communication⁴⁰.

In Canada, the Office of the Superintendent of Financial Institutions (OSFI) announced a freeze on portability transfers and annuity purchases relating to federally regulated DB plans to protect the benefits of plan members and beneficiaries at a time when the funding status is suffering from developments in financial markets. The OSFI only accepted a transfer or an annuity purchase on a case-by-case basis under exceptional circumstances. OSFI also introduced flexibility in the supervision of pension plans such as:

- Immediate, temporary relief to sponsors of federally regulated DB plans in the form of a moratorium, through the remainder of 2020, on solvency payment requirements for defined benefit plans;
- A three-month extension for annual reporting on federally regulated private pension plans. This deadline extension applied in particular to the filing of annual information returns, certified financial statements, actuarial reports, and annual statements.

In addition, a variety of temporary easing measures were introduced at the level of provinces in Canada. Alberta permitted a temporary suspension of unfunded liability and solvency deficiency payments (“special payments”) until the end of 2020 for DB plans, upon approval by the Alberta Superintendent of an application for such relief.⁴¹ This relief resulted in a suspension of a portion of the required contribution, thereby allowing employers to retain and reallocate those amounts during the suspension period. By the same token, British Columbia allowed DB plans to consider extending the amortisation periods for unfunded liabilities and/or solvency deficiencies.⁴²

Alberta also adopted a measure allowing DB plans to use more amount of their funding excess to reduce or eliminate current service contributions. Under this relief, the use of accessible excess was temporarily increased from 20 to 40 per cent for a single fiscal year of the plan. Meanwhile, in Quebec, DB plans were requested to update a degree of solvency for their payments (transfer and refunds) to ensure that the outflows of the plan's assets can be adequately determined given the solvency status of the plans.⁴³

Germany and the United Kingdom extended the deadline for submission of recovery plans for underfunded pension plans (OECD 2021b: 40). In normal circumstances, German pension funds were required to submit a recovery plan within three months after the beginning of a funding shortfall, but given the outbreak, BaFin accepted recovery plans to be submitted by 1 October 2020.

In Finland (non-IOPS member), the Financial Supervisory Authority extended the deadline for pension insurance institutions to start implementing recovery plans when their solvency capital fell below the required level (OECD 2021b: 40).

⁴⁰ For more details see IOPS statement on pension supervisory actions to mitigate the consequences of the Covid-19 crisis (IOPS, 2020), as well as examples of various supervisory measures listed on: <http://www.iopsweb.org/iopsmembersmeasurestakentoaddressthecovid-19crisis.htm>

⁴¹ <https://open.alberta.ca/dataset/43f3c7e1-c31f-4a69-afe1-44c772a91b09/resource/17f60fa8-34f3-4a90-8f7c-7a017fed762e/download/eppa-update-20-04.pdf>

⁴² <https://www.bcfsc.ca/media/1338/download>

⁴³ <https://www.retraitequebec.gouv.qc.ca/en/actualites/2020/Pages/20200416.aspx>

In Ireland, the Pensions Authority issued guidance on a number of issues that should be taken into account specifically by DB schemes, including:

- the effect of any suspension on the ability of the scheme to meet its benefit obligations
- the contributions required under a funding proposal
- whether ongoing contributions are necessary to meet current pension payments
- whether a suspension of contributions would unfairly affect a particular class of members.

In the Netherlands, the Ministry of Social Affairs extended to 2021 the reduction of the minimum required pension ratio for pension funds (from 100% to 90% for 2019/20) to prevent pension cuts. This adjustment of the supervision regime related only to the funds that are planning to move existing pension rights to the new contract (OECD, 2021b: 40 and IPE 2020⁴⁴).

The Pensions Regulator in the United Kingdom announced in March 2020 that it would refrain, from taking regulatory actions in case sponsors of DB plans stopped or reduced deficit repair contributions (DRC) according to the recovery plans; this grace period lasted three months (OECD, 2021b: 40).

Along with increased flexibility, supervisors have also strengthened their monitoring process. In the DB context, the Danish Financial Supervisory Authority (FSA) expected pension companies to report the solvency coverage and conduct a simplified stress test every week from 18 March 2020 (inclusive) until further notice. The Insurance and Pension Funds Supervisory Authority (ASF) of Portugal established an extraordinary reporting process to collect information on the financial, liquidity, and solvency position of pension funds. The ASF was also requesting some quantitative and qualitative indicators related to market conduct.⁴⁵

4. Other supervisory measures to manage solvency positions

Besides the policy and regulatory measures discussed in sections 3.2 and 3.3, there are other possible measures aimed at managing solvency positions that can be used by the supervisors or the pension funds. In this section, three viable solutions are presented; most of them are applied by some of the responding supervisors. These supervisory measures could be considered as good practices to manage solvency.

4.1. Asset-liability management

The unexpected volatility after a rapid change in interest rates or decline of stock markets is one of the main reasons for the failure to comply with the regulatory solvency criteria. Asset-liability management (ALM) is one of the efficient tools that could be used to reduce the impact of financial market volatility, including interest rate fluctuations. The objective of ALM is to maintain a match between the assets prone to investment risk and pension liabilities.

Supervisors may encourage pension funds who apply market-based discount rates to use asset-liability matching techniques in order to reduce, if deemed too excessive, the volatility of their funding ratios. Instead of using risk-free interest rates, pension funds can add a liquidity premium (which is one

⁴⁴ PE, 29 September 2020, <https://www.ipe.com/news/dutch-minister-to-prevent-unnecessary-pension-cuts/10048108.article>

⁴⁵ <http://www.oecd.org/coronavirus/policy-responses/retirement-savings-in-the-time-of-covid-19-b9740518/>

of important characteristics of pension liability) of the invested asset portfolio. This is a similar concept to the matching adjustments proposed under the Solvency II directive for EU insurers.⁴⁶ By using this method, the more a fund matches its assets and liabilities, the less volatile they become as both assets and liabilities will move similarly in response to the short-term interest rate movements.

In Belgium, in the context of the risk-management process, the FSMA expects that the SIP (Statement of Investment Principles) mentions whether an ALM study and/or any other tests have been or are to be conducted in order to develop the IORP's investment policy. In addition, the FSMA expects IORPs to conduct an ALM study every 3 years at the time of the review of the SIP. This review should be done at the same time as the review of the financing plan. The same test can be used for both the asset allocation (ALM) and the buffer (Continuity test), with the first testing the level of assets to determine the most appropriate asset allocation, and the second, the ABO to determine the necessary buffer for negative deviations.

4.2. Funding buffer

Another way to manage solvency would be to set up a “funding buffer” to sustain financial stability in cases of massive losses. This buffer would provide for an additional level of funding on top of existing funding requirements.

In Belgium, the IORP needs to justify the methods and bases it uses for calculating the technical provisions, which must be of such a nature that they guarantee the sustainability of its commitments. This means that, depending on the level of the discount rate and hence the level of risk included in that rate, a buffer must be included in the Long-Term Technical Provisions to compensate for the negative deviations. This buffer is based on a stochastic continuity test.

Canada recently decided to introduce a Provisions for Adverse Deviations (PfADs), a new explicit margin to be applied when determining minimum contributions to both going concern liabilities and normal costs.⁴⁷ A plan could be required to be funded to a level that is greater than the sum of the PfAD plus the plan's liabilities calculated using best-estimate assumptions before allowing the plan any action (such as reduction of contributions, increase of benefits, withdraw of surplus, etc.) that could weaken its funded position. The focus would be on measuring and reporting the security of all vested benefits that would be payable upon a “worst case” scenario of the plan's wind-up. A PfAD should be based on the main risk that most DB pension plans are exposed to but cannot control, such as interest rate risk. To properly absorb the risk a PfAD should become larger as the main risk increases and smaller as the main risk decreases.

In Ireland, DB pension schemes are required to hold a funding standard reserve over and above the technical provisions, which is aimed at ensuring Irish schemes hold enough assets to cover their funding standard liabilities even in times of market volatility. A pension scheme's Funding Standard Reserve is calculated as the aggregate of:

- 10% of Funding Standard Liabilities (technical provisions) less EU sovereign bonds, other bonds defined under the Occupational Pension Schemes (Funding Standard Reserve) Regulations, 2013, [S.I. No. 175 of 2013] and cash deposits held by the scheme, and

⁴⁶ <https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii-technical-information/risk-free-interest-rate-term-structures>

⁴⁷ <https://www2.gov.bc.ca/assets/gov/employment-business-and-economic-development/solvency-funding-consultation/bc-solvency-funding-review-report.pdf>

- the increase in Funding Standard Liabilities (technical provisions), if the interest rate assumption is 0.5 percentage point less than that assumed for the purposes of calculating the Funding Standard Liabilities, less the amount by which the assets of the scheme would increase at the same date as a result of the same change in interest rate(s).

Some form of a funding buffer can help to improve benefit security by increasing the assets accumulated in a pension plan, mitigating the risk associated with benefit reductions on plan wind-up owing to employer insolvency and to protect plan members against the risks to the plan associated with investment strategy, interest rate changes, and decisions to increase benefits.

4.3. Risk monitoring

Supervisors could use various techniques to monitor risks that affect the solvency position of DB pension funds. In many jurisdictions, supervisors apply risk-based supervision - a structured approach which focuses on the identification of potential risks faced by pension plans or funds and the assessment of the financial and operational factors in place to minimize and mitigate those risks. This process allows the supervisory authority to direct its resources towards the issues and entities which pose the greatest threat⁴⁸.

In Belgium, the Financial Services and Markets Authority (FSMA) uses various measures to monitor the sustainability of a pension fund (IORP):

- *Risk model* based on four axes:
 1. Financial risks: identification of potential problems on the basis of a technical analysis of the annual accounts of the IORP and of the sponsor support
 2. Assets risks: assessment of the impact of moderate shocks on the financial markets on the assets (e.g., equity, interest rate, currency)
 3. Actuarial risks: assessment of the prudent nature of the financing plan (e.g., assumptions, financing method, continuity test)
 4. Governance risks: assessment of the level to which an IORP meets FSMA's governance expectations (e.g., internal audit, compliance, data collection).
- *The advice of the person responsible for the actuarial function*: each year, the person responsible for the actuarial function has to give an opinion about the annual reporting, the assumptions and methodologies used for the calculation of technical provisions, and the sustainability of the fund. Occasionally, he or she must also give an opinion on the financing plan (for a new plan or for all modifications of the plan).
- *The continuity test*: the IORPs should undertake a continuity test to determine the assumptions and methods for the calculation of technical provisions. The FSMA recommends that IORPs repeat this study every three years to justify the sustainability of the plans, and to justify that assumptions and methods are in line with the risk and return of the IORP.

In the view of the Belgium supervisor, the level of technical provisions (which is not only the result of the discount rate) should be consistent with both the liabilities and asset sides of the balance sheet. Therefore, the FSMA imposes a continuity test that analyses the level of

⁴⁸ The *IOPS Toolkit for Risk-based Supervision* provides practical guidance and includes comprehensive case studies to illustrate how supervisors have dealt with the challenges inherent in implementing the concepts and techniques of risk-based supervision, <http://www.iopsweb.org/rbstoolkit/#d.en.408992>

technical provisions in different market scenarios, considering the actual asset allocation. Such pension funds are not forced to invest in risk-free assets, but in fact may consider the most appropriate asset allocation depending on the liability profile and the strength of the sponsor.

Box 1 Methods on continuity test performed in Belgium

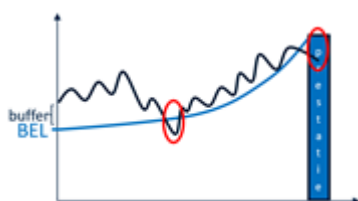
The long-term technical provisions are based on a number of parameters:

- vested benefits at the date of calculation
- prudently estimated parameters (i.e., return, mortality, etc.)
- actuarial method: unit credit method / ABO
- unconditional rights such as indexation, advantageous prepayment, etc.

Given the volatility of the calculation parameters, a buffer/margin should be included in the long-term provisions (LTP) in order to limit the probability that the IORP will not be able to meet its future obligations.

This buffer is based on a stochastic continuity test. Two tests are mainly used in Belgium:

- 1) The VaR test, which answers the question “What is the probability that a certain level of provision is no longer financed at/over a certain period (the duration)?”



- 2) The ruin test, which answers the question “What is the likelihood that all vested benefits will be paid out with a high probability over complete run-off?”



Certain conditions have to be met to run a continuity test:

- Risk limit and solvency condition: the IORP should choose the solvency condition and the risk limit in such a way that the pension rights of members are sufficiently protected
- Run-off scenario based on a closed population, without building up future benefits, without taking into account future contributions
- Starting point assets = technical provisions = Best Estimate Liability + buffer
 - ➔ the buffer is defined via an iterative method in such a way as to comply with the a priori established risk limit.

An IORP can also combine the two tests to define the buffer:

- Ruin test to protect the payment of the vested benefits::
 - ✓ Solvency criteria = payment of vested benefits
 - ✓ Projection horizon = complete run-off
- Run-off VaR Test to protect the short term level::
 - ✓ Solvency criteria = short-term level
 - ✓ Projection horizon = 3 years
 - ✓ Very strict risk limit because the short-term level must be financed at all times

In both tests, at least the assets should be modelled stochastically to examine more than a thousand scenarios to obtain stable probabilities. In light of the complexity and size of the activities, other parameters (inflation, mortality, etc.) could also be stochastically projected.

Source: Financial Services and Markets Authority (FSMA), Belgium.

In addition, a stress test can be an important tool to complement funding ratio requirements. A funding ratio measures the current funding situation and, thus, might not provide a reliable solvency estimate needed to withstand adverse conditions. Stress tests overcome this weakness by calculating the funding ratio under prescribed stress scenarios. For this reason, EIOPA conducts stress tests every other year to assess the resilience of IORPs and their pension schemes to adverse market scenarios and a longevity scenario.⁴⁹ Similar to the approach used in the banking and insurance sectors, the stress testing results could be used as part of risk-based supervision, concentrating supervisory resources on the pension plans with poorer results.

The Financial Market Authority of Austria conducts stress tests with several assumptions. One assumption influences the investment result; another refers to the termination of a pension company's contract. There is also an assumption reducing the contributions paid by employers. The Austrian Stress Test provides various calculations of the financial situation of a pension fund, making it easy to detect sensitivities and vulnerabilities of pension funds. The stress test could be used to apply necessary measures under supervisory law.

The Austrian Stress Test reveals the impact of a crisis on the financial markets on members and beneficiaries (cut of pension), on pension companies (guarantee payments), and on the employer (compensation for deficiencies in case of DB-plans). Pension funds calculate the results based on given shock-scenarios. The FMA defined both single- and multi-factor shock-scenarios to consider several influencing variables. The ST combines capital market- and pension liability-shocks (only for multi-employer-pension companies). For a five-year period, the pension funds have to complete an Excel-file based on their own assumptions (Basis scenario) and based on the prescribed scenarios (Overall-shock).

5. Conclusions

The purpose of this paper was to review supervisory approaches to supervise solvency of DB occupational pension schemes in different IOPS jurisdictions and develop recommendations for best practices related to the funding of DB plans under the current environment.

Given that employers are mostly responsible for the funding of deficits and that most jurisdictions do not have a backstop in the event that the employer goes bankrupt, it is critical that solvency be close supervised, particularly in the current environment.

The report has identified the following good practices which complement the related IOPS and WPPP principles⁵⁰ and could help manage or improve the solvency positions of occupational DB pension schemes:

- Encouraging pension funds to use asset-liability management to reduce unexpected volatility caused by, amongst the other factors, a rapid change in interest rates. Even though this action may not necessarily improve funding, it may prevent its further deterioration. Pension funds may also need to consider the merits of applying valuation rules to help reduce volatility resulting from interest rate movements, as applicable to their individual circumstances.

⁴⁹ See EIOPA (2019) for more detailed information.

⁵⁰ IOPS Principles of Private Pension Supervision (<http://www.iopsweb.org/principlesguidelines/IOPS-principles-private-pension-supervision.pdf>), OECD Core Principles of Private Pension Regulation (<https://www.oecd.org/finance/principles-private-pension-regulation.htm>)

- Encouraging or stipulating that pension funds set up a “funding buffer”, which could be used to sustain financial stability in case of unexpected losses.
- Encouraging or stipulating that pension funds use various techniques to monitor risks affecting their solvency position, such as risk modelling (including the continuity test) or stress testing. Risk modelling should induce pension funds to adopt the most appropriate, i.e., not necessarily the most conservative, asset allocation, depending on the liability profile and the strength of the sponsor.

The valuation of pension assets and liabilities is the starting point to supervise solvency of DB pension funds, as it gives the basic information on whether the pension fund has enough assets to make the future pay-outs. The use of approaches to calculate pension obligations (PBO, ABO, and VBO) varies in the responding 12 jurisdictions. Most of the surveyed jurisdictions use mortality tables with an adjustment to include recent improvements in life expectancy.

A discount rate is one of the most important factors⁵¹ in estimating a pension plan’s liabilities, as it is used in converting projected future benefits into present value. In many jurisdictions, pension funds mostly use the assumed-return approach, which uses a discount rate based on a long-term assumed average rate of return on the pension plan’s assets. Also, this paper finds that amongst the reviewed IOPS jurisdictions, a single discount rate is used more commonly than a yield curve.

Most jurisdictions relied on a ‘funding ratio’ as a regulatory criterion to supervise solvency of DB pension funds. However, even with the same ratio being applied, its implications may vary across countries owing to the differences in assumptions and methodologies used to calculate assets and liabilities. Also, a pension arrangement where benefits are fully guaranteed and one in which benefits can be adjusted should not necessarily be subject to the same solvency rules.

IOPS jurisdictions reported that they set recovery periods as a policy/regulatory measure to supervise solvency of DB pension schemes. Seven of the 10 jurisdictions that responded to the question allow a reduction of benefits, and six allow risk sharing solutions. One jurisdiction created a guarantee scheme.

The vast majority of responding jurisdictions agreed on the policy of flexibility when satisfying regulatory criteria for solvency. Half of them suggest that longer recovery periods are necessary for meeting solvency requirements, and three agreed on introducing risk sharing solutions. Two jurisdictions supported the idea of introducing legislation that would allow for reduction of benefits. No jurisdiction identified the introduction of guarantee schemes as necessary for meeting solvency requirements.

⁵¹ In some cases, the mortality rates may have even more impact than the discount rate (e.g., in closed, highly mature pension funds).

Related publications

- Actuarial Association of Europe (2001), Actuarial Methods and Assumptions used in the Valuation of Retirement Benefits in the EU and other European countries, https://actuary.eu/documents/actuarial_methods.pdf
- Rob Bauer, Roy P. M. M. Hoevenaars, and Tom Steenkamp (2006), Asset Liability Management, The Oxford Handbook of Pensions and Retirement Income
- British Columbia, Canada (2018), A Review of the Solvency Funding Framework under the Pension Benefits Standards Act: A Consultation Paper, <https://www2.gov.bc.ca/assets/gov/employment-business-and-economic-development/solvency-funding-consultation/bc-solvency-funding-review-consultation-paper.pdf>
- EIOPA (2019), 2019 Institutions for Occupational Retirement Provision (IORPs) Stress Test Report, https://www.eiopa.europa.eu/sites/default/files/financial_stability/insurance_stress_test/eiopa_2019_iorp_stress_test_report.pdf
- GAO (2014), Pension Plan Valuation - Views on Using Multiple Measures to Offer a More Complete Financial Picture, <https://www.gao.gov/products/GAO-14-264>
- IMF (2011), Stress Tests for Defined Benefit Pension Plans – A Primer, G. Impavido, IMF Working paper (WP/11/29)
- IOPS (2020), IOPS statement on pension supervisory actions to mitigate the consequences of the Covid-19 crisis, 26 May 2020, <http://www.iopsweb.org/IOPS-statement-on-pension-supervisory-actions-Covid-19-crisis.pdf>
- IOPS (2019), Are pension funds a stabilising factor in financial markets? Evidence from four countries, IOPS Working Paper No. 31, <http://www.iopsweb.org/WP-31-Are-pension-funds-a-stabilising-factor-in-financial-markets.pdf>
- Olivia Mitchell (2020), Building Better Retirement Systems in the Wake of the Global Pandemic, NBER Working Paper No. 27261, <https://www.nber.org/papers/w27261>
- Alicia H. Munnell, Jean-Pierre Aubry, and Mark Cafarelli (2014), The funding of state and local pensions: 2013-2017, http://crr.bc.edu/wp-content/uploads/2014/06/slp_39.pdf
- OECD (2021a), Pensions at a Glance 2021, <https://www.oecd.org/publications/oecd-pensions-at-a-glance-19991363.htm>
- OECD (2021b), Pension Markets in Focus 2021, <https://www.oecd.org/daf/fin/private-pensions/Pension-Markets-in-Focus-2021.pdf>