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Principles and Methodology of Solvency Valuation of Pension Funds

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PRINCIPLES AND METHODOLOGY OF SOLVENCY VALUATION OF PENSION FUNDS

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Solvency Valuation as Universal Minimum Funding Standard

Security of retirement benefits is of paramount concern for all countries. While each country has its own detailed rules on pension plan solvency, all such rules converge in a common direction. We will briefly describe these international rules and review the situation in Egypt.

United Kingdom

The Pensions Act of July 1995 introduced rules on minimum solvency requirements for all defined benefit plans. Under these rules, assets of a pension plan should be sufficient to meet its obligations. Specifically, all pension plans are required to perform a solvency valuation at least once every three years. Pension plans with less assets than the solvency liability are required to reach 100 per cent solvency level within five years.

Canada

In the Pension Benefits Act of Ontario of 1986, and revised as of 1990, all defined benefit plans are required to perform a solvency valuation at least once every three years. Plans with a solvency deficiency (i.e. plan assets less than the solvency liability) are required to fund for such deficiency over five years. Lump sum payments from underfunded plans are severely restricted.

United States

The solvency concept has been implicitly included in the current liability calculations since the 1990's. The Pension Protection Act of August 2006 set minimum funding standards based on a "funding target" (which is calculated under the solvency methodology). Assets are compared to the funding target. Underfunded plans must amortize such deficiency in seven years. Accelerated pension distributions, including lump sum distributions, from underfunded plans are severely restricted reflective of the degree of underfunding of the plans.

Situation in Egypt

The majority of private pension funds in Egypt are defined benefit plans with lump sum distributions on retirement, termination, death, or disability. Most of these plans are funded by participant contributions only. These plans are intended to provide a defined benefit upon retirement based on the pay of the participant just before retirement. In a sense, the retirement benefits are purchased by the participants using their own money. The security of these retirement benefits is of paramount concern for the Government, EISA, and all pension professionals.

An analysis of a random sample of pension funds in 2003 revealed that a sizeable portion of these plans were underfunded on a solvency basis, but were showing a surplus on an ongoing funding basis. High benefits were paid to retiring executives even though the fund would show a solvency deficiency if a solvency valuation were performed. We are not sure how the funded situation has changed since 2003. An update of the survey is critically important for the nation.

We understand that most pension funds currently do not have a solvency valuation. Only an on-going plan valuation is performed for each fund. For some pension funds, the on-going plan valuation is manipulated to artificially show a surplus. This has led to severe underfunding of these plans coupled with excessive distributions to senior executives, with detrimental effect on the benefit security of the rank and file.

Such abuses must be stopped. Solvency valuation in accordance with international standards must be introduced. Solvency rules must be strictly enforced.

This paper explains the principles and methodology of the solvency valuation, and discusses the required funding and benefit restrictions of a pension fund with a solvency deficiency.

Solvency Concept

It is imperative that all private pension funds be solvent. To be solvent means that:

The assets of the pension fund equal or exceed the liabilities of the fund determined on a market basis.

In order to guarantee solvency of private pension funds, pension plan assets determined on a solvency basis (called **solvency assets**) and **solvency liabilities** must be defined in a manner that is:

- **Clear and easy to understand and calculate**
- **Not subject to maneuver**

Solvency assets must be calculated on a market basis. Book values are not acceptable. Trading assets should be based on market trading values. Non-trading assets should be based on discounted cash-flow using market yields. Real estate should be based on market appraisals.

Solvency liabilities are calculated for each participant of the pension fund as the present value of benefit earned by the participant to-date, based on current pay and current service. Because the benefit earned only reflects current pay and service, a definite amount is determined. This benefit is payable upon retirement. The present value of this benefit is calculated by discounting it from retirement to current age by an interest rate prescribed each month by EISA. This present value of benefit is called the solvency liability for the participant. Since the interest rate is uniformly prescribed for all pension funds, the solvency liability thus determined is not subject to any maneuver. The solvency liabilities of a pension fund are the sum of the solvency liabilities for the individual fund participants.

The interest rate prescribed by EISA to discount retirement benefits is of critical importance in the calculation of solvency liabilities, and must be chosen carefully. In principle, the interest rate should reflect the long term investment return which is achievable under the economic climate on the date that the interest rate is determined. Theoretically, the solvency liabilities thus determined represent the price for which an insurance contract can be bought to cover the pension obligations of the pension fund. The solvency liabilities thus determined is considered to be determined on a market basis. A proxy for the long term investment return used in Canada is the average yield of Canadian government bonds with a maturity date longer than ten years. This proxy interest rate is used for the first fifteen years of discount. 6% interest rate is used for discounts beyond the first fifteen years..

The solvency assets should then be compared to the solvency liabilities. The ratio of solvency assets to solvency liabilities is called the **funded ratio**. To guarantee security of the retirement benefits, the funded ratio should not be allowed to drop below 100%. Ideally, pension plans should target for a funded ratio higher than 100% in order to provide for possible market fluctuations.

Some actuaries are inclined to ignore the solvency concept described above, and take comfort in the current laws which are interpreted as allowing pension funds to reduce benefits or increase future contributions when there are not enough assets to

cover the liabilities. An important improvement to the current laws is that the draft laws only allow reduction of future benefit accruals. If the solvency rules are ignored, and no corrective measures are taken on insolvent plans, there is no protection for the retirement benefits for the future retirees of the pension fund. Allowing the funds to pay high benefits to a retiring executive and thereafter reducing the accrued benefits of the rank and file is tantamount to robbing the poor to pay the rich. This completely defeats the purpose of a pension fund. We are not aware of other countries allowing such practices.

How solvency valuation improves the funded position of a pension fund?

The solvency liability produced in a solvency valuation serves as an indisputable yardstick of the amount of assets required to cover all the pension obligations of the pension fund. A pension plan with solvency deficiency must improve its funded position.

The key factors affecting the funded position of a pension plan are its **income** and its **outgo**. A pension plan with solvency deficiency must increase its income by more contributions, and decrease its outgo by more restrained distributions. We shall discuss these in the following paragraphs.

Method to increase income of a pension fund

A pension plan with solvency deficiency is required to amortize such deficiency in no more than five years.

Each year, the minimum required contribution for the plan is equal to the normal cost plus the solvency payment. The normal cost is the present value of the pension benefits expected to be earned by the participants during the coming year calculated on a solvency basis.

Plans are encouraged to contribute more than the minimum required contribution. Contributions in excess of the minimum required contributions are accumulated as credit balance of the plans, which may be used in future years to pay towards the minimum required contributions.

Method to decrease outgo of a pension fund

Pension plans with a funded ratio less than 100% are only allowed to provide lump sum distributions up to the level of the funded ratio. Additional distributions are allowed only if matched by additional contributions into the pension plan. These additional contributions are not recognized in the calculation of the credit balance.

Pension plans with a funded ratio less than 80% are not allowed to amend the plan to improve the rate of benefit accruals of the plan. Plans with a funded ratio less than 60% are not allowed to provide any future benefit accrual. These restrictions are removed after the plan actuary can certify that the plan is able to reach the required funded ratio after the pension benefit improvements.

Principles of Solvency Valuation

The basic solvency requirement of a pension fund is:

On the date of the solvency valuation, market assets must equal or exceed the liabilities determined on a market basis.

To put it in another way: If the pension fund was terminated on the valuation date, there would be enough assets to pay the full benefit entitlement to all fund participants.

Ongoing Valuation

A pension plan may perform an ongoing valuation to assess the long term financial obligation of the plan sponsor of a pension fund. Under the ongoing valuation, the retirement benefit of each participant is projected to his retirement date, and then discounted back to the valuation date. This projected total fund obligation is offset by the present value of future contributions to produce the ongoing valuation liability. All such projections are performed using actuarial assumptions recommended by the actuary. **The actuary should ensure that the assumptions used are realistic to produce reasonable cost and liabilities.** If wrong actuarial assumptions are used, the value of future contributions may be exaggerated, resulting in grossly understated ongoing valuation liabilities and cost.

Solvency Valuation

The solvency valuation, on the other hand, assumes that the pension fund is terminated as of the valuation date. Thus the solvency valuation puts a market value on all assets and liabilities. Nothing is projected. The asset is valued according to the market trading value of each asset item. The retirement benefit for each participant is calculated based on the participant's pay and service on the date of the solvency valuation. This retirement benefit is discounted back to the date of the solvency date using an interest rate prescribed by EISA. No actuarial assumptions such as salary increases, mortality, disability, or termination are used in the calculation. As such, the solvency methodology is easy to understand and apply, and not subject to individual manipulation. The solvency valuation is intended to provide a clear and indisputable yardstick on the amount of assets required to cover all pension obligations. The method also introduces logical and effective remedy to a drastic situation where there is a solvency deficiency. The following table provides a brief comparison of the two valuation methods

	Ongoing Valuation	Solvency Valuation
Assets	Averaging allowed	Strictly market
Actuarial Method	Much flexibility	Accrued benefit method
Benefits	Projected to retirement	Benefit to-date
Interest Rate	Expected future return	Market long-term rate
Cost Shown	Average cost recognizing future contributions	Cost to-date, no recognition of future contributions

Solvency Assets

Because of the very nature of solvency valuations, all assets and liabilities are determined on the assumption that the plan is terminated on the date of the solvency valuation. As such, all assets are determined on a market basis. Book values are not allowed.

Solvency Liabilities

In a solvency valuation, the liability is calculated for each participant as the present value of the retirement benefit earned to-date. The retirement benefit is calculated using the pay and service of the participant on the valuation date. The present value is obtained by discounting the value of the benefit payable at retirement of the participant to the valuation date by a specified interest rate. The interest rate used in the discounting process is prescribed by EISA, reflecting the expected long-term investment return of the market.

The solvency liability for the pension fund is equal to the sum of the solvency liabilities for the individual fund participants.

Each calculation is rigidly defined, so that different professionals will get the same results for the same plan. In this way, the solvency valuation is not subject to individual interpretation.

The funded status of the plan is calculated by comparing solvency assets to solvency liabilities.

The detailed methodology is shown in the following pages.

Solvency Valuation Methodology

The purpose of a solvency valuation is to determine the funded status of the pension plan. Based on the results of the solvency valuation, the minimum required contribution can be uniquely determined. The solvency valuation process involves:

- The determination of the solvency liability of the pension plan
- The determination of the solvency assets of the pension plan
- The determination of the funded ratio of the pension plan
- The determination of the normal cost of the pension plan

Determination of the Solvency Liability

The solvency liability of a pension plan is the sum of the solvency liabilities of all individual participants of the plan. The determination of the solvency liability for each participant involves the following stages:

1. Determination of the accrued benefit (AB) of the fund participant, based on
 - a. Plan provisions
 - b. Participant pay and service to-date
2. Determination of the present value factor (PVF), based on
 - a. Years of deferment
 - b. Market interest rate as prescribed by EISA
3. Determination of the solvency liability:

$$\text{Solvency liability} = \text{AB} \times \text{PVF}$$

The solvency liability is set such that it is greater than the participant's contributions plus interest.

1. Determination of the accrued benefit (AB)

In order to determine the accrued benefit for the fund participant, we must examine the plan provisions, and the fund participant statistics. This information is provided by the plan sponsor for the actuarial valuation.

Plan provisions specify (1) the amount of lump sum benefit payable to the participant on his retirement (B) based on pay and service before the valuation date, (2) the amount of lump sum benefit payable to the participant on account of his contributions (CB) based on pay, service and contributions before the valuation date, (3) the required age and service for unreduced retirement benefits (ura), and (4) the interest credit for participant contributions. The interest credit provided to participant contributions is not allowed to exceed the expected long-term investment returns of the assets of the pension plan.

Participant statistics provide information on (5) the age when the participant joins the fund (ea), (6) the current benefit service (bs), (7) the age the participant starts contributing into the plan (ca), (8) the number of years when the participant contributed

to the plan (cs), (9) the current age of the participant (aa), and (10) the accumulated contribution plus interest to-date (CI).

The accrued benefit (AB) and accrued benefit due to the participant's contributions (CAB) are determined by prorating the current service over the total service from the age when the participant joined the plan to the date for unreduced retirement benefits. These accrued benefits are payable on the date when the participant is eligible for unreduced retirement benefits, and are determined as follows:

$$\mathbf{AB = B \times bs / (ura - ea)}$$

$$\mathbf{CAB = CB \times cs / (ura - ca)}$$

2. Determination of the present value factor (PVF)

Because the benefit is not payable until the date for unreduced retirement benefits, there is an interest discount during the years of deferment ($dy = ura - aa$). In order to determine the interest discount, we must first determine the interest rate assumptions. In principle, the interest rate must reflect market situation in the near term and the expected long term investment yields. Since the market situation changes continuously, the near term interest rate changes every month. For uniformity, this interest rate should be prescribed by EISA. The expected long term investment yield should be stable and would not change. To reflect this difference, there should be two segments of interest rates: a short to median term rate operating for 15 years, and an ultimate rate operating thereafter. A common index used for the interest rate i_1 for the first 15 years is the average of medium term government bond yield. After the 15 years, a stable interest rate i_2 of 5% or 6% is commonly used. No mortality decrement is assumed during the deferment period. Based on these assumptions, the present value factor (PVF) is calculated as follows:

Scenario 1: Years of deferment $dy \leq 15$

$$\mathbf{PVF = 1 / (1 + i_1)^{dy}}$$

Scenario 2: Years of deferment $dy > 15$

$$\mathbf{PVF = 1 / (1 + i_1)^{15} \times (1 + i_2)^{(dy - 15)}}$$

3. Determination of the solvency liabilities

$$\mathbf{Solvency\ liability\ for\ AB = AB \times PVF}$$

$$\mathbf{Solvency\ liability\ for\ CAB = CAB \times PVF}$$

where the solvency liability for CAB must be set to be greater than the value of the fund participant's contributions plus interest (CI).

Determination of Solvency Assets

The solvency assets must be the liquidity value of the assets of the pension plan, since these assets are expected to be able to cover all plan obligations if the pension plan were to terminate on the valuation date. Thus, solvency assets must reflect the value that these assets can be sold in the market to-date.

Trading assets, which include stocks and bonds which can be bought and sold on organized markets, are valued based on market trading values.

Non-trading assets, which include mortgages and private placements, are valued based on discounted cash-flow using the market yield.

Real estate is valued based on market appraisals.

Where appropriate, non-trading assets and real estate should be further discounted to reflect the credit risk and illiquidity risk of the assets.

Where a pension plan has a credit balance, which is explained in a later paragraph, the value of the solvency assets is reduced by the value of the credit balance. This is to reflect the fact that the credit balance will ultimately be used to pay for future contributions and hence would not be used to cover the current pension obligations.

Determination of the Funded Ratio

The funded ratio is equal to the ratio of solvency assets to the solvency liabilities. The maximum value of the ratio is equal to 100 percent.

Determination of the Normal Cost

The normal cost for a pension fund is the sum of the normal cost for the individual participants. The individual normal costs are the present values of the expected increases in the accrued benefit for the individual participants in the year following the valuation date. Specifically, the individual normal cost, as determined under a solvency basis, is equal to the expected increases in accrued benefit (IAB) and contributory accrued benefit (ICAB) times the present value factor, which is computed in the same manner as in the solvency liability calculation. To determine the increases in accrued benefits, we must first determine the new benefits NB and NCB reflective of expected pay for the year after the valuation date, as well as additional service and contributions.

$$\mathbf{IAB = NB - B.}$$

$$\mathbf{ICAB = NCB - CB.}$$

Normal cost for AB (NCAB) and normal cost for CAB (NCCAB) are determined according to the following formulas:

$$\mathbf{NCAB = IAB \times PVF}$$

$$\mathbf{NCCAB = ICAB \times PVF}$$

where NCCAB must be greater or equal to the expected employee contributions for the year.

The normal cost for the participant for the year NC equals the sum of NCAB + NCCAB

$$\mathbf{NC = NCAB + NCCAB}$$

Minimum Required Contribution

An initial solvency valuation is required for all pension funds on the first date of the fiscal year of the pension fund on or after the effective date of the solvency rules. In that valuation, the solvency liability calculated according to the rules described in the previous sections is compared to the solvency assets on the valuation date.

If solvency assets are greater than the solvency liabilities, there is no solvency deficiency. The pension fund is only required to perform an actuarial valuation once every three years, and there is no additional solvency payments required other than the normal cost. There is no restriction on benefit increase and lump sum distribution, as long as such benefit increase and lump sum distribution will not cause the pension fund to develop a solvency deficiency.

If solvency assets are less than the solvency liabilities, the plan has a solvency deficiency. The plan must perform an actuarial valuation every year. The solvency deficiency is defined by the following formula,

$$\text{Solvency deficiency } SD = \text{Solvency liability} - \text{solvency assets}$$

This solvency deficiency must be made up by solvency payments SP, which must be added to the regular contributions of the normal cost.

$$\text{Minimum solvency payment } mSP = SD / 5$$

$$\text{Maximum solvency payment } MSP = SD$$

The SP may be shared by the plan participants and the plan sponsor. The amount of SP paid by the plan sponsor is tax deductible.

Each year, the minimum required contribution **mRC** is given by the following formula:

$$mRC = NC + mSP$$

Pension plans are encouraged to contribute more than the minimum required contribution. Pension contributions up to the maximum allowable contributions is tax deductible. The maximum allowable contribution **MC** is defined according to the following formula:

$$MC = NC + MSP$$

Amount of contributions in excess of the minimum required contribution is accumulated in the pension plan as the credit balance, which may be used in future years to pay for the minimum required contribution.

The credit balance **CB** is determined each year according to the following formula:

$$\begin{aligned} \text{CB at end of year} = & \text{CB at beginning of year} + \text{actual contribution} \\ & - \text{minimum required contribution} \end{aligned}$$

Benefit Restrictions for Underfunded Plans

In each solvency valuation, a funded ratio FR of a plan, defined as the ratio of solvency assets divided by the solvency liability, is also calculated.

$$\text{Funded ratio FR} = \text{solvency assets} / \text{solvency liability}$$

Note that solvency assets = market assets – credit balance.

A pension fund is underfunded if the funded ratio is less than 1. There are two penalties imposed on each underfunded pension fund.

- (1) An underfunded pension fund may not provide full distribution of retirement and other benefits. The allowable distribution is defined by the following formula:

$$\text{Allowable distribution} = \text{full distribution} \times \text{FR}$$

The plan sponsor has two alternatives:

1. Only distribute the allowable amount of distribution,
2. Plan sponsor makes additional contributions to cover the distribution shortfall. The distribution shortfall is defined by the following formula:

$$\text{Distribution shortfall} = \text{full distribution} - \text{allowable distribution}$$

Such an additional sponsor contribution is tax deductible, but is not recognized in the calculation of the credit balance.

- (2) An underfunded pension fund may not provide an early retirement window or other benefit increases which will further decrease the funded ratio of the pension fund. In particular, the plan sponsor of an underfunded pension plan is not allowed to bestow excessive lump sum retirement or severance benefits to senior executives. Such benefit increases must be done via plan amendments, which need the prior approval of EISA.

Specifically, if the funded ratio of a pension plan will be below 80% after a plan amendment, such an amendment is prohibited. If the funded ratio of a plan is below 60% on any valuation date, the benefit accrual of each participant is frozen until the funded ratio of the plan improves to above 60%.

A plan sponsor may elect to forfeit the credit balance or make an additional contribution to the pension fund to improve the funded ratio of the plan. Such contributions are tax deductible, but are not recognized in the calculation of the credit balance of the plan.

Notice that the funding requirements under these penalties are different from the requirements to make up the solvency deficiency. While the solvency deficiency may be amortized, the contributions towards the funded ratio shortfalls require immediate full payment. Furthermore the special payments for solvency deficiency may be shared between the plan sponsor and the pension participants, the funded ratio shortfall payments must be completely paid by the plan sponsor. In addition, the funded ratio shortfall contributions not increase the credit balance of the plan.

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