

# Research Paper

## Settlement Cost Compared to Going Concern Funding Targets Analysis of Pension Plans Registered in Ontario

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## Table of Contents

Introduction .....	3
How Settlement Differs from Going Concern.....	3
Data .....	4
Reasons for Differences .....	5
Analysis of Pensioner Liability.....	7
Analysis of Active Plan Member Liability .....	9
Unionized Manufacturing Plan .....	9
Private Sector Salaried Plan.....	11
Indexed Plan .....	12
Differences by Plan for Active Plan Members .....	13
Observations .....	15
Areas for Further Research .....	16
APPENDIX A – METHODOLOGY.....	17
Selection of Pension Plans .....	17
Discount Rate Differences .....	17
Indexing Differences .....	18
Mortality Differences .....	19
Salary Escalation .....	20
Combined and Residual Effects .....	20
APPENDIX B – DATA STATISTICS .....	21
APPENDIX C – ACKNOWLEDGEMENTS.....	22
Modelling Oversight Group .....	22
About the Canadian Institute of Actuaries .....	23
About the Society of Actuaries .....	24

## Introduction

Canadian pension funding regulations require two distinct types of valuations: a going concern valuation that presumes the plan will continue to operate and a solvency valuation that presumes the plan will wind up. This research report compares the results of these two types of valuations, to provide insight into the differences. The analysis is based upon data for defined benefit pension plans registered in the Province of Ontario provided by the Financial Services Commission of Ontario (FSCO).

For pensions in pay, differences in results of the two approaches are mostly explained by differences in the discount rate and mortality assumption and, for indexed plans, provision for future indexing. For active plan members, the variations in results are much broader. Although the variations can be explained in part by the anticipation of future salary increases, they also reflect variations in provisions for early retirement.

### How Settlement Differs from Going Concern

In a going concern valuation, the actuary assumes the pension plan will continue indefinitely. The valuation establishes a target level for pension assets and future contributions that, together with future investment returns, is expected to be sufficient to pay all of the pension benefits and expenses as they fall due. The discount rate usually reflects the expected rate of return on investments in accordance with the plan's investment policy. Some plan members who have not yet met the eligibility requirements for subsidized early retirement benefits are expected to continue in employment and receive those benefits, while others (including those who are already eligible to retire) are assumed to continue to work past their eligibility date or leave before their eligibility date, and so not receive the early retirement subsidy. Benefits are attributed to past or future service according to an "actuarial cost method". Almost all Ontario pension plan funding valuations use a benefit allocation actuarial cost method. For final average earnings pension plans, this means pension benefits are calculated using projected earnings in the years prior to retirement, and then the resulting amount is prorated over years of service to determine the accrued benefit (projected unit credit). For a career average earnings pension plan, the projected pension might also be allocated by years of service, but it is more common to determine the accrued benefit based on historical earnings (traditional unit credit).

In a solvency valuation, the actuary is asked to estimate the cost of settling the plan's benefit obligations, as if the plan had been wound up on the valuation date. Normally, this involves estimating the cost of a group annuity purchase and calculating lump sum commuted values for benefits that would have been payable if employment and plan membership had terminated on the valuation date<sup>1</sup>. Ontario pension legislation requires accelerated vesting of early retirement benefits for individuals whose employment is terminated involuntarily after years of age plus years of service exceeds 55 (the Ontario grow-in rule). There is no other provision for benefits that depend upon continued employment after the valuation date. In particular, there is no provision for the expected effect of future pay increases in a final or best average earnings

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<sup>1</sup> In rare circumstances, an actuary might prepare a solvency valuation assuming plan membership would terminate but employment would continue after the valuation date. Also, in rare circumstances it would not be practical to purchase a group annuity (because of indexation features or market capacity), and so the solvency valuation would reflect an alternative settlement method. Guidance for estimating the price of group annuities and dealing with these unusual situations is provided in periodic educational notes published by the Canadian Institute of Actuaries.

pension benefit formula<sup>2</sup>. The question of an actuarial cost method does not arise, since no benefits are attributable to service after the valuation date.

Post-employment indexation of pensions is common in the public sector but uncommon in the private sector. When it is included in private sector pension plans, it is often restricted to the period when pensions are in pay, or to members who retire from active service (that is, excluding deferred pensions). It may be provided on an ad hoc, non-guaranteed basis, or be determined by a complicated partial indexation formula involving the consumer price index, the fund rate of return, minimums, maximums, or offsets. Negotiated improvements to a flat benefit plan are a form of non-guaranteed indexation. While guaranteed indexation would be reflected in a going concern valuation (although perhaps only as an adjustment to the discount rate if it is based on the rate of return on investments), it need not be included in an Ontario solvency valuation. The most common approach is to include the value of indexation for increases that are already in pay, but to exclude the value of pension increases that might be granted in the future, whether guaranteed or not. The data in the Actuarial Information Summary identifies plans with indexation features, but does not provide sufficient detail for analysis of the differences between solvency and going concern valuation of these features.

## Data

The analysis is based on Actuarial Information Summary forms submitted to the Financial Services Commission of Ontario for the most recently completed actuarial valuation reports of Ontario-registered pension plans, as of March 2016. Most pension plans have a year-end date of December 31. Valuation reports must be filed either once every three years or annually (depending on the funded status), within nine months of the valuation date. Consequently, most of the valuation reports have effective dates at the end of 2012, 2013, or 2014. The scattergram in figure 1 below shows the excess of the solvency liability over the going concern funding target, as a percentage of the going concern funding target. It includes all 2,436 pension plans with available data. The ratios reflect the total of all defined benefit liabilities (active members, pensioners, deferred members, and other liabilities), but do not include defined contribution balances.

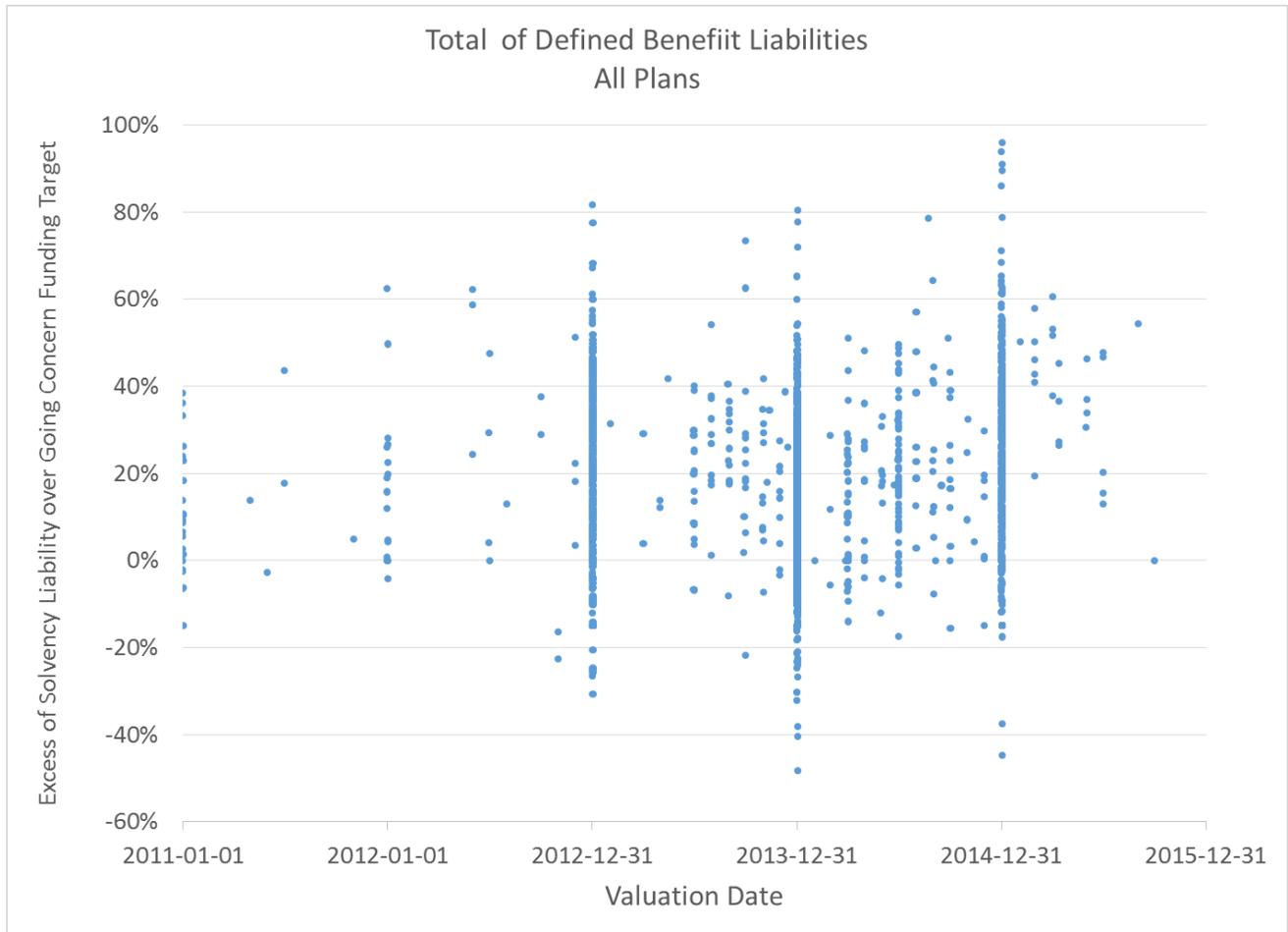
Pension plans were included in the analysis only if the membership data included at least one active plan member and at least one pensioner. This has the effect of excluding a large number of Individual Pension Plans that provide a tax-sheltered retirement fund for a single executive or owner-operator, with contributions based upon defined benefit pension limits rather than defined contribution limits. Other plans were excluded from the data because of difficulties in interpreting the assumptions or results. Details of the exclusions are provided in appendix A.

In total, 1,114 pension plans were included in the analysis of pensioners and active members.

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<sup>2</sup> Some pension plans include benefits that are payable only with the employer's consent, or are payable only in the event of a plant closure or permanent layoff. Plans might include early retirement benefits that are available only for a limited period of time (windows) or are cancelled if an early retiree finds other suitable employment (special allowances). These provisions are subject to special Ontario solvency funding rules, and there is not sufficient detail in the actuarial information summary for identification of the affected plans or analysis of the resulting differences between solvency and going concern funding.

Figure 1: Available Data



### Reasons for Differences

From figure 1 above, it is apparent that the cost of settlement usually, but not always, exceeds the funding target for ongoing operation of a pension plan. Differences can often be quite large—as much as 50 percent, or even more. There is some pattern of variation by date, with a slightly smaller excess at the end of 2013 than at the end of 2012 or 2014, attributable to slightly higher long-term bond yields at that time. This does not appear to be the most important factor over the time period considered.

These differences between solvency liabilities and the going concern funding target are related to the competing objectives of pension funding:

- If a pension plan is funded on a going concern basis, there is a good chance it will not have enough money to settle all its obligations in a future wind-up.
- If a pension plan is funded on a settlement basis, there is a good chance that, in the absence of a plan wind-up, it will eventually have more money than needed to support the continued operation of the plan. In fact, full funding on a settlement basis could produce going concern surplus that exceeds the present value of all future benefits for current and future plan members (runaway surplus). This is a greater concern in a mature or closed plan.

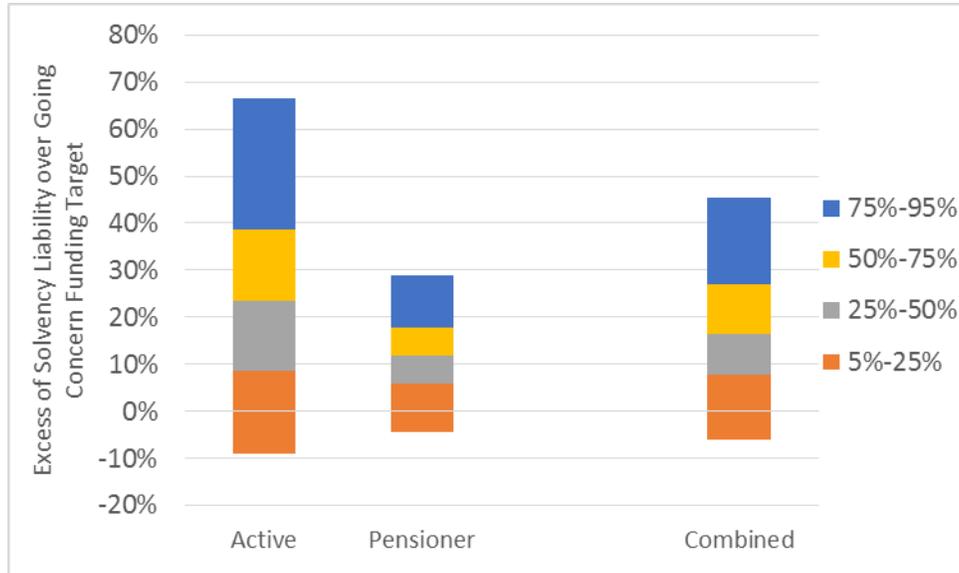
The main reasons for the differences are shown in table 1 below.

Table 1: Differences Between Going Concern and Settlement Valuations

1. Discount Rate	<p>Insurance companies invest most of the proceeds of group annuity sales in fixed-income securities that match the term of the annuities, in order to minimize risk and avoid excessive reserve requirements. Pension plan assets are typically invested for a longer time horizon (taking account of contributions and benefits that will arise in the future) and with greater emphasis on maximizing returns. Different investment strategies lead to different choices of discount rate for going concern and settlement valuations.</p> <p>In Canada, commuted values paid in settlement of defined benefit pensions are intended to represent the economic value of the foregone pension. The only addition to yields on government bonds is due to the illiquid nature of defined benefit pensions.</p>
2. Mortality	<p>The mortality assumption in the guidance to pension actuaries for group annuity pricing and in the standard for commuted value calculations does not reflect the individual circumstances of pension plans.</p>
3. Expense Provision	<p>Group annuity pricing includes provisions for expenses and return on insurance company shareholder equity that are different from the expense allowances and provisions for adverse deviations in going concern pension plan valuations.</p>
4. Indexation	<p>Ontario solvency valuations may exclude or partially exclude the value of post-employment indexation, even when this value is reflected in the going concern valuation.</p>
5. Salary Projection	<p>Going concern valuation makes provision for future salary increases while settlement valuation does not.</p>
6. Allowance for Early Retirement	<p>Settlement costs include early retirement subsidies for all members who have met the age and service requirement (55 points upon involuntary termination in Ontario), whereas a going concern valuation makes limited or no provision for plan members expected to suffer involuntary termination of employment prior to eligibility for early retirement.</p> <p>Committed values are calculated on the assumption that plan members will elect to start receiving their pension at the age that produces the largest commuted value (the “most expensive age”). Group annuity prices are usually calculated on the assumption that plan members who have not already started to receive a pension will elect their pension at the earliest possible date. In contrast, a going concern valuation normally uses a retirement scale, with some plan members leaving earlier than the most expensive age and others retiring later.</p>

The impact of each of these factors depends on whether plan members have retired. Figure 2 below shows the distribution of the excess of solvency liability over the going concern funding target from data for Ontario-registered pension plans. The distribution is provided for active plan members and pensioners separately, alongside the differences for both groups combined.

Figure 2: Distribution of Aggregate Difference by Membership Group



For active plan members and pensioners combined, figure 2 shows the 50<sup>th</sup> percentile of the distribution is 16.7 percent. That is, 557 of the 1,114 plans included in the analysis have solvency liabilities at least 16.7 percent larger than the going concern funding target.

### Analysis of Pensioner Liability

Some of the reasons for differences between settlement costs and the going concern funding target do not apply to pensions in pay. Except for indexation and estimation errors, it is possible to explain the entire difference for each plan using data from the Annual Information Summary.

For non-indexed pension plans, the only reasons for differences between settlement cost and the going concern funding target are the discount rate and the mortality basis. Figure 3 and table 2 below illustrate these differences. Details of the methodology for determining the effect of each source of difference are provided in appendix A.

Figure 3: Distribution of Components for Non-indexed Pensions in Pay

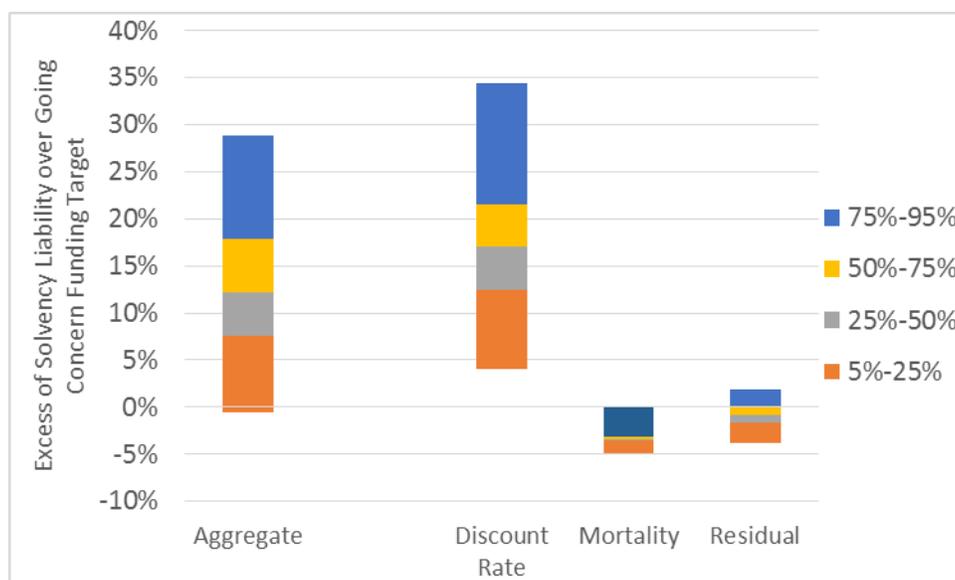


Table 2: Non-Indexed Pensioner Liabilities

	Mean	Standard Deviation
Aggregate excess of settlement cost over going concern funding target	13.0%	8.8%
Excess due to differences in discount rates	17.6%	8.6%
Excess due to differences in mortality assumptions	(3.0%)	1.4%
Residual differences	0.9%	2.0%

The residual differences are easily attributable to estimation errors:

- Ontario does not capture discount rate sensitivity statistics in the actuarial information summary, and so duration of pensioner liability was estimated from the average age of pensioners. This duration would be overstated for plans with bridge benefits and could be understated for plans with unusually high election of joint and survivor pensions or improvements in pension benefits.
- Settlement costs (for annuities and lump sums) would have been valued using the UP94 mortality table, while the most common mortality assumption for going concern funding targets was the CPM-2014 Private Sector table, with no adjustment factor. Using only average age and discount rate, the effect of this difference in mortality tables is estimated to be between 3.4 percent and 4.9 percent (with an average of 3.8 percent). In fact, the effect on single life annuities ranges from 3 percent at retirement age to 6 percent at ages in the late 70s, and less than zero for extremely old annuitants. Effects are smaller for joint and survivor annuities and pensions with bridge benefits.

It is difficult to discern the effect of an indexation assumption on valuation results. Indexation might apply only in unusual circumstances, or might be addressed through an adjustment to the discount rate or a more complicated formula, rather than a simple rate of escalation applied to projected future pensions. Of the 201 plans with a pensioner escalation rate included

in the going concern actuarial assumptions, the indexation assumption helps to explain the difference between solvency and going concern results in 149 cases. For these cases, figure 4 and table 3 below illustrate the reasons for differences between solvency and going concern liabilities.

Figure 4: Distribution of Components for Indexed Pensions in Pay

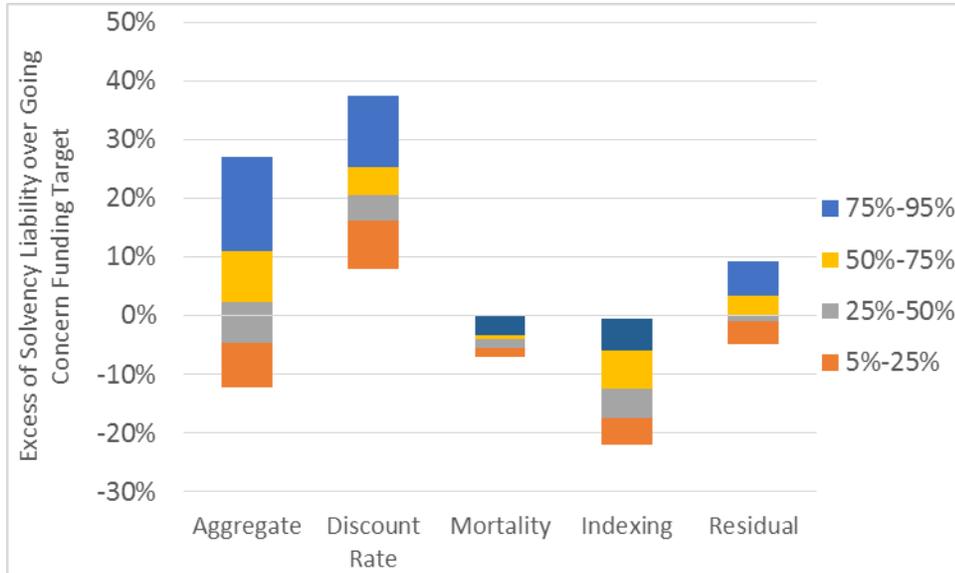


Table 3: Indexed Pensioner Liabilities

	Mean	Standard Deviation
Aggregate excess of Ontario solvency liability over going concern funding target	4.0%	11.9%
Excess due to differences in discount rates	21.5%	8.9%
Excess due to differences in mortality assumptions	(3.9%)	2.2%
Excess due to differences in provision for indexation	(12.0%)	6.8%
Residual differences	1.2%	4.2%

The larger residual differences are attributable to lack of information concerning the extent of provision for indexation.

**Analysis of Active Plan Member Liability**

For members who are still actively employed, plan design features can create dramatic differences between settlement costs and a going concern funding target. This is best illustrated by examining common examples. In each plan design, the liability for an individual who entered full-time service at age 25 is illustrated.

**Unionized Manufacturing Plan**

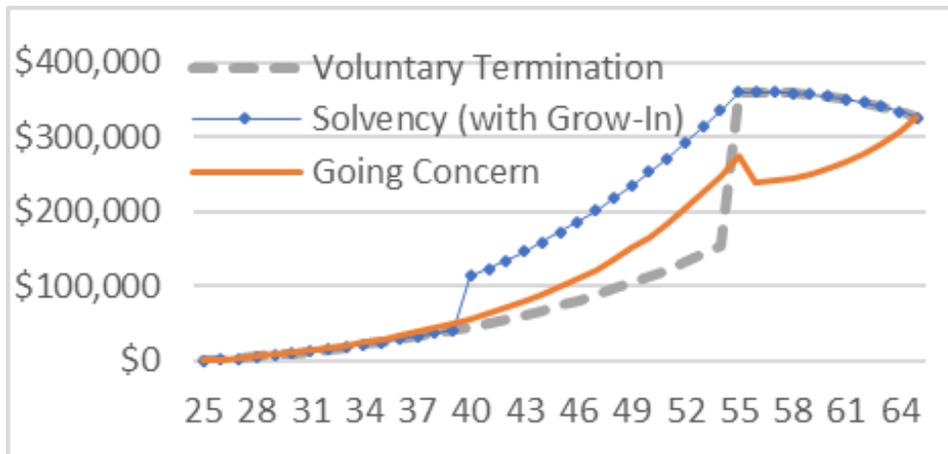
Within the Ontario manufacturing sector, flat benefit plans were common for hourly paid workers. Some provided an unreduced pension after 30 years of service and a bridge benefit from retirement to age 65. Figure 5 below shows the development of benefit values in a plan with the following features:

- A lifetime pension of \$50 per month per year of service (for example, \$18,000 per year after 30 years of service);
- A lifetime pension commencing at age 65 (or a reduced pension of equal value commencing earlier) if retirement or termination of employment occurs prior to age 65 and prior to completion of 30 years of service;
- No reduction in the pension for early retirement if retirement occurs after age 65 or after completion of at least 30 years of service; and
- A bridge benefit of \$6,000 per year from retirement until age 65 if retirement occurs after at least 30 years of service<sup>3</sup>.

If termination is involuntary, as would be the case in a plan wind-up, and a plan member has 55 points on the date of termination, Ontario requires the plan administrator to pay the unreduced pension commencing at the date the member would have attained 30 years of service had employment continued.

For comparison, both going concern and solvency liabilities are illustrated using a 4 percent discount rate. Differences due to use of different economic and mortality assumptions are not part of this illustration.

Figure 5: Illustration of Pension Value for Unionized Manufacturing Plan



At ages 25 to 39, the solvency liability is 10 percent to 20 percent lower than the going concern funding target, because the potential future value of early retirement benefits is excluded. At age 40, the solvency liability jumps to double the going concern funding target. The difference gradually disappears over the years to age 65. Solvency liability is much higher than the going concern funding target after attainment of 55 points because the solvency calculation assigns a 100 percent probability to the most expensive age, while the going concern assumptions assign best-estimate withdrawal probabilities to various ages<sup>4</sup>.

<sup>3</sup> For convenience in the going concern illustration, the bridge benefit has been attributed to the entire period of service rather than the first 30 years of service.

<sup>4</sup> Lifetime pensions are calculated assuming 20 years of payment after age 65 (i.e., death at age 85). Withdrawal rates are equal to four times the increase in value of voluntary termination benefits during the year (expressed as a percentage of pay) minus three times the comparable statistic during the prior year. This crude formula produces plausible withdrawal rates, with a spike in the first year of eligibility for subsidized early retirement. Pay is assumed

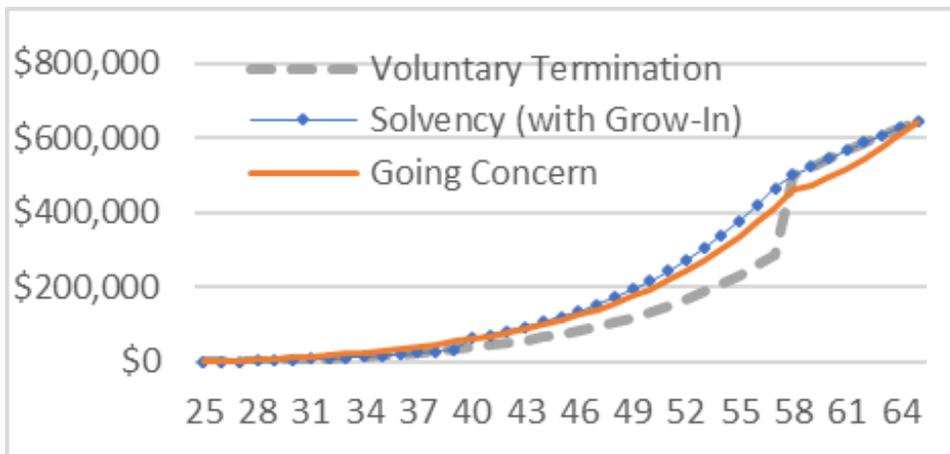
While a plan like this might not have much difference between the total solvency liability and the going concern funding target during the early years of operation, it can have solvency liabilities much higher than going concern liabilities once most of the active plan members have attained 55 points and are eligible for grow-in. The gap can be particularly acute if plan members with less seniority are permanently laid off or the plan is closed to new entrants. In a closed plan, the gap will narrow once most members are retired or continuing to work past 30 years of service.

**Private Sector Salaried Plan**

In the past, defined benefit pension plans for salaried employees in the private sector typically provided non-indexed pensions based on final or best average earnings. Most private sector pension plans have been converted to defined contribution for new entrants and many have also frozen pensionable salaries for defined benefit plan members. Figure 6 below shows the development of benefit values in a plan with the following features:

- A pension of 1 percent of average pensionable earnings per year of service;
- No reduction in the pension for early retirement if retirement occurs after age 65 or after age plus years of service equals at least 90 points;
- A lifetime pension commencing at age 65 (or a reduced pension of equal value commencing earlier) if retirement or termination of employment occurs prior to age 65 and prior to 90 points; and
- No bridge benefit.

Figure 6: Illustration of Pension Value for Private Sector Salaried Plan



At hire, solvency liabilities are 50 percent lower than the going concern funding target, due to the absence of salary projection. This differential declines to 40 percent at age 39. Grow-in provides a pension at age 57.5 if involuntary termination occurs after age 40, and so solvency liabilities are slightly higher than the going concern funding target after age 40. The excess

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to increase at a rate of 3.5 percent per year from an initial rate of \$30,000 per year for the purpose of calculating the withdrawal rates.

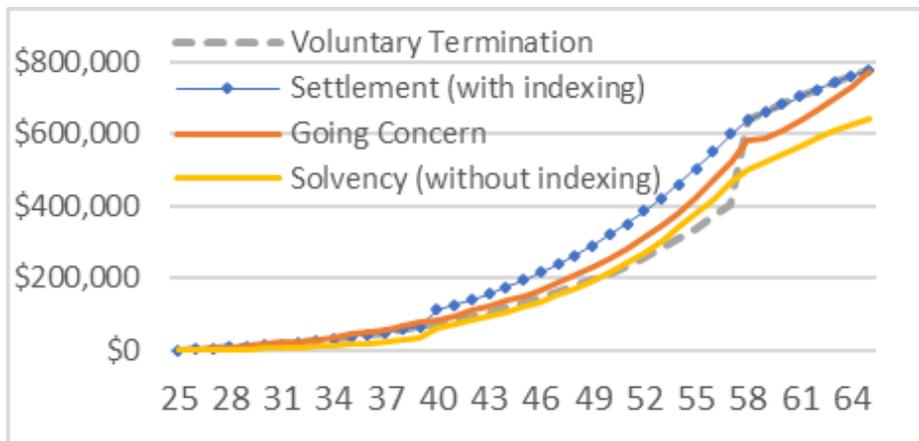
peaks at 10 percent at age 58. This differential depends on the interaction of expected salary increases, expected retirement rates, and the plan’s early retirement subsidies<sup>5</sup>.

For this type of pension plan, solvency liabilities will be significantly lower than the going concern funding target during the first few decades of operation. Even after a plan matures, total solvency liabilities might remain smaller than the going concern funding target as long as there is a steady stream of younger new entrants.

**Indexed Plan**

The effect of adding a pre-retirement escalation clause to a pension plan is to narrow the gap between settlement costs and a going concern funding target. Figure 7 below illustrates the same sample situation as the private sector salaried plan in figure 6 above, except pensions increase by 2 percent per year both before and after retirement.

Figure 7: Illustration of Pension Value for Salaried Plan with Escalation



Settlement values (including indexing) are never smaller than 85 percent of the going concern funding target in this illustration. On the other hand, since Ontario solvency liabilities may be computed without the value of indexation, the solvency liabilities in figure 7 are never larger than 85 percent of the going concern funding target, and at the youngest ages can be as little as one-third of the going concern funding target. At age 40, the ratio jumps due to grow-in from 85 percent to 130 percent for settlement values and from 45 percent to 75 percent for solvency liabilities. Inclusion of a post-retirement escalation provision increases the value of pensions at all ages, while inclusion of escalation in the period from termination of employment to commencement of the pension largely offsets the value of future salary increases.

Note that a fixed rate escalation is not the same as indexation linked to the Consumer Price Index or a similar measure of inflation. Even if the rate of escalation is the same as the expected rate of inflation, the price of an annuity linked to actual inflation will be much higher. In recent years, the guidance published by the Canadian Institute of Actuaries for estimating the price of group annuities has included a spread of 1.5 percent to 2 percent between indexed and non-indexed discount rates. This translates into an inflation risk premium of 15 percent to 25 percent for pensions in pay, and more for deferred pensions. Consequently, settlement costs can far exceed the going concern funding target for a typical public sector pension plan.

<sup>5</sup> Assumptions are the same as for the flat benefit plan illustration in figure 5. In particular, average pensionable earnings are assumed to increase at a rate of 3.5 percent per year.

**Differences by Plan for Active Plan Members**

Figure 8 and table 4 below illustrate the differences between settlement costs and the going concern funding target for benefits for members of Ontario pension plans who were still actively accruing benefits at the valuation date.

Figure 8: Distribution of Components for Active Members – All Plans

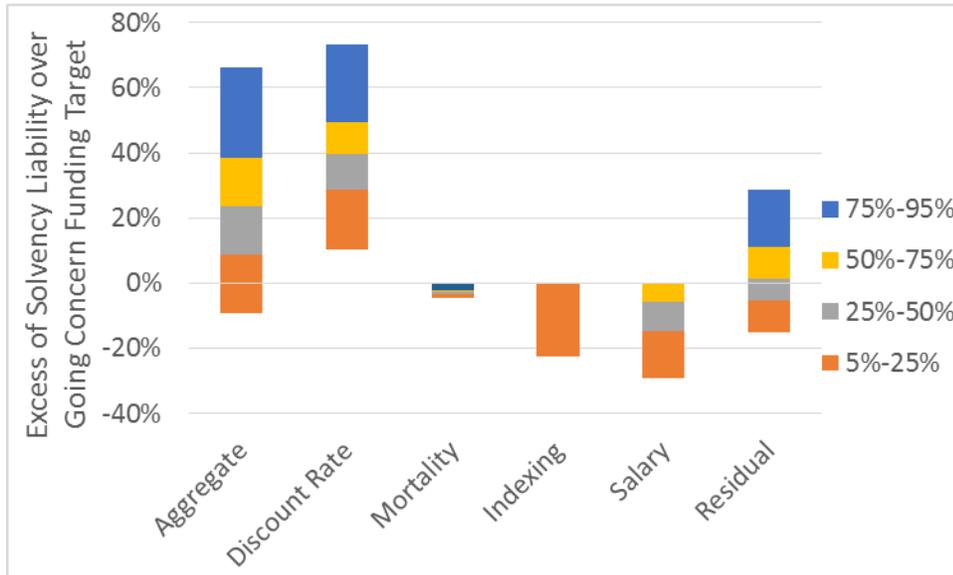


Table 4: Active Member Liabilities

	Mean	Standard Deviation
Aggregate excess of settlement cost over going concern funding target	25.1%	23.1%
Excess due to differences in discount rates	40.0%	18.7%
Excess due to differences in mortality assumptions	(2.5%)	1.3%
Excess due to differences in provision for indexation	(2.2%)	6.4%
Excess due to frozen salaries in settlement costs	(8.5%)	10.0%
Residual differences	3.5%	14.4%

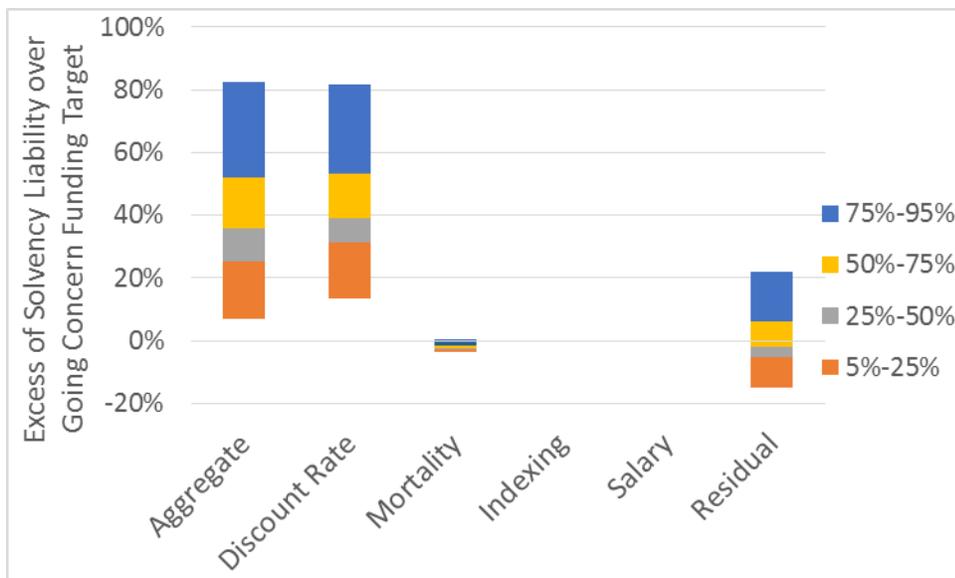
The range of residual differences is broad, and is not easily explained by statistics in the actuarial information summary. In addition to the measurement issues that are present with pensioner liabilities, analysis of active plan liabilities suffers from lack of information about early retirement benefit provisions and the benefit formula. Many pension plans include different benefit provisions for different groups of employees, distinguished by union affiliation, type of work, year of service (due to a plan amendment), or date of hire (grandfathering). Some pension plans provide a combination of defined benefit accruals and defined contributions, or other more exotic benefit formulae. Table 5 below shows the number of plans included in figure 8 above, by type of plan.

Table 5: Types of Pension Plans

Benefit Accrual Formula	Number of Non-indexed Plans	Number of Indexed Plans
Final or Best Average Earnings	217	76
Flat Benefit	182	8
Career Average Earnings	87	11
Hybrid, Other, or Unspecified Formula	427	106
Total	913	201

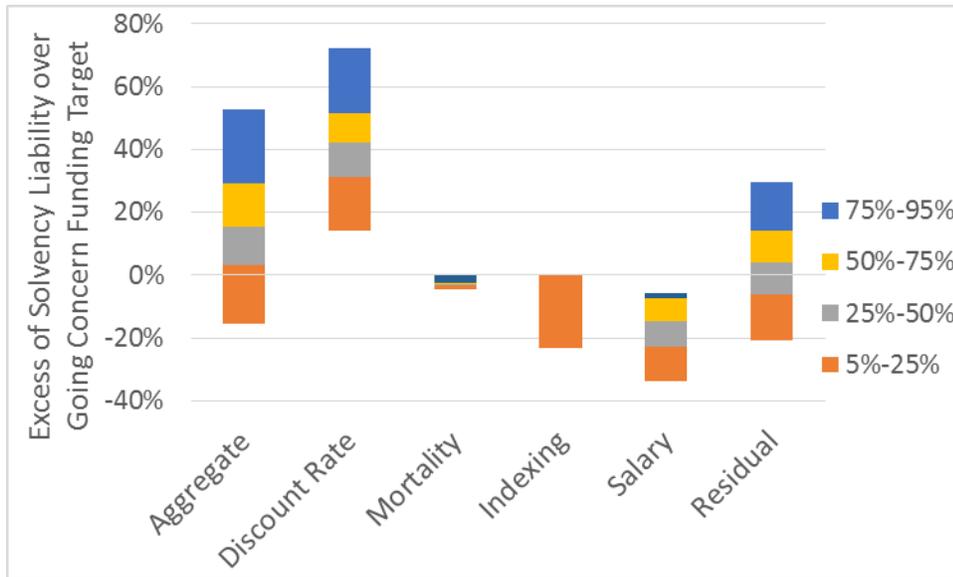
Additional insight is possible by isolating plans based on their provisions for future inflation or pay-related benefit increases. Plans without such provisions include career average earnings pension plans and flat benefit plans, if they have no escalation assumption in the going concern funding target. Career average plans are grouped with flat benefit plans even though some would include a small element of earnings projection if projected benefits are pro-rated by service rather than earnings. The analysis of plans without inflation protection is presented in figure 9 below.

Figure 9: Distribution of Components for Active Members of Non-indexed Flat Benefit and Career Average Plans



The most common means of protecting pensions for active plan members from inflation is to link benefit accruals to final or best average earnings. Analysis of this type of pension plan is presented in figure 10 below.

Figure 10: Ratio of Solvency to Going Concern for Active Members – Final Average Plans



In each case, the residual differences are due to a combination of measurement errors and differences in early retirement benefits. Early retirement benefits can favour either the going concern funding target or the settlement cost, depending on the demographic composition of the plan. While inflation protection features of the plan design lead to larger measurement errors, it would appear that the range of outcomes due to different early retirement provision is similar.

**Observations**

The analysis of Ontario data considers a wide variety of pension plans, over a period of several years. It does not consider differences in size of pension plans. Each pension plan is considered equally representative. Thus, while the analysis provides information on the range of possible differences between settlement cost and the going concern funding target that any one pension plan could experience, it does not provide insight into the difference for the Ontario pension system as a whole.

Of the 10 largest pension plans, seven were excluded from the analysis, typically because they used a plan-specific mortality table rather than a variation on one of the standard tables. These excluded plans represent more than 60 percent of the total of going concern funding targets for all 2,436 plans. They are typically fully indexed best average earnings pension plans, open to new members. As a result of the lower average age and the ability to exclude provision for future salary and price inflation from the solvency liabilities, they report solvency liabilities much lower than their going concern funding target. In aggregate, the ratio of solvency liabilities to going concern liabilities for these excluded plans is of the order of 85 percent, as compared to an aggregate ratio of 121 percent for pension plans included in the analysis. Of course, the actual settlement costs for these excluded plans (including inflation protection) would have been higher.

It is reasonable to expect that the cost of purchasing annuities will be higher than the going concern funding target. The size of the differential depends mostly upon the spread between the investment returns anticipated in pension funds and the investment returns anticipated in

the assets of insurance companies. To the extent pension funds invest in the same types of investments (generally fixed income investments matching the time horizon of the benefit payments), this difference ought to be small. To the extent pension funds invest in equities and real property to achieve higher returns and more economical contributions, the difference will be larger. Historically, going concern discount rates and normal contribution rates have not varied as quickly or as widely as bond yields and annuity prices. This may be because actuaries and sponsors do not believe expected returns on equities are correlated with bond yields, or because they have allowed the decline in bond yields over the last three decades to erode margins of conservatism in going concern discount rates. Regardless, it is possible that the average of differences between settlement costs and going concern funding targets attributable to discount rates in different periods will not remain at the 2012–2015 levels reported here.

There could be some relationship between the Ontario funding regime and the types of pension plans that have been common in Ontario. For example grow-in requirements might have been added to legislation in response to the prevalence of early retirement benefits that could be denied to long-service plan members through involuntary termination of employment. Caution should be exercised when applying statistics based on current Ontario plan designs and funding regulations to other jurisdictions or proposals for new plan designs and funding regulations.

### Areas for Further Research

This research report provides insight into the differences between a going concern funding target based on long-term investing and a pension plan's settlement liability. This will assist actuaries in assessing the ramifications of funding towards one target or the other.

This research does not consider the variability of each measure of funded status over time. To do so would require an assessment of how going concern discount rates vary with market conditions.

It also does not quantify the extent to which wind-up funded status would be weakened if solvency funding were eliminated and changes to going concern funding (such as minimum provisions for adverse deviations or accelerated special payments) were introduced in their place. Research to address these questions would require examination of the complete funding regime, including frequency of valuations and amortization requirements.

Ontario grow-in regulations and Ontario's unique exemption from funding for guaranteed indexing limit the applicability of this research to other jurisdictions. It would be useful to examine the relationship between going concern funding targets and settlement costs in other jurisdictions where the hypothetical wind-up liability is used without adjustment to determine minimum solvency requirements. This would provide a better indication of the risk that the going concern funding target might prove inadequate in an actual wind-up.

## APPENDIX A – METHODOLOGY

### Selection of Pension Plans

Data was provided by FSCO in March 2016. It included the most recent actuarial information summary and annual information return for all plans with an active Ontario registration. Valuation reports and forms are submitted by actuaries electronically, within nine months after the valuation date. Reports are required once every year or once every three years, depending on the funding status, and after a plan amendment. Thus, most of the valuation dates were between 2012 and early 2015. Some reports on wound up or inactive pension plans were older.

The data encompassed single employer defined benefit plans, plans that provide both defined benefits and defined contributions (defined contribution balances are normally excluded from the summary data), multi-employer defined benefit plans and jointly sponsored plans. All the records provided were included, except for the following:

- Defined contribution pension plans (which have actuarial reports only in unusual circumstances) and a small number of “other” pension plans;
- Plans with no pensioners or no active members (this eliminates nearly a thousand “individual pension plans”);
- Plans with step-rate going concern discount rates or step-rate indexation assumptions;
- Plans with different going concern assumptions for pensioners and active members;
- Plans with missing or invalid discount rate or indexation assumption data;
- Plans with going concern cost methods other than projected unit credit or traditional unit credit;
- Plans with going concern mortality assumptions based on tables other than GAM83, UP94 or CPM-2014 (public, private or combined);
- Plans with adjustments to the base going concern mortality table other than simple scaling factors (a few plans had age setbacks or unspecified adjustments to reflect individual pension amounts);
- Plans with solvency mortality assumptions other than UP94 with generational projection on scale AA;
- Plans with projection scales other than the one intended for use with the base table (AA for UP94 or GAM83 or CPM-B for tables based on CPM-2014);
- Plans with mortality projection methods other than static, fully generational, or none; and
- Plans with ambiguous descriptions of the mortality assumption such as mention of an adjustment for plan experience with no specification of the size of the adjustment.

### Discount Rate Differences

The effect of the difference in discount rates is calculated using the estimated duration for each pension plan. The ratio of solvency liabilities to the present value of the same projected benefit payments determined using the going concern discount rate is estimated by

$$e^{D(i_g - i_s)(1 - 7(\frac{i_g + i_s - r_s}{2} - 5.25\%))}$$

where

$D$  is the estimated duration at a 5.25% discount rate;

$i_g$  is the going concern discount rate;

$i_s$  is the solvency discount rate; and

$r_s$  is the rate of indexation assumed in the solvency valuation (if any).

The duration of non-indexed pensioner liability at 5.25 percent is estimated to be 9 years when the average age of pensioners is 70 and one year more (or less) than this for every five-year decrease (or increase) in the average age of pensioners. The duration of active member liability at 5.25 percent is estimated to be 17 years when the average age of active members is 50 and one year more (or less) than this for every four-year decrease (or increase) in the average age of active members (irrespective of indexation provisions). This approach is based upon analysis of pension plans registered in British Columbia<sup>6</sup>. Actual duration would typically be within one year of these estimates for pensioners and within two years of these estimates for active members.

For pensioner liabilities, the annuity purchase discount rate is the solvency discount rate. For active plan member liabilities, an approximate equivalent level solvency discount rate is calculated as a blend of the annuity purchase rate, the select commuted value discount rate and the ultimate commuted value discount rate:

- 50% weight on the annuity purchase discount rate;
- $50\% \times 10/D$  weight on the commuted value discount rate applicable to the first 10 years; and
- $50\% \times (1 - 10/D)$  weight on the commuted value forward discount rate applicable after the first 10 years.

### Indexing Differences

For indexed and partially indexed plans, the going concern and solvency discount rates reported may be real or nominal. Where indexation assumptions are reported, they may not apply to all pensions. The prescribed annuity purchase and commuted value rates for each valuation date were compared to the reported indexing assumptions and solvency discount rates.

- If it was evident that nominal rates were used in the solvency valuation and an explicit indexation assumption was used in the going concern valuation, then the difference in nominal discount rates was treated as the difference in discount rates, and the difference in indexation assumptions was based upon a percentage of full indexation estimated from the commuted value indexing assumption.
- If it was evident that rates lower than the prescribed nominal rates were used in the solvency valuation, then the difference was treated as a provision for indexation and the prescribed nominal rate was used to determine the difference in discount rates.
- In many instances, a going concern indexation assumption was reported, but it did not help explain the difference between going concern and solvency results. This could be

<sup>6</sup> D. Chandler, "[Discount Rate Sensitivities in Pension Plans](#)," March 2017, Society of Actuaries and Canadian Institute of Actuaries.

because the indexation assumption was applied only to benefits limited by the income tax limits or some other small subset of the pensions. If the application of an indexing difference would have led to a residual unexplained difference in pensioner liability of more than 10 percent, then the going concern indexing assumption was ignored for pensioners. It was also ignored for active members' liability, unless the plan was career average or flat benefit.

The ratio of non-indexed solvency liabilities to indexed solvency liabilities was calculated using the going concern indexation assumption and the same approach to duration and convexity as for differences in discount rates. Since average age provides no indication as to the duration of pensions at a future retirement date, the duration of indexed liability at a discount rate of 5.25 percent was assumed to be 12 years for active members in all plans with indexation.

### Mortality Differences

Guidance for calculation of settlement costs in effect for valuation dates prior to 2016 called for use of the UP94G mortality table in all but exceptional circumstances. The ratio of liabilities calculated using the going concern mortality assumption to liabilities calculated using the UP94 solvency assumption was calculated for each pension plan using a synthetic population with an average age that roughly matched the reported average age. No attempt was made to match variations in the male/female mix in the plan statistics<sup>7</sup>.

For pensioners, the synthetic population reflects the following:

- All retirements at age 60;
- 50 percent male, 50 percent female members at retirement;
- 30 percent single life annuitants, 70 percent joint and survivor annuitants at retirement;
- An average survivor pension of 60 percent of the member's pension at retirement; and
- A growth rate from one retiree cohort to the next equal to zero with an average pensioner age of 76.9 and larger (or smaller) than this by 1.1 percent for each year the average age of pensioners is less (or greater) than 76.9.

For active plan members, the synthetic population reflects the following:

- An equal number of members at each age in a range that has the average age of the plan's active members as its midpoint;
- A 25-year age range if the average age is under 45 and an age range ending at age 70 if the average age is over 45;
- Cohort weights that increase from the lowest age in the range to the highest age in the range to reflect the average service of the group and a half-year increase in average service for each one year increase in cohort age;
- Retirements at age 60 (immediately for cohorts over age 60 on the valuation date);
- 50 percent male, 50 percent female members at the valuation date;
- 30 percent single life annuitants, 70 percent joint and survivor annuitants at retirement; and

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<sup>7</sup> No information was available on form of pension or proportion married. Membership statistics reflect headcounts, not liabilities. Any adjustments for gender in these circumstances would have been spurious.

- An average survivor pension of 60 percent of the member's pension at retirement.

The effect of mortality assumption differences is a weighted average of annuity factors calculated using the real going concern discount rate (net of the indexation assumption, if any).

### Salary Escalation

In a going concern valuation of a final average earnings pension plan, the projected pension at retirement or earlier termination of employment is prorated over years of service. The number of years of salary projection included in the going concern funding target (but not included in the settlement cost) depends on each plan member's attained age and the decrement assumptions. The size of the projected increase depends upon the following:

- Actual increases that have occurred over the averaging period and are reflected in the plan member's earnings on the valuation date but would not be fully reflected in the best average earnings used in a settlement calculation on the valuation date.
- Assumed increases in the overall pay scale of the employer due to general wage inflation.
- Assumed increases in individual pay due to seniority, merit, promotions, industry-specific factors, or employer-specific factors (including pay increases that have already been negotiated or announced on the valuation date).

While the actuarial information summary provides the rate of increase due to the second factor, it is difficult to estimate the average number of years of projection or the combined effect of all three factors on the plan as a whole. The effect of salary projection as a component of the overall difference between settlement costs and the going concern funding target for active plan members has been estimated as compound growth for a fixed number of years at the rate of general pay increase. The number of years is the difference between 55 and the average age of active plan members (but never less than two years). Age 55 can be thought of as a liability-weighted average age at decrement, taking account of both retirements and pre-retirement decrements. This age produces an average residual difference between solvency liabilities and the going concern funding target that is similar to the average for flat benefit and career average plans. It also produces less variation in the residual difference than other ages and formulae that were considered.

### Combined and Residual Effects

Each component difference is determined as a ratio. The residual difference is determined as a balancing item, so that when all the ratios are multiplied together, the result is the aggregate ratio determined from the reported solvency liability and going concern funding target. The order of the steps moving from going concern to solvency is the following:

1. Mortality;
2. Indexation rate;
3. Salary scale; and
4. Discount rate.

## APPENDIX B – DATA STATISTICS

In total, 1,114 pension plans were included in the analysis. Additional details of the relevant characteristics of these pension plans are provided below.

Table B1: Median Economic Assumptions

	Number of Plans	Going Concern		Solvency		
		Discount Rate	Indexation Rate	Annuity Purchase Discount Rate	Blended Discount Rate*	Salary Scale (if not zero)
Non-indexed Plans	913	5.50%	0.00%	3.80%	3.74%	
Indexed Plans (included)	149	5.50%	1.76%	3.80%	3.73%	
Indexed Plans (excluded)	52	5.25%	2.00%	3.72%	3.67%	
All Plans	1,114	5.50%		3.80%	3.59%	3.25%

\*The blended discount rate is a blend of short-term and long-term commuted value discount rates and the annuity purchase discount rate, reflecting the estimated average duration of each pension plan's active membership.

Table B2: Going Concern Mortality Tables (Numbers of Plans)

	Without Adjustment	With Adjustment
1983 Group Annuitant Mortality Table with Scale AA	1	–
1994 Uninsured Pensioner Mortality Table with Scale AA	103	12
2014 Canadian Pensioners Mortality Table (Combined) with Scale CPM-B	77	15
2014 Canadian Pensioners Mortality Table (Private Sector) with Scale CPM-B	673	167
2014 Canadian Pensioners Mortality Table (Public Sector) with Scale CPM-B	42	24

Table B3: Average Ages

	Active Members	Pensioners
Median of all plans	50.5	71.0
Aggregate of all plans, weighted by number of members	45.7	72.7

## APPENDIX C – ACKNOWLEDGEMENTS

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### Modelling Oversight Group

The Canadian data-driven in-house retirement modelling oversight group is a collaboration of the Canadian Institute of Actuaries and the Society of Actuaries. It provides insight into the retirement industry's data-driven actuarial research needs and guidance over priorities. The author, the Society of Actuaries, and the Canadian Institute of Actuaries thank them for their ongoing volunteer service.

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