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# Is the Cost Method of the Canada Pension Plan Suitable for Adoption by Other Countries?

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## Abstract

This paper describes the cost method used for the Canada Pension Plan (CPP). It proposes actuarial principles for a partially funded social security pension. The paper shows that the cost method for the CPP does not meet consistently the principle of rationality and so should not be considered a sound actuarial cost method.

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The most common method of financing a social security retirement system (SSRS) is Pay Go, in which funds to pay benefits are made available at the time that benefits fall due. For administrative convenience, most Pay Go systems operate with a slight excess flow of revenues over expenditures. Certain SSRS operate on the basis of a planned excess of revenue over expenditures of significant magnitude and are considered partially funded SSRS. The Canada Pension Plan (CPP) is a notable example.

Many developed countries that manage their SSRS on a Pay Go basis are experiencing population aging. There is concern regarding funding shortfalls or the need to increase contribution rates. For example in the USA, in The 2011 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance and Trust Funds (referred to as OASDI), it is projected that in 2036 the reserves will be depleted and tax income coming into the trust funds will cover approximately 77 percent of benefits due, if there is no change to contribution or benefit rates.

Some countries have amended their plans to strengthen the financial sustainability of the plans. France passed a law increasing the normal retirement age from age 60 to age 62. At the end of the last century, Sweden replaced its defined benefit SSRS by a notional defined contribution Pay Go SSRS that incorporates certain adjustment mechanisms, such as continuing to raise the retirement age to take into account increases in life expectancy and an automatic balance mechanism to adjust financial imbalances.

Raising tax (or contribution) rates is never a popular measure. Amending plans to reduce benefits or entitlements is not popular either. In France, industrial action protesting the raising of the retirement age crippled transport and commerce in the country for several weeks.

The legislated contribution rate for CPP is 9.9% of covered earnings. According to the most recent actuarial report (Office of the Chief Actuary, 2010), it is likely to be sustainable over a seventy-five year horizon. Due to its relatively low contribution rate and long term stability, the operation and management of the CPP is being examined by many countries as a model. Some of the characteristics of the CPP that are considered to be best practice include the operation of the CPP on a partially

funded basis and the governance structure of the CPP and the Canada Pension Plan Investment Board. For the actuarial profession, it would be very positive, if the cost method used in the valuation of the CPP were actuarially sound. If so, it might be adopted by other jurisdictions that have partially funded SSRS?

In the first section of this paper background regarding the definition of partially funded SSRS and methods of financing partially funded SSRS is provided. In the second section, the actuarial principles that should be used to assess the soundness of a cost method applicable to partially funded SSRS are identified. In the third section of the paper, the cost method used in the valuation of the CPP is described and is assessed with respect to the principle of rational allocation of contributions. The fourth section concludes that the cost method for the CPP does not satisfy completely all of the principles stated.

## **1.0 Defining a Partially Funded SSRS**

The definition of what constitutes a partially funded SSRS has been the subject of debate. This section reviews the literature in order to develop a set of requirements for a SSRS to be considered partially funded. It then concludes that the CPP and the QPP meet the requirements and are examples of partially funded SSRS.

In OASDI, excess income is lent to the Treasury and special instruments are issued to the OASDI Trust Fund. Goss and Wade (2007) argue that this does not change in any way the Pay Go nature of the plan. Effectively, the excess income is being used by government. When the time comes for the OASDI Trust Fund to cash in some of the special instruments, governments will have to raise funds from other sources, by means such as taxation, reduction in other spending, or issuance of new debt. For Goss and Wade (ibid) a minimum requirement for a partially funded SSRS would be that excess income is invested, at least in part, in investments that are not government issued or backed, say investments in the equity or debt of publicly traded corporations.

Brown (1997) approaches the definition from the perspective of the amount of excess funds accumulated. He places partial funding on a continuum between no funding and full funding. He picks an arbitrary threshold for the size of the contingency reserve as determining when an SSRS moves from being Pay Go to becoming partially funded, i.e., when the reserve exceeds two years of benefit expenditures then the system ceases to be Pay Go.

Settergren (2008) argues that one must look at the intention of the SSRS to determine its nature, regardless of the amount of excess funds. So if a SSRS intends to operate on a Pay Go basis, it does not matter how much excess funds are accumulating and how those funds are invested. He refers to a Pay Go SSRS with excess funds as Pay Go with a buffer fund (ibid).

Even in such a situation, Guerard (2008) would likely require that the organization doing the investing needs to be well governed and free from government direction. If not, the funds might be used or manipulated by the government, so the SSRS might have an appearance of partial funding but in reality be a front for Pay Go.

Based on these considerations, both the CPP and the QPP are examples of partially funded SSRS.

## **1.1 Premium Structures for Partially Funded SSRS**

Plamondon et al. (2002) describe three methods for financing an SSRS on a partial funding basis; classical scaled premium, reserve ratio system, general average premium; although, they state that there are a wide variety of approaches. Under the scaled premium method the contribution rate is level for a determined period of equilibrium and then increases at the end of that period. Under the reserve ratio approach the projected reserve divided by the annual expenditure for any year should not be less than a specified level. The general average premium method calculates a contribution rate that would be adequate to meet the projected disbursements over a set period.

The QPP uses both of these first two approaches. The actuarial report (Regie des rentes du Quebec, 2010) examines two tests of funding: whether the assets at the beginning of each year exceed twice the required annual outflow; and the determination of a steady-state contribution rate. The legislation governing the QPP requires a projection of its funding over a thirty year period. Over this period, the plan's funds and cash flows are more than adequate to provide the required outflows and would exceed the test that assets are more than twice annual cash outflow.

Plamondon et al. (2002) considers the cost method of the CPP to be a version of the reserve ratio approach. However, it differs from the standard description of the reserve ratio approach because it does not specify an ultimate reserve ratio, but rather equates the projected reserve ratios at two future dates, separated by fifty years. This method produces a stable contribution rate for the valuation period, so in that respect it is similar to the outcome of the general average premium method; however, it does not equate the present value of future expenditure and the present value of future income over a long period and so it does not fall within the traditional characterization of the general average premium method. Accordingly, the actuarial cost method used by the CPP is considered innovative.

## **2.0 Actuarial Principles for a Cost Method**

Although Psaras (2008) presents a very nice review of cost methods used by partially funded SSRS and of occupational pension plans, he does not present any principles for a cost method. In this section, the following four actuarial principles are proposed for a cost method used for a partially funded SSRS to be considered sound and the reasons for selecting these principles are outlined.

1. The systematic accumulation over time of dedicated assets to secure benefits in respect of members' service already rendered.
2. The orderly and rational allocation of contributions among time periods.
3. Produces a stable contribution rate.
4. The funds accumulated are adequate to pay benefits in each year but not so large that they have economically detrimental effects for the country (referred to as the "Goldilocks principle").

The Standards of Practice of the Canadian Institute of Actuaries (Committee on Pension Plan Financial Reporting, 2006) have specified objectives for funding an occupational pension plan. “The objectives of funding a plan in accordance with accepted actuarial practice are the systematic accumulation over time of dedicated assets which, without recourse to the employer’s assets, secure the plan’s benefits in respect of members’ service already rendered, and the orderly and rational allocation of contributions among time periods.” This quotation, albeit not intended for social security plans, suggests the first two principles for a cost method for a partially funded SSRS.

Stability of the contribution rate has been suggested by a number of authors (such as Plamondon and Latulippe, 2004 and Menard, 2008) as a reason for financing. A stable contribution rate reinforces the link between contributions and benefits. It distributes costs more equally across generations. It promotes greater public confidence in the scheme. If the contribution rate is modified to recognize the long-term implications of plan amendments, it promotes fiscal discipline and governance.

Presumably an objective of partial funding is that the fund be sufficient to provide for any shortfall in contributions in any particular future year. Provided that the partial reserve is not negative in any future year, how large might the partial funding be? Certainly an upper limit on partial funding is the full funding limit. How close to the full funding limit may partial funding rise, in principle, and still be considered partial funding?

A SSRS exists within a country (or possibly a transnational) context and is designed to enhance the conditions within the country. If the funding of the SSRS has achieved the principles already listed, then any excess funding, which has economically detrimental effects for the country should be considered inappropriate. Examples of economically detrimental effects include the following: the size of the funds accumulated become so large that they crowd out private investment; the funds accumulated become so large that there are not sufficient investment opportunities of appropriate risk level in which to invest, resulting in the investment in risky projects at inadequate risk premiums; the rate of contribution is so high that tax revenues required for other important services were unavailable, such as education or health care.

These two considerations suggest that the level of partial funding should be “just right”, i.e., the Goldilocks principle.

### **3.0 An Assessment of the CPP Cost Method**

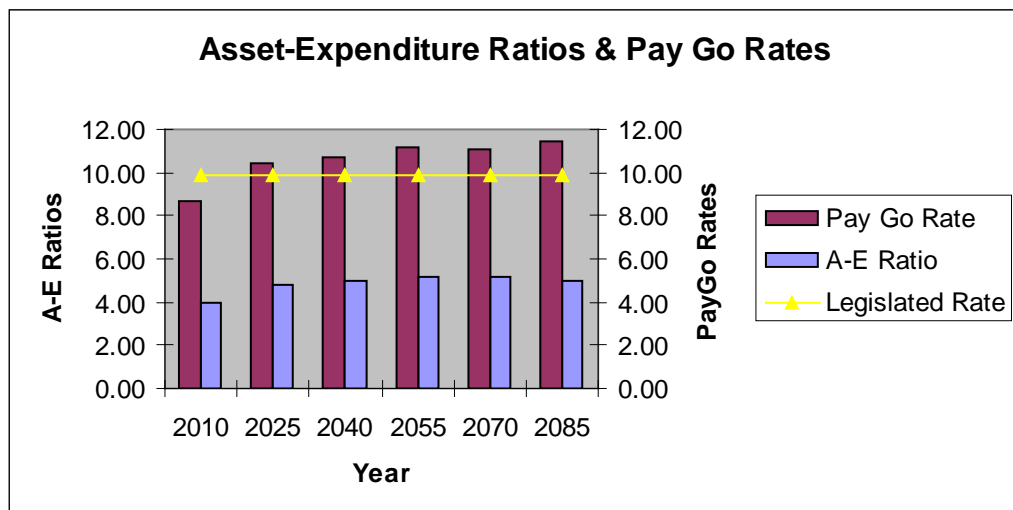
In 2010, the Pay Go rate was estimated to be 8.65% (Office of the Chief Actuary, 2010), which exceeds the legislated rate of 9.9% of covered earnings, so there are excess funds available for investment. The actuarial report also shows a minimum contribution rate (MCR) of 9.86% for years 2013 to 2022 and 9.85% thereafter (ibid).

The MCR consists of two components, both calculated on the basis of the actuarial assumptions using a seventy-five year projection period from the valuation date. The steady-state contribution rate is the smallest level contribution rate to the nearest 0.001% for which the projected ratio of assets to expenditures ten years after the review period is equal to the projected ratio of assets to expenditures sixty years

after the review period, i.e., thirteen years and sixty-three years after the valuation date. The report quotes the steady-state contribution rate as 9.84% (ibid). The second component of the MCR is an additional amount to fully fund an amendment to the CPP with respect to disability benefits. This component adds an additional 0.02% to the MCR for the years through 2022 and 0.01% thereafter (ibid).

It is the method of calculating a steady-state contribution rate by equating a projected ratio of assets to expenditures at two dates that makes this an innovative cost method and potentially a significant contribution to actuarial science. The steady-state contribution rate calculated is quite stable.

The following chart shows for various years the asset-expenditure ratios and the Pay Go rates, compared to the legislated contribution rate of 9.90%. Despite the Pay Go rate being above 9.90% for most of the observation period, the assets remain at a significant level, approximately five times expenditures from 2025 to 2085; hence, the plan is well funded and the funded percentage, measured in terms of annual expenditures is stable and the legislated contribution rate may be maintained.



Source: Office of the Chief Actuary, 2010

Based on this author’s assessment, the cost method satisfies the principle of a systematic accumulation of dedicated assets and the principle of a stable contribution rate. Since the valuation method used does not provide for any minimum level of partial funding or any maximum level of partial funding, it is possible that the cost method would not satisfy the Goldilocks principle. The cost method provides for an orderly allocation of contributions. In the remainder of this section it is shown that the cost method does not provide for a strictly rational allocation of contributions.

### 3.1 Rational Allocation

For rationality to hold, the cost method should produce a logically consistent result, in all circumstances, not just in the most likely set of circumstances. For this analysis, an action is considered rational if it is the action that would be taken by a rational and prudent person who was saving for retirement. For example, if a rational and prudent person experienced a period of extraordinarily strong investment performance, it would be rational to reduce the rate of saving (or possibly maintain it) but it would not

be rational to increase the rate of saving. Similarly, if a rational and prudent person experienced a period of extraordinarily poor investment performance, it would be rational to increase the rate of saving (or possibly maintain it) but it would not be rational to reduce the rate of saving.

In the context of assessing the cost method, an example of rationality would be if there were a one-time shock to the system, then the system should respond by an appropriate adjustment in the MCR. Specifically, if there were an extraordinarily strong investment return achieved, then the rational response would be a decrease in the steady-state contribution rate. However, as will be shown, there are certain circumstances, in which such an extraordinarily strong investment return might lead to an increase in the steady-state contribution rate, which is logically inconsistent and not rational. Therefore, the cost method does not meet the standard to be labelled categorically as rational.

The following simplified mathematical analysis of the CPP cost method illustrates this contention.

Some approximations are used for simplicity of discussion. Use <sup>e</sup> for expected, <sup>a</sup> for actual. Define  $A_t$ ,  $C_t$ ,  $E_t$ , and  $I_t$  as the assets, contributions, expenditures, and investment income for year  $t$  respectively. Also define  $i$  as the rate of interest according to the actuarial assumptions and assume that the expected investment return can be approximated by assuming that all contributions and expenditures occur half way through the year.

Suppose  $\frac{A_{13}^e}{E_{13}^e} = \frac{A_{63}^e}{E_{63}^e} = r$  under the assumptions, prior to any investment shock.

Suppose  $A_t^e = A_{t-1}^e + C_t^e - E_t^e + I_t^e$   
and  $I_t^e = i[A_{t-1}^e + 1/2(C_t^e - E_t^e)]$ .

Let there be a shock so investment return in year 0 is  $I_0^e + \Delta I_0$   
and  $A_0^a = A_0^e + \Delta I_0$ .

Then

$$A_1^a = A_0^e + \Delta I_0 + C_1^e - E_1^e + I_1^a = A_1^e + (1+i)\Delta I_0$$

$$I_1^a = i \left[ (A_0^e + \Delta I_0) + \frac{1}{2}(C_1^e - E_1^e) \right] = I_1^e + i\Delta I_0$$

Then

$$A_2^a = A_1^e + (1+i)\Delta I_0 + C_2^e - E_2^e + I_2^a = A_2^e + (1+i)^2 \Delta I_0$$

$$I_2^a = i \left[ (A_1^e + (1+i)\Delta I_0) + \frac{1}{2}(C_2^e - E_2^e) \right] = I_2^e + i(1+i)\Delta I_0$$

Then, it follows that  $A_{13}^a = A_{13}^e + (1+i)^{13} \Delta I_0$

And that  $A_{63}^a = A_{63}^e + (1+i)^{63} \Delta I_0$

So 
$$\frac{A_{13}^a}{E_{13}^e} = \frac{A_{13}^e}{E_{13}^e} + \frac{(1+i)^{13} \Delta I_0}{E_{13}^e} = r + \frac{(1+i)^{13} \Delta I_0}{E_{13}^e}$$

and 
$$\frac{A_{63}^a}{E_{63}^e} = \frac{A_{63}^e}{E_{63}^e} + \frac{(1+i)^{63} \Delta I_0}{E_{63}^e} = r + \frac{(1+i)^{63} \Delta I_0}{E_{63}^e} .$$

Then the two ratios will be equal if  $\frac{(1+i)^{13} \Delta I_0}{E_{13}^e} = \frac{(1+i)^{63} \Delta I_0}{E_{63}^e}$  or if

$$\frac{E_{63}^e}{E_{13}^e} = \frac{(1+i)^{63} \Delta I_0}{(1+i)^{13} \Delta I_0} = (1+i)^{50}$$

Note that  $(1+i)^{50}$  is determined by the assumptions. Since the assumptions are not being changed, it is a constant.  $E_{63}^e$  and  $E_{13}^e$  are determined by the plan provisions, economic and demographic developments. Although they may also appear to be constant, they are defined by reference to other items, as shown by rearranging the equation of expected terms, as follows:  $E_t = C_t + I_t + A_{t-1} - A_t$ . By changing the contribution rate, all the terms on the right hand side of the equation will change over time.

If  $(1+i)^{50}$  is greater than the expected expenditure ratio (in year sixty-three to year thirteen), then without changing the actuarial assumptions, the desired ratio of expected expenditure can be achieved by reducing the contribution rate, which reduces the expected investment income, which has a twofold impact on the growth of assets. It reduces assets because there are lower contributions and also because there is less investment income. But it has a proportionately greater effect (reduction) on the shorter term expected expenditures than on the longer term expected expenditures. At present, this is the situation with respect to the CPP. With  $i$  equal to approximately 6.7% nominal,  $(1+i)^{50}$  equals 25.6, which greatly exceeds the expected expenditure ratio, e.g., the ratio of expected expenditures in 2069 to 2019 is 9.3.

However, if  $(1+i)^{50}$  is less than the expected expenditure ratio, then without changing the actuarial assumptions, the desired ratio of expected expenditure can be achieved by increasing the contribution rate, which increases the expected investment income and so has a twofold impact on the growth of assets. It increases assets because there are higher contributions and also because there is more investment income. But it has a proportionately greater effect (increase) on the longer term expected expenditures than on the shorter term expected expenditures. So, for example, this situation would occur for an expected expenditure ratio of 9.3 whenever  $i$  is 4.56% per annum nominal or less.

This effect is illustrated in the following table. For the cases A and B, where  $i$  is greater than 4.56% per annum nominal, the steady-state contribution rate behaves logically. If investment income experiences a special shock of an additional 50% return in 2007, then the steady-state rate decreases; whereas if investment income experiences a special shock of a 50% decrease in investment return in 2007, then the steady-state rate increases. All other assumptions are unchanged.



However, for cases C and D, where  $i$  is less than 4.56% per annum nominal, the steady-state rate behaves illogically. If investment income experiences a special shock of an additional 50% return in 2007, then the steady-state rate increases; whereas if investment income experiences a special shock of a 50% decrease in investment return in 2007, then the steady-state rate decreases. All other assumptions are unchanged.

**Table 1 Impact Of Extraordinary Investment Shock in 2007 on Steady-State Contribution Rate (SSCR)**

Case	Assumed Interest Rate	SSCR Before Shock	SSCR After +50% Shock	SSCR After -50% Shock	Rational
A	6.7%	9.802	9.475	10.218	Yes
B	8.0%	9.002	8.441	9.716	Yes
C	4.0%	11.458	11.548	11.340	No
D	4.25%	11.294	11.325	11.226	No

Source: based on data supplied for December 31, 2006 valuation of CPP

It might be asked how likely is it that the nominal rate of interest assumed might be 4.56% or less, say a 2% inflation rate combined with a 2.5% real rate of return? The Bank of Canada has done a very good job over the last two decades in maintaining the inflation rate within a tight range centred on 2% per annum. In view of this past performance, it is likely that the Bank of Canada will continue to maintain the inflation rate close to 2% per annum. Although a real rate of return of 2.5% would be considered low, it is certainly within the plausible range; thus a long-term nominal rate less than 4.56% is conceivable. In such economic circumstances, it might be argued that it would not be desirable to operate on a partially funded basis. A discussion of the economic support for long range economic assumptions regarding the distant future is beyond the scope of this paper. However, the point has been demonstrated that the cost method does not meet a rigorous definition of rationality.

Moreover, given that the valuation method makes adjustments in a different way depending on the assumed nominal interest rate, it can be said not to operate consistently across all markets. A failure to be market consistent is further evidence of the lack of rationality.

## 4.0 Conclusions

Both the CPP and QPP are considered to be examples of partially funded SSRS. This paper proposes the following principles for an actuarial cost method for a partially funded SSRS to be considered sound:

1. The systematic accumulation over time of dedicated assets to secure benefits in respect of members' service already rendered.
2. The orderly and rational allocation of contributions among time periods.
3. Produces a stable contribution rate.

4. Goldilocks principle – funds accumulated plus current contributions are always at least sufficient to pay benefits and are not so large as to have an economically detrimental effect.

CPP uses an innovative cost method to calculate the steady-state contribution rate. It meets the first and third principles and the first part of the second principle regarding orderliness; however, the cost method for the CPP is not considered to meet the test for rationality in all circumstances. Moreover, there is no assurance that it would meet the fourth principle.

Under some economic and demographic assumptions, an extraordinarily strong investment return (shock) might lead to an increase in the contribution rate, which is a logical inconsistency. Also, under the same economic and demographic assumptions, an extraordinarily negative investment return (shock) might lead to a decrease in the contribution rate, which is also a logical inconsistency. Moreover, the cost method does not test to determine if the ratio of assets to expenditures is at least equal to one in all years, which is a desirable refinement consistent with the principle of rationality.

In conclusion, the cost method adopted by the CPP is innovative and appropriate in most circumstances; however, in applying it, care must be taken to ensure that the combination of demographic and economic assumptions is such that any adjustments to the contribution rate are rational. If such care is taken, the cost method could be considered for use by other SSRS, which are to be managed on a partially funded basis.

## 5.0 Acknowledgements

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