Social Security:

Paygo Financing and Privatization Exacerbate Poverty

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Executive Summary

Nowadays, the two most common forms of national retirement pension systems are centrally administered public defined benefit (DB) plans, which are normally financed on a quasi pay-as-you-go (*paygo*) basis, and mandatory private defined contributions (DC) plans, i.e. individual accounts programs that are normally fully funded. Despite the generally accepted overall soundness of these major types of systems, this paper argues that a third, more effective and affordable type of social security system deserves to be promoted. It is a hybrid of the above-mentioned systems and simply consists of a funded centrally administered public program. This proposed system could be designed on either a DB or a DC basis, as the difference between these two bases is somewhat immaterial within the framework of a centralized public system. Under this proposed system, full funding is preferred to paygo financing and public centralized administration is preferred to a fragmented private system for the following reasons:

1. **Full funding**
   While paygo financing has at times been unduly and overly criticized, the validity of this approach now appears to be accepted with excessive complacency. Because it implies an inequitable allocation of costs between successive generations of contributors, its use should be avoided wherever possible. Full funding appears to be the only financing approach truly consistent with the social objectives contemplated by national pensions systems because it:
   - Provides optimal social value by allowing all contributors, lower income earners in particular, to participate in, and get real value from, the gross national production not only through their work but also through their injection of investment capital in the economy via their contributions to the funded social security program.
   - Underlies a fairer claim on benefits that is based on individual ownership rather than the government power to tax.
   - Reallocates income on an intra rather than an inter-generational basis, which ensures that current generations do not get richer or poorer at the expense or benefit of preceding or subsequent generations.
   - Provides an optimal degree of individual and collective equity in terms of the close relationship between contributions paid and benefits received by successive cohorts of participants in the social program.
   - Prevents the social security program from being a further capitalistic tool that widens the gap between rich and poor people by not allocating investment earnings on deposits.
   - Is not affected by that part of the aging process resulting from lower fertility.
   - Subjects the contribution rate to an optimally low degree of volatility from year to year.
   - Is one of the key means of ensuring optimal compliance with the payment of social security contributions by virtue of the above-mentioned advantages.
   - Due to its normally much lower level of contribution rates compared to paygo financing,
     - Further reinforces willingness to comply with the program
     - Provides lower income earners with less straining earnings both before and after retirement.

2. **Public centralized administration**
   As they are fully funded, mandatory private individual accounts systems would appear to be a good approach for providing the above-mentioned advantages of full funding and overcoming the issues affecting programs financed on a paygo basis. However, the private approach is unduly costly compared to the public approach because it is run for profit and structured on a fragmented rather a centralized basis. International experience in both developed and developing countries indicates that the issue of higher intrinsic operating costs affecting private systems is generally exacerbated by abusive charges. Ceteris paribus, the contribution rate under funded private systems is accordingly practically at the same level as under a public centralized system financed on a paygo basis.

Under a fully funded public system, therefore, the contribution rate is lower than under any of the two most common systems, and the serious cost equities inherent to the paygo financing approach are avoided.

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A- Introduction

Over the past few decades, most, if not all social retirement pensions systems in the world have experienced rising costs that are projected to reach, if not already the case, very high, unsustainable and/or unaffordable levels within the next coming decades of the 21st century. As explained below, population aging and ineffective governance are the two main causes for such pension cost increases.

1. Aging

Most populations of the world are aging.

The first and more obvious reason for aging is that people gradually live longer due to increased standards of living, medico-technological developments (e.g. drugs, surgery, and eventually genetics) and other factors such as "*nutrition, child spacing and family size, housing and public sanitation"* (Brown, 1998). Although the resulting improvements in longevity currently projected for Canadian social security programs are small on a yearly basis, i.e. about one week at birth and two weeks at age 65 are projected to be gained by those born in a given year compared to those born in the previous year, expert demographers do not foresee when the sustained declines in mortality rates observed in developed countries during most the 20th century could ever halt. At these hypothetical paces, life expectancy at age 65 in year 2100 will be increased by about five years.

Irrespective of the financing approach of a retirement pension program (e.g. paygo, full funding, partial funding), sustained longevity improvements (i.e. mortality declines) increase pension costs every year by a small proportion. For a plan with a normal retirement age of 65, that small annual percentage increase might well be in the neighbourhood of 0.3%. Under such circumstances, a contribution rate of 10% would need to be increased to 10.03% after the first year, to 10.0601% the second year, and so on until it would reach a level of 10.30% after 10 years, 10.78% after 25 years, 11.62% after 50 years, and 13.49% after 100 years. In other words, mortality declines may be expected to increase pension costs by 35% over a period of 100 years.

The second and more important reason for population aging is the worldwide trend of decreasing fertility rates during the 20th century, especially over the last 35 years in most developed countries and some developing countries such as China. With fewer children, a population increases at a lower rate, or even gradually shrinks if the total fertility rate is less than two. Ceteris paribus, the lower the total fertility rate, the lower the proportion of children in the population, and therefore the higher the proportion of elderly people. The effect of lower fertility on pension costs does eventually plateau after fertility rates reach a certain floor value, e.g. 2.0. Nonetheless, assuming mortality rates at levels currently prevailing in North America, an aggregate decrease of the total fertility rate from 3.0 to 2.0 would over time (about 75 years) approximately double the age dependency ratio (i.e. proportion of people over age 65 to people in the 18 to 64 age range).

Contrary to lower mortality, lower fertility does not affect pension costs of programs that are fully funded through the entry age actuarial cost method. Indeed, in the absence of productivity, or if pensions are indexed to wages, a doubling of the age dependency ratio exclusively due to a reduced fertility rate (e.g. from 3.0 to 2.0) would under stabilized conditions double the paygo contribution rate of a national retirement pension program, while the contribution rate would not be affected under the entry age actuarial cost method.

2. Ineffective governance

The second cause for higher or increasing pension contribution rates is ineffective governance in terms of:

- Inappropriately high administrative costs.
- Unduly high expenditures ensuing from inconsistent benefit provisions such as replacement rates being excessive or tied to only a few of the most lucrative years of the contributory period.
- Poor compliance with the payment of prescribed contributions, which may result from many factors such as an inefficient tax collection system, a large informal sector, difficulty to encompass self employment such as within the farm sector, and/or various flaws in the pension program financing and benefit provisions, such as e.g. reluctance to participate if contributions are deemed too high in proportion, or not related, to benefits.

Although poor compliance has so far been observed mainly in developing countries, likely because of their generally higher informal sector, it could also emerge to some extent in developed countries over the next 30 years if the paygo financing approach were to remain the prescribed approach. Population aging will indeed cause sizeable increases in paygo contribution rates in the coming decades, which contributors may seriously resent.

Therefore, ineffective governance may pertain to either or both the public and the private sectors. However, even under optimal effective governance conditions, operating costs are normally lower with a centrally administered system than with one that is fragmented. As the management of a national social security program cannot generally be done on a true centralized basis through the private sector, and as private business operates on a profit rather than a social basis, the level of administration expenses and of the investment returns allocated to the individual participants can be optimized only if a social security program is run publicly rather than privately.

The purpose of this paper is therefore to discuss the level of operating costs of social security programs and propose a governance framework that would optimize not only their contribution rates but also their equity in relation to pension benefits. This framework consists of doing the administration on a centralized basis and the financing of pensions costs on a full funding basis.

B- Respective merits of public centrally administered programs and mandatory private plans

In light of the most common international practices for the governance of social security programs, it is sometimes taken for granted that defined benefit plans are implicitly sponsored by governments and financed on a paygo basis, and that defined contribution plans are private and financed on a funded basis. However, defined contribution plans may not only be publicly sponsored but also financed on a paygo basis. So-called notional accounts have been recently implemented in Sweden, and in some sense in China. As well, defined benefit pans could be sponsored on a national basis through the private sector for social security purposes, though no program of this type would appear to exist presently. However, private plans are normally run on an advance-funding basis. In any event, the objective of this section is to highlight the respective merits of the public and private channels through which a social retirement pension program can be run, regardless of the various ways a social program can be designed under either channel.

Although private national social security programs would normally be expected to benefit greatly from the valuable equity they provided through full funding, both in terms of ownership and fairness of pensions, it is unclear whether that objective can ever be met in a satisfactory manner. This is due to the erosion of equity entailed by the underlying administrative fees, which are much higher than would be the case, by virtue of the economies of scale, under a centralized administration system. As the management of a national social security program may be done on a true centralized basis only through the public sector, privatization appears as a weak alternative to the governance of such a program, especially considering that a publicly administered program may itself operate on a full funding basis.

The annual operating costs of the Old Age Security and Disability Insurance (OASDI) national program in the USA represent about 1% of benefit expenditures, while they represent about 1.3% for the Canada Pension Plan (CPP) and 1.4% for the smaller (about one third of the CPP) Quebec Pension Plan (QPP). A charge of 2% of assets is normally levied annually in respect of contributions made to a private Registered Retirement Saving Plan in Canada. An additional charge of about 5% also applies to the accumulated assets when they are used to buy a lifetime retirement pension once the applicant is over age 60 (but under 70). Other charges may also apply, but as a minimum, it can be seen that the level of operating charges under private means is at least four times as large as under public means. Experience indicates that it is much more. Indeed, this issue of intrinsically higher administrative costs of private individual accounts is further exacerbated by abusive charges. Sinha (2000) makes a good case for the abusive private operating costs applying generally to the Latin American private individual accounts systems. Likewise, the March 1999 report *Administrative Costs in Individual Accounts in the United Kingdom*, based on a WB research project, shows that administrative fees and other costs consume more than 40% of contributions.

In addition to these disappointing observations regarding the level of administrative costs of private decentralized individual account systems, an ironic aspect of the privatization of social programs is that it sets a platform for counteracting precisely what social security programs are designed to accomplish. Indeed, even if ideally engineered, privatization happens to revert back to individuals the responsibility of saving properly for retirement, a task at which they have generally failed in the absence of mandatory programs.

History shows clearly that even in the most developed countries, where private retirement savings are largely promoted at the individual and group (employment) levels through tax shelters and other means, a large proportion (often at least 50%) of people do not avail themselves of these tax advantages, and similar proportions of individuals find themselves with very inadequate (below poverty level) income in retirement, unless they get financial assistance through earnings-related social retirement programs. Canada is a patent example of such experience.

This explains why income-tested and earnings-related social programs exist in many countries, i.e. to alleviate poverty and maintain a portion of individuals' standards of living in retirement, respectively. These public programs are generally of a defined benefit type, as opposed to the defined contribution basis of the private individual accounts systems. However, this difference is not significant, as contributions and benefits have to come into balance in the pension equation, as highlighted in the pension cost formula presented in section D-1.

Compliance with private individual account systems may be affected by their abusive administration charges, because the resulting internal rate of return is not much better than under a public program financed on a paygo basis. Indeed, expressed as a percentage of contributions, the administrative charges of a funded program would have to rise to about 22% of contributions before the net return on pension assets becomes lower than the internal rate of return underlying a centrally administered public program that is financed on a paygo basis. The above-mentioned average level of operating costs experienced by private individual accounts in UK and in Latin American countries already exceeds that 22% breakeven point. This level of 22% was assessed using the pension cost formula presented in subsection D-1 and is consistent with current demographic conditions whereby the aging process is not yet competed and the underlying fertility rate would be 3.0, corresponding to a demographic rate of increase of about 2.2% and an age dependency ratio (population over age 65 to population at ages 18 to 64) of about 16%. When the aging process would be matured, e.g. fertility at 2.0 associated with a demographic rate of increase of -0.2% and a dependency ratio of 36%, the administrative breakeven point is increased from 22% to about 66%.

A publicly administered program may itself operate on a full funding basis. This option is often disregarded as a valid option because of reports of governmental interference and abuse over the control of the huge public funds involved, particularly in developing countries. This issue is discussed in subsection D-3.

C- Range, correlation and behaviour of key long-term demographic and economic assumptions

The merits of a given financing approach over another (e.g. full funding vs. paygo or partial funding) depend on various factors. Of key importance is the level of the financing approach's contribution rate. Beyond the financing approach itself, the factors that affect pension cost levels may be separated into two major categories: assumptions and plan provisions.

Section D-1 deals, inter alia, with the determination of the contribution rate of an earnings-related retirement program under stabilized conditions. For this purpose, use is made of the mathematical formula accurately reproducing the ultimate cost of an indexed earnings-related retirement pension under both the paygo financing approach and the entry age (full funding) method. This formula relies on four plan parameters and four assumptions that synthesize all key assumptions involved in pension costs, with the exception of administrative expenses and income taxes. One of the plan parameters is the pension indexation rate, which introduces the inflation rate as a fifth assumption, should the pension indexation rate be tied to inflation.

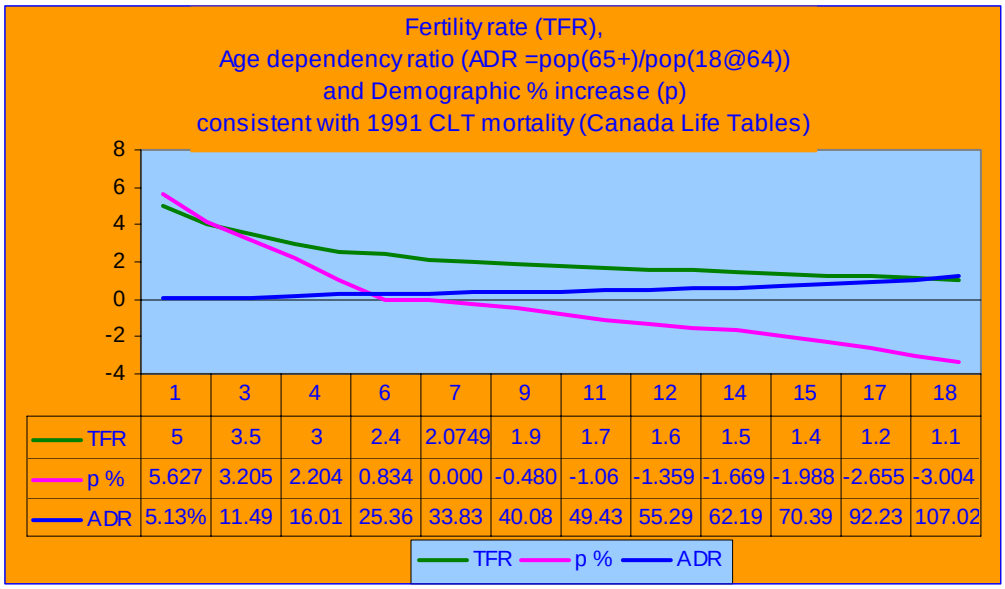
This section looks specifically at the full set of key demographic and economic assumptions that affect pension costs in the long term, except, as stated above, administrative expenses and income taxes. Operating costs could differ somehow for a national pension program depending on the applicable financing basis, i.e. paygo or full funding. This aspect is not addressed herein but the higher operating costs of private systems are discussed in the preceding section.

This section presents some theories whereby assumptions interact on average in the long run in a manner that differs from their behaviour in the short term and that allows one to draw some conclusions on the absolute (e.g. expected range) and relative (paygo versus full funding) level of contribution rates. No one knows the future, but the effect of the wide range of possible ultimate assumptions is somewhat attenuated in the long run by these theories and their associated rules.

In order to reflect as simply as possible the relative value of assumptions expected on average in the long run, stabilized conditions are deemed to apply. This happens to be convenient for the above-mentioned pension cost formula, into which assumptions are fed, which would otherwise lose its useful simplicity. Stabilized conditions mean that the various factors affecting pension costs are assumed to vary at a constant annual rate, e.g. an interest rate, an average earnings increase and an inflation rate of 7%, 4% and 3%, respectively. With stabilized conditions, it can be proven (stated but not demonstrated herein) that:

- A population ultimately increases or decreases each year (at each age for either gender) at a constant rate that depends on the assumed constant fertility, mortality and migration rates. Because longevity improvements stem from mortality rates that are not constant, *ceteris paribus* they prevent a population from being stabilized. Declines in mortality rates are accordingly not involved in the ultimate pension cost measurements used for discussion purposes in the next section but are nonetheless discussed in the framework of constant assumptions developed below.

- Assuming no migration, the age dependency ratio (e.g. ratio population aged 65 and over to population aged 18 to 64) of a stabilized population depends, given a specific set of mortality rates, on the level of the assumed constant fertility rate. The relationship between the fertility rate, the demographic increase rate and the dependency ratio are shown in the graphic below for various levels of fertility. These values were derived assuming constant mortality at the 1991 Canadian level (Canada life tables for 1991, i.e. 1991 CLT). It can be seen that a drop of 1.0 in the fertility rate doubles the age dependency ratio if the fertility rate is about 3.0, but that it takes a lower drop to achieve the same result if the fertility rate is lower than 3.0, and vice versa.



	1	3	4	6	7	9	11	12	14	15	17	18
TFR	5	3.5	3	2.4	2.0749	1.9	1.7	1.6	1.5	1.4	1.2	1.1
p %	5.627	3.205	2.204	0.834	0.000	-0.480	-1.06	-1.359	-1.669	-1.988	-2.655	-3.004
ADR	5.13%	11.49	16.01	25.36	33.83	40.08	49.43	55.29	62.19	70.39	92.23	107.02

Source: Author's model "DOSOPRO Stabilized earnings and benefits modeling"

- Contributions, benefit expenditures and the fund (partial or full) all increase at the assumed rate of increase in covered payroll, which itself corresponds to the compounded assumed rates of increase in average covered employment earnings and participation in the program. In that connection, stationary conditions are a sub-case of stabilized conditions whereby the population is stable (e.g. no migration and fertility corresponding to a net reproduction level of 1) and there is no inflation and no increase in covered average salaries, notwithstanding the level of the return on pension assets.

Consistent with the formula used for the measurement of pension costs discussed in Section D and with the above definition of stabilized conditions, only the following five key assumptions, or demographic and economic factors, affect the cost of an earnings-related pension:

1. The rate of inflation (i.e. the annual rate of increase in the Consumer Price Index or CPI), which affects pension costs only if benefits are indexed at a rate that is tied to inflation.

2. The annual rate of increase in the annual average covered earnings of participants.

3. The interest rate, i.e. the annual nominal rate of return or yield on pension assets, which affects pension costs only if the program is financed on a basis other than paygo (i.e. fully or partially funded).

4. The annual rate of increase in participation in the program, which affects pension costs if the program is financed on a paygo basis or the unit credit actuarial cost (full funding) method. The contribution rate under the entry age normal actuarial cost method is not affected by the rate of increase in participation under stabilized conditions. Participation in a national earnings-related pension program depends on the applicable eligibility rules, the employment rate, the size of the population at working ages and the rate of compliance with the program. Because the eligibility rules, the employment rate and the compliance rate cannot change indefinitely in the future, the rate of increase in participation in the program corresponds exclusively, under stabilized conditions, to the constant annual demographic increase.

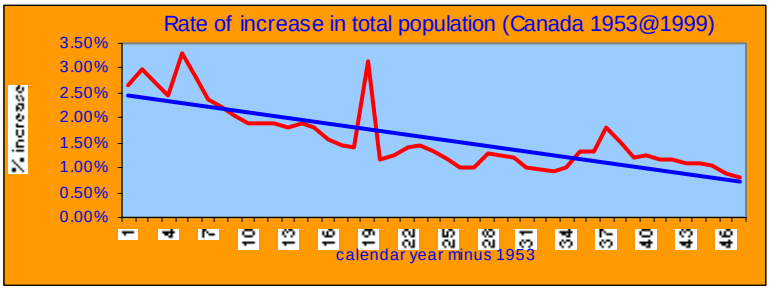
5. The constant set of mortality rates by individual ages and gender.

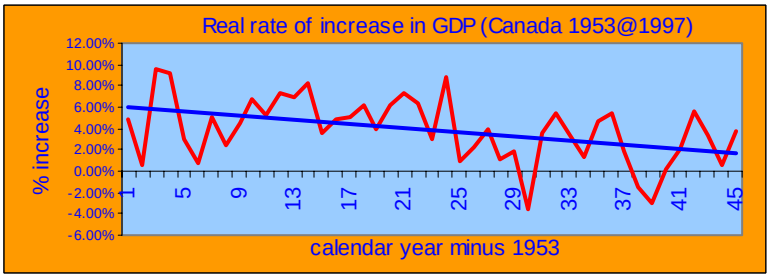
There are implicitly more than five assumptions involved in ultimate pension costs. Some demographic assumptions, i.e. fertility rates by age, male/female birth ratio, immigration and emigration rates by age and gender, are apparently missing in the above list. However, these are actually encompassed by the rate of increase in participation in the program (item 4 above). In a similar vein, annual increases the Gross Domestic Product (GDP) and unemployment rates are also explicitly absent from the above list of five key assumptions, as they are implicitly and appropriately covered through the rate of increase in average covered earnings (item 2 above) and the employment rate (referred to in item 4 above), respectively.

In setting the pension cost-related ultimate assumptions, it must be kept in mind that although the absolute value of each assumption must make sense (e.g., for the inflation rate, 0% would appear too low and 10% would normally appear too high in the long run), their relative value (e.g. real rate of return on investments, i.e. difference between the yield on assets and the inflation rate, and real earnings increases, i.e. the difference between the increase in average earnings and inflation) is of exclusive importance in estimating the ultimate contribution rate of a pension program under which benefits are earnings-related and/or indexed to inflation. Indeed, for a plan indexing benefits to inflation, the ultimate pension cost would be exactly the same whether inflation, salary increase and return on investments were set at 3%, 4% and 7%, respectively, or 4.5%, 5.51% (i.e. (1.04/1.03)*1.045 - 1) and 8.56%, (i.e. (1.07/1.03)*1.045 - 1), respectively.

As national pension programs are ongoing programs, assumptions have to be determined in a manner consistent with the macro-economic self-adjustments that are hereby deemed to take place over the long run. Any correlation between any two single assumptions accordingly has to be taken into account in selecting any given set of assumptions for the calculation of ultimate pension costs. In that sense, the case is now made that on average in the long run the demographic and economic assumptions involved in the ultimate pension cost behave and interact as follows:

- The real economic growth rate, i.e. the real increase in GDP or in the national payroll, corresponds to the demographic growth rate plus a residual rate, not necessarily positive, deemed to correspond to the average national productivity rate. This theory presumes that the size of the GDP is proportionate to the size of the population, but also includes a productivity margin consistent with a gradual increase, or decrease, in standard of living on the long run. The results corresponding to 1953-1997 Canadian experience shown in the following two graphics are fairly consistent with that theory. The linear regression lines are included to highlight trends. These results are further discussed below in conjunction with the experience on investment returns shown in the second following bullet.

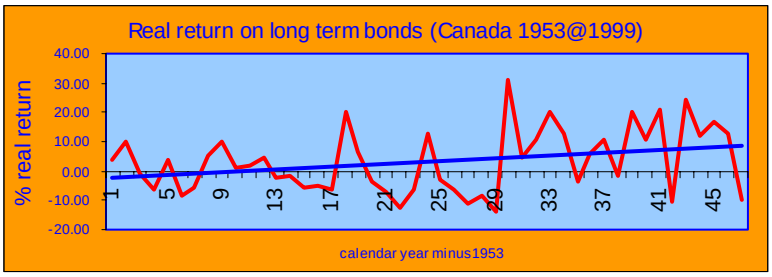




Source: Graphic by author using CIA Report on Canadian Economic Statistics 1924-1999

- The residual productivity rate corresponds, as described in the preceding bullet, to the geometric difference between the assumed real economic growth and the assumed demographic rate of increase. The residual productivity rate is deemed to be commensurate with the age dependency ratio (ratio of the population over age 65 to the population at ages 18 to 64), i.e. the lower the age dependency ratio, the higher the productivity rate. In that sense, an increase in the normal retirement age coupled with an aging of the population would not necessarily increase productivity. Material aging could thereby even entail negative productivity and therefore a decrease in the per capita GDP. In any event, a positive productivity rate may have some perverse effects on economic growth, as on a micro basis an employer might, in order to reduce operating costs, pursuant to increased productivity, reduce its workforce rather than produce more goods and services.

- The real rate of return on assets corresponds to the residual productivity rate grossed-up for taxes. This theory presumes that investors expect a non-negative net real return on investments that matches the productivity rate. In other words, someone's income stemming exclusively from investments would accordingly keep in line with the average increases in standard of living. The nominal return on assets is therefore larger than the nominal economic growth rate if the geometric sum of the inflation rate and the productivity rate, grossed up for taxes, exceeds the geometric sum of the demographic growth and the residual productivity rate. With a nil income tax rate, this would ensue if the inflation rate were greater than the demographic growth rate. The 1953-1997 Canadian experience regarding the return on long-term bonds is shown in the graphic below.



Source: Graphic by author using CIA Report on Canadian Economic Statistics 1924-1999

The following table combines the results of the above three graphics in a manner consistent with the definitions and long-term economic theories set forth above.

	Canadian experience	
	44-year averages (1953-1997)	20-year averages (1977-1997)
Average increase in total population (p)	1.54%	1.18%
Average nominal increase in GDP (e)	8.18%	7.06%
Average inflation (k)	4.21%	4.87%
Average real rate of increase in GDP (e_r =((1+e)/(1+k))-1)	3.81%	2.09%
Residual productivity (t=((1+e_r)/(1+p))-1)	2.23%	0.90%
Nominal wage increase s=((1+t)*(1+k))-1	6.54%	5.81%
Average gross nominal return on long-term bonds (i)	7.71%	12.46%
Tax rate (x)	45.0%	45.0%
Net real return (i_{nr} =((1+i*(1-x))/(1+k))-1)	0.02%	1.90%
Average real return on bonds (i_r)	3.35%	7.24%

Source: Author's calculations using CIA Report on Canadian Economic Statistics 1924-1999

Notwithstanding the downward trends for the demographic and the GDP rates of increases and the upward trends for the return on long-term Canada bonds, which depend on several factors (e.g. post-war economy, early 1980s and 1990s recessions, baby-boomers,) the Canadian economic experience for the above 44-year and 20-year periods espouses fairly well the above theories:

- The fall in demographic increase matches a fall in economic growth.
- The productivity rate gets lower with the aging of the population.
- The real return (on bonds) net of taxes is positive, though higher than productivity only for the 20-year period.

- Longevity improvements (reminder: they prevent the pension contribution rate to ever become constant, as they are inconsistent with stabilized conditions) are commensurate with the productivity rate. In other words, it is deemed that if there is positive productivity, longevity will improve (i.e. mortality rates will decline), and vice versa. Moreover, the higher the productivity rate, the larger the longevity improvements. This theory is not and may not be ever rigorously demonstrated but is supported in some sense by the following observations:

    - The unprecedented increases in standard of living (measured as the GDP per capita) over the 20th century in developed countries have been accompanied by unprecedented increases in mortality declines at all ages.

    - Several statistical studies have clearly demonstrated that on average higher mortality is experienced by persons with lower employment earnings, and vice versa, i.e. the higher the earnings, the lower the mortality rates. It may then be concluded that the higher earnings associated with a higher rate of productivity should normally be accompanied by lower mortality rates.

    - Likewise, several studies have established a strong relationship between higher unemployment rates and higher disability incidence, as well as between higher disability prevalence and higher mortality rates. As productivity and employment are obviously low during recessions, the case can then be made that low productivity is associated to some extent with higher mortality.

A framework of benchmark assumptions for the long-tem constant pension cost can now be determined as follows on the basis of the above rules and theories.

- Fertility has already dropped below the net reproductive level of 1 in aggregate for most, if not all developed countries. Although the total fertility rate has also materially decreased since the mid-1960s in developing countries, it is still higher than 2 in many of them. However, due to the one child policy in China, the total fertility rate has already dropped below 1.9 on average in urban areas. Therefore, it appears reasonable to assume a long term stabilized negative rate of demographic change of 0.2%, which corresponds to a total fertility rate of about 2.0 assuming current Canadian mortality and which is slightly below the rate of about 2.07 corresponding to a net reproduction rate of 1. This would correspond to an average worldwide demographic decrease of 0.2% in the long term. It is not thereby expected that the world population will shrink indefinitely but rather that it would decrease at a rate of 0.2% over the next 100 years, which corresponds to a global demographic decrease of 18% over the 21st century. However, it is well known that the population of a given country may well increase at a rate quite different from that of any other country with apparently similar characteristics. For example, the demographic increase of some developed European countries is much smaller than in Canada or the U.S.A, not so much because of their lower fertility rates, but because of the migration flows from Europe to North America. Nonetheless, on a worldwide basis, net migration can only be nil.

- As explained above, the absolute level of inflation is irrelevant for purposes of determining the contribution rate. The inflation rate is therefore first set at a somewhat (though not entirely) arbitrarily level of 3%.

- Considering the above trends in the residual productivity rate for Canada (a developed country) and the not yet ended aging process, the residual productivity rate has to be assumed at a lower level than its long and medium term averages. Straight extrapolation of the trends would suggest a negative residual rate of productivity. However, consistent with mankind's desire and ability to maintain economic progress, and the fact that productivity is often higher in developing countries as long as there is room left for closing the gap in per capita production, residual productivity is hereby assumed at a level of 0.97%.

- The rate of increase in average earnings is, by definition, equal to the geometric sum of the inflation and the productivity rates. Therefore, the assumed wage increase is equals to 4%.

- The income tax rate could be set at 50% in light of the level applicable in most developed countries. However, 50% is a maximum rate, not an average rate. And income taxes do not apply in all countries. Therefore, the tax rate is assumed at an arbitrary lower level of 42.86% designed to produce a rounded figure for the rate of return on assets (next bullet).

- In accordance with the above theories, the rate of return on assets is equal to the geometric sum, grossed-up by the tax rate, of the inflation rate and the residual productivity rate. Therefore, the assumed rate of return is equal to 7%, i.e. ((1.03)*(1.01)-1)/(1-.4286). Such nominal return of 7% may be seen as a ceiling value with respect to government bonds and a floor value with respect to a diversified portfolio.

- Under such conditions, the projected constant economic growth rate would then be 3.792%, i.e. the geometric sum of the assumed rate of increase in average employment earnings of 4% and of the assumed rate of population decrease of 0.2%. If productivity were assumed at 4% rather than 0.97%, the economic growth rate would be 6.786%% instead of 3.792%. This indicates that the economic growth rate would, under the above rules and theories, be generally lower than the rate of return on investments (7%) from a diversified portfolio. This is an important consideration in the analysis of pension financing approaches, as the projected internal rate of return for a national pension program is equal to:
    - The assumed economic growth rate for the paygo financing approach
    - The assumed rate of return on pension assets for the full funding approach.

- Consistent with the above-assumed productivity rate of 0.97%, declines in mortality rates would need to be assumed in projecting the costs and liabilities of a national retirement pension program. However, as longevity cannot be deemed to improve under stabilized conditions, mortality is assumed at the recent Canadian levels (more precisely as per the Canada Life Tables for 1991, i.e. 1991 CLT) for purposes of the ultimate (or stabilized) pension cost analysis presented in the next section. As Canada is a good example of a developed country, the mortality rates of the 1991 CLT may well be seen as corresponding to the average worldwide mortality in a few decades when mortality will be lower than today in developed countries and be closer to, though still lower than, current developed countries' levels in developing countries. If the contributory period is 47 years and the normal retirement age is 65, the three components of the pension cost formula (presented in subsection D-1) that account for the effect of mortality do actually amount, on a unisex basis, using 1991 CLT, to:
    - 84.6% for the probability of surviving from the beginning to the end of the contributory period
    - 45.1 years for the life expectancy over the contributory period
    - 18.1 years for the life expectancy over the retirement benefit period

Obviously, the above set of selected assumptions is just one of an infinity of possible scenarios. But it is a realistic benchmark that was designed, along with the pension cost formula, as a consistent basis for the analysis of the range of the ultimate contribution rates of a national pension program under various scenarios of plan design, assumptions and financing approaches. Such analysis is presented in the next section. Moreover, considering the above rules and theories, extreme values for a given ultimate assumption cannot be selected without also imputing a somewhat neutralizing extreme value to one or more of the other key ultimate assumptions involved in the valuation process. For example, it would not be appropriate to assume an interest rate lower than 7% without ensuring that return on investments still make up for productivity, inflation and income taxes.

D- Comparing pay-as-you-go (paygo) financing with full funding

The objective of this section is to identify and discuss the differences between paygo financing and full funding as they may apply under stabilized conditions to a given earnings-related national retirement pension program. For this purpose, all factors affecting costs are taken into account, except administrative expenses and income taxes. Income taxes vary significantly from country to country and do in many cases have an important impact on pensions costs. However, their impact might not generally be affected by the financing approach, e.g. paygo vs. full funding. In any event, the impact of income taxes is significant and deserves to be analysed. Likewise, although the underlying level of administrative expenses could vary appreciably between paygo financing and full funding, the impact of operating costs is examined only in section B above, in connection with the applicable channel used for social security governance purposes, i.e. public or private.

Full funding means financing pension costs under a recognized actuarial cost method. Generally speaking, the assets of a funded pension plan are sufficient at any given time to provide all future pension payments due by virtue of the pension credits accrued until that time. In other words, anytime the plan would be terminated, there would be just enough money in the pension fund to pay all remaining benefits promised by the plan. To discuss pension costs, the entry age normal method was selected for the following two reasons:

- The formula that determines its underlying ultimate contribution rate is the same as that for paygo financing.

- It is the only method that is fully consistent with the equity concept discussed in subsection 2 below. In practice, however, this method is never used as such. Strictly speaking, the contribution rate would actually have to vary by age wherever mortality declines would be assumed. In this sense, the unit credit cost method would also be consistent with the above-mentioned equity concept provided the contribution rate would vary by age as well. However, even under stabilized conditions, the unit credit method is less simple than the entry age method because for any given calendar year of birth cohort of contributors, the contribution rate increases by age even in the absence of mortality declines.

1. Contribution rate

For a given national retirement pension plan and a given set of ultimate demographic and economic assumptions, the contribution rate, deemed to apply to covered employment earnings, varies depending upon the prevailing financing approach. In this respect, the difference between the paygo financing and the full funding approaches stems exclusively from their respective underlying internal rate of return (IRR). With full funding, the IRR corresponds to the assumed nominal rate of return on pension assets. For the paygo financing approach, the IRR corresponds to the assumed increase in total covered payroll (or, in other words, to the economic growth rate or the rate of increase in national payroll for a plan covering the employment earnings at the national level, i.e. the geometric sum of the demographic increase and the increase in average earnings). This relationship for the IRR under paygo financing can be demonstrated in several ways (e.g. along the mathematical development of the pension cost formula hereafter discussed), but no demonstration is herein provided.

To determine the contribution rate "CR" of a given earnings-related national retirement program under stabilized conditions, the following pension cost formula is used:

$$CR = \frac{BR*PSCP*PVB(ELBP,db)}{(1+dc)^{(CP-ELCP)}*ACC(ELCP,dc)}$$

Where:

BR = cumulative benefit replacement rate as a % of final average earnings (e.g. 60%)

PSCP = probability of surviving from normal entry age to normal retirement age

ELBP = expected length of the benefit period, i.e. life expectancy at retirement age

CP = length of the contributory period from entry to retirement age

ELCP = expected length of the contributory period, life expectancy from entry age to retirement age

PVB(ELBP,db) = annuity-due certain (present value) of $1 annually over ELBP years at discount rate "db"

ACC(ELCP,dc) = accumulation over ELCP years at discount rate "dc" of $1 deposited at the beginning of each year

db = **d**iscount rate for the present value of **b**enefits = IRR geometrically reduced by the plan's annual benefit indexation rate "**c**"

dc = **d**iscount rate for the accumulation of **c**ontributions = IRR geometrically reduced by the assumed annual increase "s" in covered average earnings

IRR = internal rate of return, i.e.:

- Interest rate "**i**" (return on plan assets) for the full funding (entry age) approach
- Annual increase "**e**" in total covered employment earnings for the paygo financing approach, i.e. the annual increase "s" in average covered earnings geometrically increased by the annual increase "p" in plan participation, i.e. economic growth rate for a program covering all employment earnings at the national level.

This formula produces the strictly accurate value of the constant ultimate (i.e. under stabilized conditions) contribution rate to the extent that:

- Administrative expenses and income taxes are disregarded
- Rates of participation in the plan and average covered earnings do not vary be age
- Annuities certain for a duration equal to life expectancy replicate the value of life annuities
- Contributions and benefit payments are spread evenly over the calendar year

Beyond the effect of administrative expenses and income taxes that the above formula disregards, the error generated by the three above-mentioned approximations normally has no material impact on the level of the contribution rate.

For purposes of the following discussions and measurements of the contribution rate, an indexed lifetime earnings-related retirement pension is the only benefit deemed to apply, e.g. no benefit whatsoever is provided in case of death either before or after retirement. This scenario is preferred to the one whereby contributions accumulated with interest (or economic growth rate "e" under paygo financing) are reimbursed in case of death before retirement, which generally applies to a funded plan. If such death benefit applies, the ultimate pension cost formula is simpler (see paragraph (b) below) than the one above for the retained preferred scenario. This preference rests on the desire to simplify as much as possible the analysis of the ultimate contribution rate by restricting the underlying plan provisions to the retirement pension.

Replacing the "db" and "dc" assumptions by their above-specified value for the paygo financing and the entry age approaches, respectively, the above formula for the contribution rate takes the following specific form for each of these two financing approaches (any sum or difference shown in quotes means a geometric rather than arithmetic sum):

(a) No reimbursement of accumulated contributions in case of death before retirement

$$CR_{paygo} = \frac{BR*PSCP*PVB(ELBP,"p+s-c")}{(1+p)^{(CP-ELCP)}*ACC(ELCP,p)} \quad CR_{enrty\ age} = \frac{BR*PSCP*PVB(ELBP,"i-c")}{(1+"i-s")^{(CP-ELCP)}*ACC(ELCP,"i-s")}$$

(b) Reimbursement of accumulated contributions in case of death before retirement

$$CR_{paygo} = \frac{BR*PVB(ELBP,"p+s-c")}{ACC(CP,p)} \quad CR_{entry\ age} = \frac{BR*PVB(ELBP,"i-c")}{ACC(CP,"i-s")}$$

where "p", "s", "c" and "i" are as defined within the definitions of "db", "dc" and "IRR" above.

The formula is convenient in that it can be easily applied using spreadsheets by relying on only four plan parameters and five key assumptions and accurately reproduces, under stabilized conditions, the contribution rate of an earnings-related program for both paygo and full funding (entry age) financing approaches. Besides, it is a very simple tool having much explanatory power in respect of all factors that affect the contribution rate under either paygo financing or full funding. For example, taking (as one normally should) the indexation rate "c" as a plan provision rather than an assumption, the expression for the paygo financing approach in paragraph (b) above indicates that, beyond the mortality involved in the expected length of the benefit period (ELBP), the only assumptions to which the contribution rate is sensitive are:

- **The interest rate "i" and the salary increase "s" for the full funding approach**
  As the assumption "p" is both demographic (population increase) and economic (deemed concomitant increase in employment), it could as such be present in the formula. That does not happen to be the case because the entry age financing approach keeps track of the earnings and benefits of a given single cohort of persons all born in a given calendar year and affected by mortality and migration after birth, but not fertility. But this is not peculiar to all actuarial cost methods, as "p" is present in the denominator of the formula (not presented herein) for the projected unit credit actuarial cost method.

- **The demographic increase "p" and the salary increase "s" for the paygo approach.**
  As expected and by definition, a pure paygo financing approach is not sensitive to the interest rate, as no assets and therefore no investments are involved. As "p+s" corresponds to economic growth, the benefit period-related component (numerator) of paygo is sensitive to economic growth, while the contributory period-related component (denominator) is sensitive only to the demographic increase "p". If the demographic increase "p" is isolated from "s-c" in the numerator, one can see that the demographic increase is involved in both the numerator and denominator, while "s-c", which essentially corresponds to the productivity rate if benefits are indexed to inflation, is involved only in the numerator. The pension cost formula thus demonstrates that the contribution rate can be affected by a change in productivity (e.g. +1%) about one third as much as a similar change (1%) in the demographic increase. This 1 to 3 ratio stems from the length of the contributory period (denominator) being deemed twice that of the benefit period (numerator).

Using the pension cost formula as shown in paragraph (a) above, spreadsheet calculations of the ultimate contribution rate under the paygo and the entry age financing approaches have been done assuming in both cases a benefit rate of 25%, a benefit indexation rate equal to the inflation rate, a contribution period of 47 years (from age 18 to 65) and a benefit period corresponding to life expectancy at the deemed normal retirement age of 65. Using in both cases the assumptions set in the preceding section, i.e. 3% inflation rate, 4% increase in average earnings, 7% return on pension assets, a fertility rate of 2.0 (generating a constant demographic decrease of 0.2%) and

1991 Canada Life Table mortality on a unisex basis (producing a value of 84.6% for PSCP, 45.1 for ELCP and 17.1 for ELBP), the resulting ultimate contribution rate is 2.87% for the entry age actuarial cost method and 8.34% for the paygo financing approach.

The above difference between the paygo and the entry age (funding) contribution rates is huge as the paygo contribution rate is 2.9 times the entry age rate. (Using the unit credit rather than the entry age funding method, the paygo/funding ratio would remain high at 2.4.) This difference stems exclusively from the assumed gap of 3.21% in internal rates of return, i.e. 3.79% for the paygo approach and 7% for the entry age method. As a rule of thumb, each increase of 1% in the IRR normally decreases pension costs and liabilities by 20% to 30%. In the above case, the corresponding decrease is 28.3% (i.e. $8.34*(1-.283)^{(3.21)}=2.87$), which falls within the rule of thumb.

The above calculations were made in respect of the long-term worldwide scenario developed in the previous section on assumptions. The underlying material gap of 3.21% between the return on investments and economic growth is largely due to a presumed indefinite continuation of fertility rates at a level of 2.0 that corresponds to a gradual shrinking of the world population of about 18% over the 21st century. To the extent that the rationale (described in the previous section) used for the development of that scenario is valid, it may be said that the ultimate contribution rate is expected to be much lower on average with full funding than under the paygo financing approach.

For a deeper insight into the effect of lower fertility on contribution rates, the pension cost formula indicates that changing the fertility rate from 2.0 to 3.0 i.e. changing the demographic increase from -0.2% to +2.2%, the paygo contribution rate is reduced from 8.34% to 3.67%, while the entry age rate remains at 2.87%. Ceteris paribus, the increase in average earnings needs to be increased from 4% to 17.45% in order to offset the effect of the lower fertility rate and maintain the paygo rate at 3.67%. In such case, however, the entry age rate would have risen to as much as level of 33.19%. Ceteris paribus, the entry age and the paygo contribution rates coincide at 6.56% assuming a total fertility rate of 2.0 if the increase in average earnings is 7.2% instead of 4%. If the assumed total fertility rate were 3.0, the two contribution rates coincide at a level of 3.49% provided the assumed average earnings increase is 4.7% instead of 4.0%.

Therefore, pension costs under the paygo financing approach are destined to be materially affected by decreases in fertility, as productivity (i.e. excess of wage increases over inflation) cannot practically be maintained at the high level of 4.2% (i.e. 7.2%-3%) required to keep the paygo contribution rate at par with that under the entry age method. Indeed, the productivity rate has averaged less than 2% over the last 50 years in Canada and would be expected to be even lower during the 21st century in accordance with the lower projected fertility rate (2.0 versus 3.0) and the theory set forth in the preceding section on assumptions to the effect that aging induces lower aggregate productivity.

Full funding remains one of the key solutions to optimally attenuate the financial strain that aging is causing to paygo-financed social retirement programs. However, a full funding initiative need not and should not be coupled with a privatization initiative. This is discussed in subsection 3 below.

The much higher age dependency ratios that aging will ultimately generate in many countries over the next three decades will reduce the proportion of the population at working ages. Taken in isolation, this lower proportion of workers will strain economic growth unless productivity is increased and/or retirement is postponed. But a theory is set forth in section C whereby productivity decreases with an aging of the population. Thus, contrary to full funding, paygo financing exacerbates such economic strain through its contribution rate that increases with the lower fertility-related aging of the population. Besides, if contributors were given the choice to select between the paygo financing and funding, they would obviously select the one that involves the lower contribution rate.

It may be legitimately claimed that on a macroeconomic basis paygo financing and full funding are equivalent as they differ only in the way pension costs are spread over the years and allocated among successive cohorts of contributors. However, paygo financing involves a perverse effect at the microeconomic level for lower income earners. Indeed, with full funding, the saved difference between paygo and funding contributions is made up through higher income tax rates. Because income tax rates are generally more progressive than pension contribution rates, particularly in cases where earnings covered by the social security program are capped, it is preferable for low-income earners to have the difference between paygo and funding contributions to consist of income taxes rather than social security program contributions.

In that vein, it appears that paygo financing is generally adopted by default at the time of implementation of a major national earnings-related program. Indeed, social security programs normally phase-in the accrual of pension credits for contributors close to or over the retirement age at the time of implementation of the program at a faster rate than for younger and future contributors. Paygo financing is then advantageous as it relieves contributors from having to pay for both their own benefits and those of current older generations. Such course of action is thoroughly discussed and favourably validated in 1936 by Reinhard Hohaus. He defines and envisions equity in a manner that imposes financial obligations on current younger generations for the benefit of current older generations to account for the capital legacy that each generation leaves at death to subsequent generations. Such equity considerations are totally opposite to the view presented in subsection 2 below. Moreover, even it were socially desirable and legitimate to grant special benefits at the time of implementation of a social security program, it appears preferable to finance these subsidies outside the program, e.g. through general taxes rather than through the new program contributions, as their cost would thereby be spread over the aggregate national payroll rather than the generally lower payroll covered by an earnings-related program.

It is claimed from time to time that a financing method should be selected in accordance with the level of its contribution rate, in other words that paygo is to be preferred to advance funding when economic growth exceeds the rate of return on investments, and vice versa. However, one should not consider full funding as a better or more appropriate financing method on the basis of that factor. Obviously, a lower contribution rate is to be welcome and appreciated. But, as discussed in the following sub-section, full funding should be preferred to paygo financing for other reasons, even if its contribution rate could be higher than under the paygo approach.

2. Equity (fairness and ownership)

The word equity is hereby meant to have a pure financial connotation and accordingly relates to both fairness and ownership. For purposes of this discussion of pension costs, fairness is deemed to relate exclusively to the proper allocation of pension benefits among those who have paid for them, and that allocation is further deemed applicable on an ownership basis within any single cohort of people, both men and women, born in a given calendar year. Under such conditions, fairness is considered on a somewhat individualistic basis, as it does not contemplate a right for retired persons to be supported by their working descendants, no more that it contemplates an obligation for workers to support their retired parents.

This is not to say that social security programs should contemplate pure individual equity because such equity exists only in the absence of insurance programs of any sort. Indeed, without any such program, each individual would have to assume his/her own financial responsibilities and risks as they occur. Rather, social security, as it pertains to income security in retirement, aims at ensuring that each individual gets a certain level of adequate income (within the range from pure welfare to higher degrees of well-being) throughout the whole retirement period. Such security is provided through social means because some human beings find themselves with an inadequate level of income during their retirement period for various reasons that are not necessarily under their control, even in the presence of a sound non-mandatory private insurance system.

Under the assumed principle (successive birth year cohorts) set in the second preceding paragraph, social security would achieve its objective (adequate income though poverty alleviation and floor-level maintenance of pre-retirement income) on a fair basis by reallocating over time the income of each birth year cohort within each such cohort. This cannot be achieved through paygo financing. Full funding is the only mechanism that is fully consistent with achieving on a fair basis the above social security objective.

Nonetheless, irrespective of the applicable financing method, the payments of social security retirement benefits are actually assumed essentially by the gainfully employed individuals, as most of the recipients of retirement benefits no longer participate in the production of goods and services and no longer gain employment earnings. Benefits are paid in any event on the basis of the accrued rights prescribed by the existence of the social security program.

Therefore, paygo could appear to be a legitimate approach for the financing of social security retirement benefits. In such case, the entitlement to benefits rests entirely on social rights and the security of benefit payments rests on the availability of a sufficient amount of national employment earnings and the government power to tax them. However, such approach entails the following significant cost-related social inequities and behaviours:

- Ceteris paribus, the social security price, i.e. the paygo contribution rate, will fluctuate from year to year and from generation to generation if the population is not stabilized. In real life, populations are not stabilized for several reasons, the main ones being variations from year to year in fertility, mortality and migration rates. The North American baby boomers of the mid-20th century are a patent example of sizeable variations in fertility rates. While baby boomers are at working ages, the paygo pension price is temporarily reduced by virtue of the lower proportion of retired to working people. While baby boomers are at retirement ages, the paygo pension price is temporarily increased for the opposite reason. Generally speaking then, with paygo financing, people born during years of higher fertility rates get a better pension deal than preceding and succeeding generations.

- Over the 20th century, the proportion of people at retired ages (65 and over) to people at working ages (18 to 64) in developed countries has gradually doubled in size pursuant to the aging of the populations, which stems from sustained average decreases over time in fertility and mortality rates. Successive generations might be seen as having to bear the higher price of social pensions arising out of lower mortality rates, as they thereby receive a higher pension benefit in aggregate due to their higher longevity. However, the aggregate increases in the paygo pension price arising out of lower fertility rates is so huge that the younger contributors seriously resent the much higher contribution rates that they would eventually have to assume. Even if such resentment would never lead to a tax revolt, it nonetheless bears a non-negligible risk of poor compliance with the prescribed participation in the underlying social security program, which further exacerbates the aging-related rising paygo cost issue.

It might be claimed that paygo still remains a socially acceptable financing approach on the grounds that successive generations should have to pay a gradually increasing price commensurate with the strain put on the economy by the aging process, i.e. a gradually decreasing proportion of people being responsible to maintain the standard of living among all age-layers of the society. Still, paygo financing does not address the above two issues as properly as full funding does. Indeed, with full funding:

- In the long run, the contribution rate needs to be increased only on account of increasing longevity. It is immune against demographic fluctuations and against that part of population aging arising out of lower fertility rates. Such longevity-related increases in the full funding contribution rate happen to be to the same proportional extent as for the paygo approach, but the underlying annual increases are very small. Indeed, for a plan

with a normal retirement age of 65, such annual percentage increase is about 0.3% if mortality rates are assumed to decrease annually by 0.5%. Under such circumstances, a current contribution rate of 10% would need to be increased to 10.030% next year, 10.0601% the following year, and so on until it would reach a level of 10.3041% after 10 years, 10.7776% after 25 years, 11.6157% after 50 years and 13.4925% after 100 years. As longevity increase is the only factor affecting cost levels in the long run under a funded approach, participants do understand and accept more easily making the small required changes in the contribution rate and/or the prescribed normal retirement age when needed.

- The contribution rate underlies an optimally fair allocation of pension costs among each successive cohort of contributors and is not affected by demographic fluctuations and by that part of aging due to lower fertility. The resulting reduction in cost inequities and volatility optimizes the public acceptance of the program costs.

- The entitlement to benefits is based on ownership rather than social rights. This maintains a higher level of willingness to comply with the program contributions, as workers gains a true sense of participation in the economic activities, and as they own their accrued benefits rather than merely being socially entitled to them. Whenever the aging-related strain put on the reduced proportion of workers to maintain the production of goods and services would reach critical limits, contributors and pensioners will feel more comfortable if the transfer of income from workers to pensioners required in respect of the social security programs is done on an equitable ownership basis rather than a social requirement imposed on workers to support the retired persons.

- The security of benefit payments rests on the average long-term soundness of the money markets rather than economic growth and the government power to change income tax rates upon need. With full funding rather than paygo financing, benefit payments are secured by the presence of a much larger fund that represents a much safer cushion against the effect of temporary unfavourable investment returns on contribution rates than the cushion against variations in economic growth offered by a small contingency fund under paygo financing. Indeed, although programs financed on a paygo basis are usually backed by a small contingency fund, which rarely exceeds on average the equivalent of two years of benefit payments, funded programs are backed by a fund (i.e. total liabilities) that represents a much larger number of years of benefit payments. Under stabilized conditions, this number is equal to $(1-CR_{funding}/CR_{paygo})*(1+i)^{0.5}/(i-e)$, i.e. 18.44 for the scenario retained for discussion purposes herein (i.e. c=3%, e=2.856% stemming from s=4% and p=-1.1%, i=7%, $CR_{funding}$=2.73% and CR_{paygo}=10.45%).

3. Investment risk

A funded social security program under direct government sponsorship is often regarded as unduly risky due to:

- The volatility of investment returns on stocks

- Eventual limitations of demand for investment capital

- Possible and actual cases of government interference with, and abuses over, the control of the huge public funds involved, particularly in developing countries.

Whether a country is developed or developing, the investment risk involved with a funded retirement program should not be materially different whether the social program is sponsored by its government or by the private enterprise. Indeed, it has to be believed that the risk taken in having one's money put under someone else's responsibility should not necessarily be materially

different within a given country, whether that someone is a government or a private financial institution.

Despite the above-mentioned three risks, sustained satisfactory results have been observed following the proper mechanisms put in place in 1966 for the sound and effective governance of *La Caisse de dépôts et de placements du Quebec*, an arms' length semi-governmental entity responsible for the investments of the quasi paygo financed Quebec Pension Plan (QPP) and of other public pension plans.

Similar arrangements were made to the CPP in 1997. Moreover, the 1997 CPP/QPP reform contemplates an increase in the funding ratio from 7% to about 20% over the 20-year period starting in 1997. Although the fund projected for 2017 represents only one fifth of the target under full funding conditions, it nonetheless corresponds in today's terms to about $160 USD billion, or about 25% of the Canadian GDP.

The investment risk issue underlying public funds under government control has been raised and discussed at length by several expert individuals and groups, e.g. *Social Security Reform: Trust Fund Investments*, published in December 1999 through the Issue Briefs of the American Academy of Actuaries. However, no conclusion has so far been reached regarding the impossibility of managing these risks. Therefore, it would not be sensible to use the investment risk as a reason to shelve the resolution of the key equity issue discussed in the preceding subsection D-2 unless it could be proven that those risks cannot be managed within reasonable limits.

4. Macro-economic effects of paygo financing and full funding

Many discussions have taken place recently among worldwide experts on the extent of the effect of the existence of social security programs and of the applicable financing approach (paygo or full funding) on savings, economic growth and international competitiveness. The ISSA publication *The social security reform debate: In search of a new* consensus and the ISSA Conference on *The Future of Social Security* having taken place 29 June to 1 July 1998 in Stockholm are two good examples of such fruitful discussions on social security. A certain consensus was reached to the effect that social security, funded or not, is expected to have a relatively low impact on economic growth, amount of national savings and international competitiveness.

The alleviation of poverty and the contribution to well being that is provided in retirement by a soundly designed social security program reduce the importance of social development-related issues, which in turn leaves relatively more time and energy to be spent on economic development-related activities. Therefore, the combination of an effective money market and of a funded, well-designed and soundly governed social security program in a given country should be expected to provide some momentum for, and/or synergy favouring, more dynamic development, both on social and economic grounds, than if only one or none of these were in place. In that sense, a well-designed social security system would act as a catalyst for sustained economic growth rather than a factor fostering further economic growth.

In any event, the amount of production of goods and services, of the level of productivity and of economic growth will always remain strongly dependent upon entrepreneurship. That explains why economic growth could exist even before the advent of social security programs. But it is to be believed that the presence of a social security program materially contributes to the quality of the social fabric, which in turn can only be beneficial for the economic environment and development, and more so if it is funded.

5. Converting from paygo financing to full funding

Beyond the possibility that paygo financing can provide, as soon as a social security program is implemented, full benefits to people near or already in retirement as if they had contributed over the regular entire contributory period, it is difficult to see what a government may gain by adopting

such a financial approach. Under paygo financing, contribution rates are normally projected to be much larger than with full funding. Not only does this put a greater strain on the tax system, but, by definition, with paygo financing, the government can only watch the incoming contributions be redirected immediately towards the payment of benefits rather than feeding the public accounts.

In light of costs rapidly and dramatically rising under the paygo financing approach, several countries have gone through converting their national public retirement programs to a funded basis. Whether such conversions are coupled with privatization or not, they imply sizeable long-term transitional expenditures that represent the future payments of all pension credits accrued from the initial implementation date to the conversion date. In this regard, a partial approach was adopted for the CPP and the QPP in 1997 with the gradual implementation of a partial funding approach whereby:

- The two programs remain under government auspices (Canada and Quebec, respectively).

- The successive annual contribution rate increases otherwise required under the paygo financing approach are accelerated so that the ultimate rate is lower (9.9%, compared to about 12.5% after removing the effect of the now frozen year's basic exemption on contributory earnings) and is reached sooner (2003 versus 2030). Therefore, this Canadian pension reform represents a relative contribution rate reduction of about 20%.

- New cash flows and maturing government securities of the existing fund are invested at arms' length in a diversified portfolio rather than exclusively in provincial securities. However, such diversified investments have already been in place for the QPP since its inception in 1966. The QPP represents about 25% of the whole national program (CPP+QPP).

With such new measures for the CPP and the QPP, the funding ratio (i.e. assets/liabilities) is projected to increase from its 1997 level of about 7% to about 20% over a period of about 20 years (i.e. by about 2017), and to plateau somewhat at this level afterwards for the rest of the 21st century. The underlying statutory actuarial projections assume a nominal rate of return of about 7% on the plan fund. Ceteris paribus, if the return were to be significantly larger than the assumed rate of 7% on average for the rest of the century, then the funding ratio would equally rise significantly beyond its projected level of 20% provided the contribution rate is maintained at its steady-state level of 9.9%.

E- Comparing Defined Contribution (DC) plans with Defined Benefit (DB) plans

Essentially, a DC plan is not much different from a DB plan. Under a DC plan, the contribution rate is explicitly pre-determined along with all characteristics of the eventual retirement pension, except for the benefit rate that is set only at retirement in accordance with the then actual pension fund on hand and the benefit rules (other than its rate). Conversely, under a DB plan, the benefit rate BR is explicitly pre-determined along with all characteristics of the retirement pension and of the contributory conditions, except for the contribution rate CR that is reviewed and revised periodically in accordance with actuarial estimates of the value of benefits accrued by the valuation date and those prescribed to accrue until the next evaluation date. This DB-DC dichotomy of pension programs is in a sense well illustrated by the pension cost formula presented, in the preceding section, which opposes contributions, on the left side, to benefits on the right side.

In other words, under a DC plan, the contribution rate is guaranteed, while under a DB plan, the benefit rate is guaranteed. As the objective of social security programs is essentially to secure income during retirement, ceteris paribus DB plans should be preferred to DC plans. Notwithstanding their inherent flaw regarding the absence of a benefit guaranty, DC plans remain popular for some reasons, the main one being their much greater administrative simplicity, e.g. not statutorily subject to

periodical actuarial evaluations, no complex benefit provisions, visibility of the accrued money's worth, etc.

It is often argued that under a DC plan, benefits are more directly related to contributions than under a DB plan. Most of this belief may originate from the inequities underlying the DB public programs financed on a paygo financing basis. In any event, the relation of benefits to contributions is a matter of plan design that can be addressed equally well under either a DB plan or a DC plan.

Under public sponsorship, there is not much difference in administrative complexity between DC and DP plans, as public pressures normally impose periodical actuarial evaluations of both DC and DB plans. Under a DC plan, contributors need to be informed periodically of the expected benefit replacement rate, while under DB plans, they need the contribution rate to be determined as accurately as possible to avoid unduly large volatility in year to year contributions levels and inappropriate allocations of pension costs over successive cohorts of contributors, which might sporadically require cumbersome capital adjustments.

Considering all the above, it appears that a DB plan should be preferred for its superior benefit guarantee if the program is under public auspices, while DC should be preferred for its simpler administrative constraints and its lower operating costs if the program is under private sponsorship.

F- Conclusion

Nowadays, people have fewer children and live longer and longer. Consequently, populations are aging. Accordingly, the proportion of people over age 65 will, by year 2030, be over twice what it was in the mid-1960s. Therefore, unless people retire from the labour force at a consistently higher age and/or become consistently more productive, there will be a decrease in per/capita production of goods and services, i.e. in standards of living. Taken in isolation, the level of sustained higher productivity required to maintain standards of living is over 5%, a rather unrealistic level. Likewise, it is difficult to determine by how much the retirement age may need to be increased to offset the effect of aging on standards of living because employment patterns are much affected by the actual persistent decreases in individual productivity at this late stage of life.

Population aging will therefore put economic growth at a certain risk during the 21st century. Whether and to what extent that risk will materialize is unknown at this time, but if it does, the financial harm associated with decreased standards of living will find its way through the management of social security programs. Governments will be pressured by social security contributors to ensure that any decreases in standard of living are shared in a fair manner between working and retired people. In that sense, aging exacerbates the intergenerational cost-related inequities that other (than aging) demographic fluctuations cause to the social security programs that are financed on a paygo basis. Demographic fluctuations are unavoidable, but cost-related inequities can be largely overcome if social security is financed on a funded rather than a paygo basis.

Besides, full funding kills more than the inequity bird. It allows all covered workers to build some capital through the social security program, an opportunity that many low-income earners do not otherwise have. Moreover, low-income earners enjoy a larger and more decent take-home pay through the lower contribution rate prevailing with funding compared to paygo financing. Paygo remains a possible financing method, but is an extreme case that should be used only on a last resort basis, e.g. temporarily when there would be no room for investments. Full funding induces better compliance with social security program contributions payments, as it allocates pension costs on a fairer basis to successive generations of contributors and costs less on average on the basis of deemed natural economic and demographic rules. The presence of a social security program materially contributes to the quality of the social fabric, which in turn can only be beneficial for the economic environment and development, and more so if it is funded.

Each of the two most popular structural frameworks for providing social security benefits (public paygo DB and private funded DC) have their own way of going counter clockwise with some of the main objectives of social security. On the one hand, the private approach implies high operating costs and redistributes income on a business for profit basis rather than a social basis, while on the other hand, the public approach, through paygo financing, implies unduly high contribution rates and reallocates income outside rather than within the boundaries of successive cohorts of workers and beneficiaries.

A natural solution to the above two key issues, i.e. lack of equity under paygo financing and abusive operating costs under privately sponsored social security programs, is a centralized administrative system under public governance coupled with a financing approach relying on advance funding. Understandably, as indicated in subsection D-5, the conversion of a partially funded program to a fully funded program normally involves a long and somewhat costly transition period. Nonetheless, adopting full funding as a prescribed financing objective is a first good step towards the optimization of the cost as well as the intra and inter-generational equity of a social security program.

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