

ACTUARIAL ISSUES IN THE DESIGN OF AN OPTIMAL SOCIAL SECURITY SYSTEM

ABSTRACT

This paper looks at potential models of Social Security systems. It refers often to the systems that exist in the United States and Canada (the latter more particularly) to outline the issues involved in attempting to design an optimal social security system. Of course, one of the issues is the definition of “optimality”. This paper will use criteria such as: poverty alleviation, retirement income adequacy, benefit/contribution sustainability, income equality and wealth distribution.

In the course of the discussion, the reader will be exposed to many issues that need to be addressed in the establishment of any Social Security system in the world. This may prove to be helpful in countries where new systems are established (this could be any country in the world, since even existing systems are always evolving).

It is also hoped that future students of Social Security will find this paper helpful in that it is meant to lay out some basic principles consistent with good Social Security design.

Keywords: Social Security
Pay-as-you-go
Individual Accounts
Notional Defined Contribution

I Introduction

What makes a good Social Security system?

It is the goal of this paper to outline in general terms a number of key principles that need to exist in any Social Security system that would earn a “good” review. The paper describes Social Security in a fairly narrow sense. It does not include the provision of Health Care delivery nor Workers Compensation. Further, the paper uses the Social Security systems that presently exist in Canada and the U.S. as benchmarks against which one can consider issues of optimality. Thus, the paper will explore issues related most particularly to the provision of Retirement Income Security by government-sponsored systems.

II The Economist’s versus the Actuary’s View of Social Security

Many Social Security systems were designed by economists. In fact, it is somewhat depressing the minor role that actuaries have played in the public policy decisions regarding Social Security. In general, actuaries had little to say in the public policy issues surrounding the creation and expansion of our Social Security systems. Actuarial involvement is normally reserved solely to “pricing” the various designs brought to them by the policy makers.

Why is this an issue? Why would one care whether Social Security systems are designed by economists or actuaries?

Economists and actuaries come to the drawing table where social security systems are designed with a different set of principles and priorities. These arguments are now officially stated in a recent document (IAA 2006) from the International Association of Actuaries in which the IAA Social Security Committee responded to the World Bank (2005) publication: *Old-Age Income Support in the 21st Century: An International Perspective on Pension Systems and Reform*.

In their response, the IAA states (p 3/4):

“We consider that actuaries and economists view Social Security systems in remarkably different ways.

When considering these models, it appears that economists have as their priorities:

- individual equity
- reduction in labor force distortions caused by social security (contributions and age of retirement)
- national savings
- strong financial institutions
- wealth creation

Some economists believe this naturally leads one toward a Defined Contribution model.

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By comparison, actuaries tend to focus more on:

- insurance and risk sharing (based on the law of large numbers)
- annuitization for the longevity risk (or other similar mechanisms)
- low expenses
- a long-term view of stability and sustainability (not an annual balancing requirement)
- predictable benefits
- improvement in societal utility (of wealth)
- transparency and understandability

This focus on insurance, risk-sharing, and the law of large numbers, leads more naturally to Defined Benefit national social security models. Although some of the above can be obtained through DC systems, it is more difficult to maintain the above principles for all time, as can be seen from United States benefits history. For example, individuals with individual accounts who see their account balance every quarter will be more likely to demand access to them, and resist required annuitization (as experience has shown in the United States with IRAs and 401(k) arrangements)."

In this regard, one might ask whether the new World Bank mantra of Notional Defined Contribution plans for Social Security are Defined Benefit or Defined Contribution Plans.

Michael Cichon (1999 and 2005) argues (convincingly) that the "new" Notional Defined Contribution plans are mathematically equivalent to Career Average Defined Benefit Plans if the Notional Investment return on the former is equal to the Salary Scale function in the latter.

U.S. actuaries will recognize Notional Defined Contribution Social Security as a version of Cash Balance Plans which are categorized as Defined Benefit Plans in the U.S. because the benefit is "guaranteed" (more on this in a moment) and the major plan risks (e.g., investment risk, interest-rate risk and longevity risk) can be borne by the pension plan sponsors (in the case of social security, the plan sponsor is society).

Economists designed these Notional Defined Contribution schemes because they satisfy most of the priorities of economists listed above. Actuaries might find some comfort in these Notional DC schemes since they are equivalent to Defined Benefit Career Average plans. Actuaries have objected strenuously, however, to the automatic balancing formula proposed in the Swedish Notional DC system (see Scherman, 2005 and Hagberg and Wohlner, 2002) which means the benefits are not guaranteed.

As for Individual Account Social Security schemes, there are other (actuarial) reasons to oppose them.

As we know, these systems transfer virtually all the major risks (investment risk, interest-rate risk (at the time of annuity purchase), inflation risk and longevity risk) to the worker. This is contrary to the actuarial principle of grouping risks and achieving the advantages of the Law of Large Numbers. Small account balances face higher expense ratios. Thus, these systems are regressive. Total expenses in these systems are higher than most government-administered systems.

Overall, DC plans do provide retirement savings and may even encourage saving for retirement. However, a savings plan does not a retirement system make!

Actuaries tend to favor Defined Benefit designs for all the risk mitigating reasons listed above and the paper will not consider Individual Account Social Security systems further in this discussion of designing an optimal social security system.

III Financing Extremes: PAYGO versus Fully-Funded

It is the position of this paper that the financing of any social security scheme is of secondary importance.

This is based on another fundamental belief that Social Security should not be thought of as a big Private Pension Plan, but rather as a wealth transfer scheme.

Under PAYGO financing, the required contribution rate, $C = \frac{P_t}{A_t} * \frac{B_t}{AIW_t}$

where:

- P_t = The number of pensioners
- A_t = The number of active workers (in the formal sector)
- B_t = The average pension benefit
- AIW_t = The Average Wage upon which contributions are made.

This can be viewed as being the product of the Demographic Ratio and the Financial Ratio. So in a country that tries to replace 39% of income through Social Security benefits for the average worker and where the Aged Dependency Ratio is 0.33, the contribution rate will be 13% (this approximates the U.S. reality quite closely).

If we change the formulation slightly, then we can say that for a \$1 retirement benefit starting at age 65, the required PAYGO contribution rate at a given point in time is:

$$C = \frac{\int_{65}^{\infty} e^{-rx} L_x dx}{\int_{20}^{65} e^{-rx} L_x dx}$$

Where: L_x = Population Alive Aged x
 r_x = The growth rate in covered earnings which in turn is dependent on the growth rate of the labor force plus the growth rate in real wages due to gains in productivity.

In a Fully-Funded, Individual Accounts Social Security system, again using age 65 as the retirement age, the contribution required per unit of benefit is:

$$C = \frac{\int_{65}^{\infty} e^{-\delta x} l_x dx}{\int_{20}^{65} e^{-\delta x} l_x dx}$$

Where: δ = the rate of return on investments (here assumed constant)
 l_x = Life Table “survivors” which provides survivorship probabilities

One sees that these formulae are not remarkably different. Hence, the method of financing Social Security results in remarkably similar economic impacts.

In a PAYGO system, workers deny themselves current consumption and make contributions to the social security plan. These contributions are immediately paid out to retirees who use these dollars to buy current consumption. An analogy helps. Assume the social security contribution rate is 10% (who pays it may not matter since the impact will ultimately fall back onto the workers’ shoulders regardless). In this system, workers give up one-half of one days’ worth of product and provide that output to the elderly for consumption (e.g., Monday morning in a five-day week).

In a fully-funded system, workers deny themselves current consumption and buy assets from the marketplace (they invest). Years later when these workers retire, they then must find current workers to buy their assets so as to transfer the value into currency to purchase consumption.

However, the end result is virtually identical.

Both systems are absolutely dependent on a next generation of workers to produce goods and services. Neither is demographically immune. It does not matter a whit how much money you have; if no-one is producing Gross National Product, you will starve to death in the dark.

Many proponents of fuller funding (or individual accounts) argue that such systems are more stable than PAYGO systems. However, neither system is particularly stable. At the very least,

neither system is guaranteed to be more stable than the other. Which is more stable: interest rates or fertility rates?

PAYGO financing depends strongly on the Demographic Ratio. No one can really suggest that it can be predicted 25 to 50 years out. The fully-funded system depends heavily on the rate of return on invested assets. No one can really suggest that these rates can be predicted 25 to 50 years out (or even their average value over that time period).

Both systems suffer from political risk. In a PAYGO system, the government can change the benefit or contribution formula and deny workers their assumed contract. In a fully-funded system, the government can allow inflation to deplete the value of the Individual Accounts, once again nullifying the implied contract with workers. For a fuller discussion see Brown, 1997, Barr, 2000 and Conesa and Garriga, 2004. Further, in a fully-funded scheme, the local dictator can abscond with the plan assets in the middle of the night. With a PAYGO plan, he can only steal the plan liabilities!

Beyond this point, the aspect of financing will not be of primary focus. The critical ultimate outcome in the affordability of any social security system is a healthy and growing economy. The method of social security financing may be close to irrelevant in this regard.

IV Actuarial Issues in the Design of Social Security

What should be the priorities in any well-designed Social Security system?

It can be argued that the number one priority should be the mitigation and alleviation of poverty amongst the elderly. If one accepts this as the primary priority then it follows that an optimal social security system will transfer more wealth to poor participants than to wealthy participants.

A second goal is to help citizens maintain an acceptable standard of living post-retirement. This means that there will exist some notion of an acceptable “replacement ratio” provided by the Social Security system. But note that the goal is to help citizens in attaining an acceptable standard of living. The Social Security system does not need to be the sole provider of such security. Most countries design their Retirement Income Security systems as a combination of: government-sponsored systems, employer-sponsored plans and individual savings. These broader-based systems often come with significant tax incentives (and thus are at least partially “public” systems). For Canada and the U.S., within defined limits, contributions to qualified plans (employer or individual) are tax deductible (i.e., come out of before tax dollars), the investment income accrues tax free and income, when taken, is taxable in full.

A third goal is “solidarity”. That means that all contributors (normally workers and employers) should want to support the Social Security system. That is, there should not be a large proportion of workers who do not participate and benefit in the system. This will mean that there will have to be benefits for wealthy people even if that may seem otherwise unnecessary.

One also needs to be wary of providing significant minimum benefit guarantees in the total package of benefits. This may seem to be consistent with the priority of alleviation of poverty, but it brings with it huge risk of moral hazard. That is, if workers (and employers) know that by achieving a minimal hurdle one can achieve enough benefits to avoid poverty, many workers (abetted by their employers) will just achieve that hurdle and not one millimeter more. This will mean that the system will pay benefits for which there are not equivalent contributions. At the least, such benefits should be minimalist (only alleviate poverty) and come from a program which is financed from general tax revenues, not Social Security contributions.

More on this later.

Other priorities (considered here as less important) fit with those emphasized by the economists.

To the extent possible, the Social Security system should not create perverse economic incentives. These include incentives to stay out of the formal economy (and pay taxes and Social Security contributions) and enter the cash economy. That means that the total of taxes and Social Security contributions cannot be too high. What “too high” means will vary from time to time and culture to culture, but there is definitely a limit on the total of taxes and contributions beyond which a country will reap fewer dollars of income.

Similarly, one does not wish to have the total of taxes and contributions be so high that employers do not want to hire new labor. Employers have a choice. If taxes and contributions get too high, they can move work offshore by outsourcing. Even before acting to that extent, employers have the choice of offering overtime to existing workers rather than hiring new workers. Depending on the design of the Social Security system, offering overtime to existing workers may not add any extra Social Security contributions as most systems have a maximum salary to which contributions attach.

The system should not have a benefit structure that creates any disincentives for individual workers also to save for their own retirement. This could be the result if your benefits are too large. But for marginal workers this could also result if there exists a “claw back” of early public benefits that is so rapid (steep) that it creates the equivalent of very high marginal tax rates on personal savings.

The system design should not create an incentive for workers to leave the workforce prematurely. This can happen if workers get no increase in benefits once they have contributed for “n” years (which is true in both Canada and the U.S.). It is also true if the adjustment for early or late benefits is not a full actuarial adjustment (again true in both Canada and the U.S.).

Finally, the system design should not encourage unnecessary absences from the labor force. This can happen if you have benefit formulae that exempts periods of time out of the labor force for certain defined reasons. The Child-Rearing Drop Out in Canada is such an example. Exemptions from periods out of the labor force because of disability exist in both Canada and the

U.S. However, it is the position of this paper that it is better by far to have explicit drop-out provisions (as in Canada) than to just have a short qualifying period for benefits (say, 20 years) for all.

Any social security system will also need to have sustainable contributions and benefits.

It is somewhat obvious that it is impossible to create any Social Security system that satisfies all of these priorities. Some economists would argue that Defined Contribution plans come the closest. Many actuaries would argue in favor of Defined Benefit plans.

However, all of the above criteria need to be considered in the design of a country's system.

V Two Living Examples: Canada and the U.S.

Given the priorities outlined in Section IV, the paper now looks at the systems in Canada and the US to see how they attempt to satisfy these goals.

The optimal design features presented in this paper are produced in a context of a country with an honest government and good governance. That is, the proposals presented are theoretically optimal given the validity of these assumptions. All listed criteria would have to be reconsidered in a country with a dishonest government or with weak governance.

As will be seen, both Canada and the U.S. come close to satisfying the listed criteria. However, at this moment, both OASDI and the QPP have some problems with their long-term sustainability (neither plan is in actuarial balance projected out 75 years).

In the 1996 amendments to the Canada Pension Plan (CPP), a sustainability clause was added to the scheme. After the 1996 amendments, the CPP is meant to exist forever with a contribution rate of 9.9% of Pensionable Earnings (the contribution is split 50/50 between employers and workers, while the self-employed pay the full 9.9%). If, in any actuarial valuation, the plan actuary finds that the CPP cannot be sustained for 75 years with the 9.9% contribution rate then a two-pronged response automatically occurs. First the contribution rate is raised so as to cover one-half of the long-term deficit. Second, benefits are frozen (do not rise with indexation) until the other half of the deficit disappears. Thus, the immediate response is shared virtually 50/50 between contributors/workers and beneficiaries/retirees.

This seems preferable to the new Swedish automatic balancing mechanism where all of the response comes from decreasing benefits (through de-indexation) until equilibrium is satisfied (i.e., contributions must remain constant). This feature of the new Swedish system has been highly criticized (Schermann, 2005 and Hagberg and Wohlner, 2002) and means that Swedish benefits cannot be considered "guaranteed".

It is the paper's position that an automatic stabilization feature is highly beneficial and that the Canadian methodology could be used as a suitable model.

The paper will now discuss the apparent "goodness" of the social security systems used in Canada and the U.S. based on other criteria previously listed.

The following six figures give a pictorial image of the manner in which these two countries provide retirement income security through government sponsored systems.

Because the total benefits in both countries depend on the amount of personal income of the individual worker, the following graphs assume that the worker will save enough so that his/her private retirement income plus total social security benefits will provide a replacement ratio of 70% of final earnings. If the government social security benefits provide this 70% replacement ratio, then the worker is assumed to have saved nothing and provides no extra retirement income.

The Canadian Social Security system has three tiers. The Guaranteed Income Supplement (GIS) is a welfare benefit. It is paid depending on a person's income from the previous tax year (data come from Income Tax filings). There is no asset test. The benefits are paid from general tax revenues. GIS Benefits are "clawed back" at the rate of 50% for each dollar of personal income (except OAS). GIS benefits are non taxable.

Old Age Security (OAS) is usually referred to as a "Demogrant" benefit. You must have 40 years of residency between ages 18 and 65 to get a full OAS (fewer years result in pro rata benefits). However, the OAS benefit also has a claw back whereby 15% of one's OAS is lost for each dollar of personal income once your income exceeds a stated threshold (see <http://www.sdc.gc.ca/en/isp/pub/factsheets/rates.shtml> for details). Thus, wealthy Canadians receive no GIS nor OAS. The OAS claw back is based on individual income whereas the GIS claw back is based on household income; thus some elderly females (normally it is females) in wealthy households still get the OAS. OAS benefits are taxable income.

The Canada/Quebec Pension Plans (C/QPP) are virtually identical and provide retirement benefits (70% of the total plan expenditures) based on lifetime contributions. Both contributions and benefit accruals stop once earnings get to a level approximately equal to the Average Wage. Thus, the benefits are not enough for a comfortable retirement for most Canadians. OAS plus C/QPP benefits replace about 40% of earnings for an average worker. C/QPP benefits are taxable income, but there is no claw back.

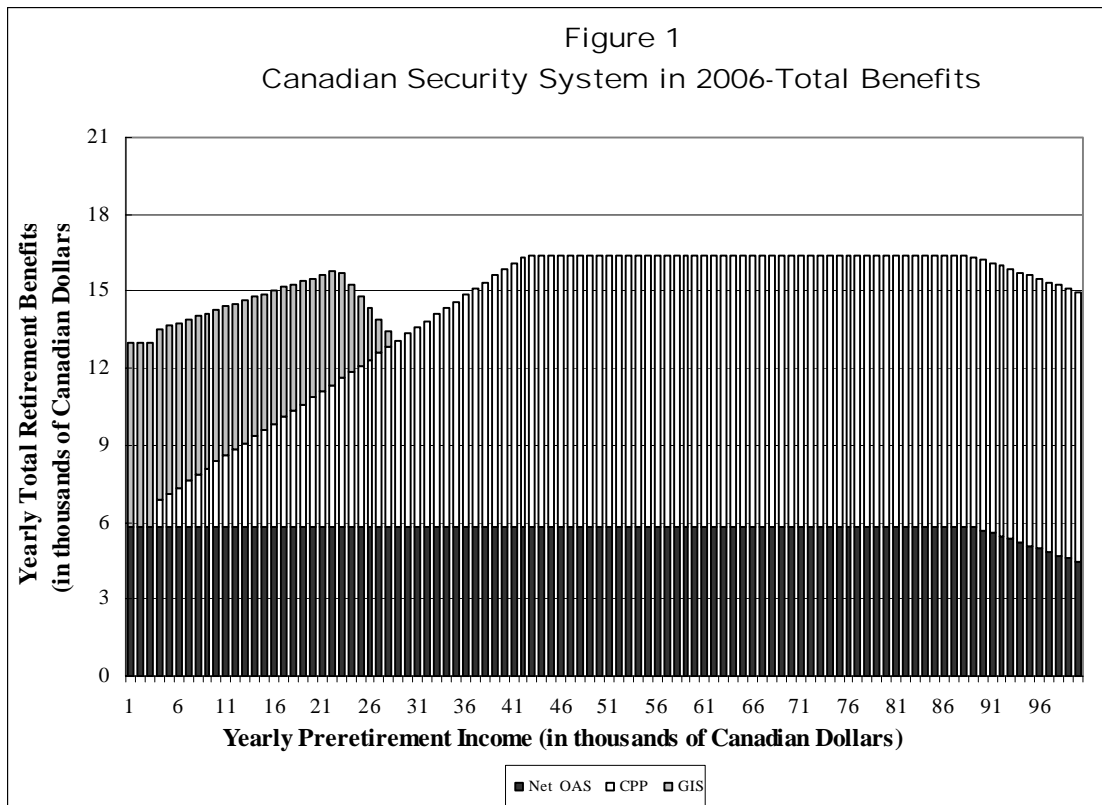


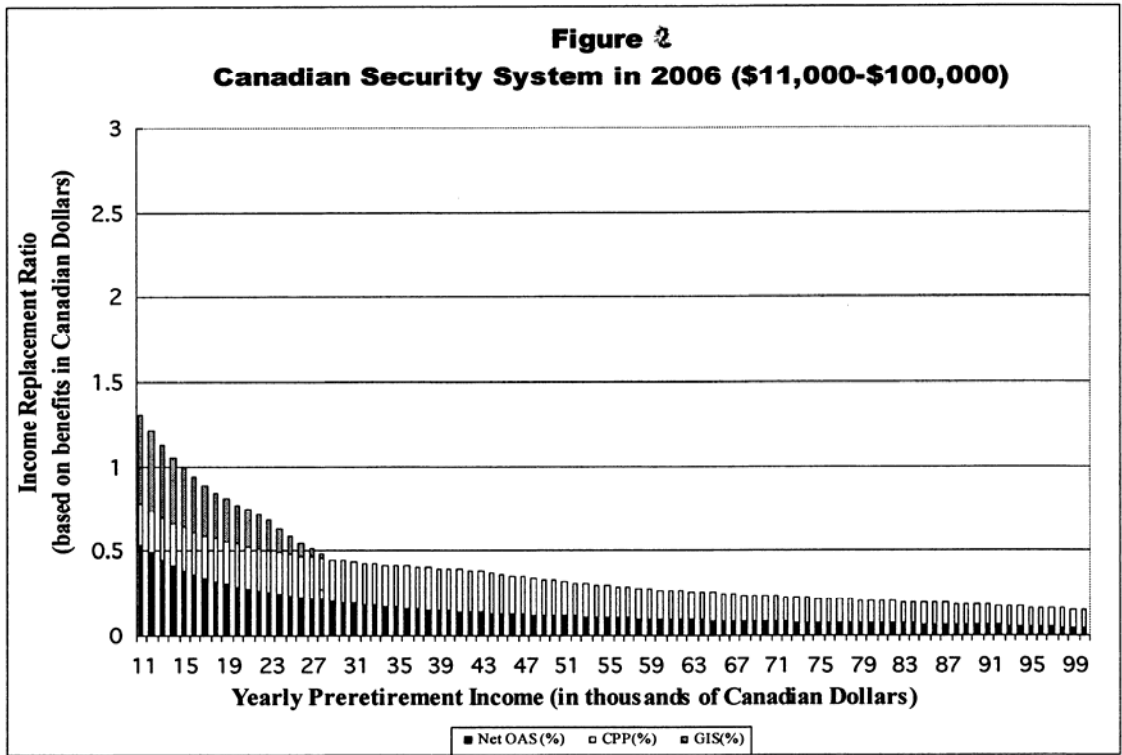
Figure 1 indicates quite clearly that if one were to depend totally on the government-sponsored systems for one's total retirement income, then a wide range of Canadians would live on virtually the same income post-retirement. One can see here (and later in Table 1) that the Canadian government-sponsored retirement income system is heavily targeted to the poor and much less concerned about individual equity.

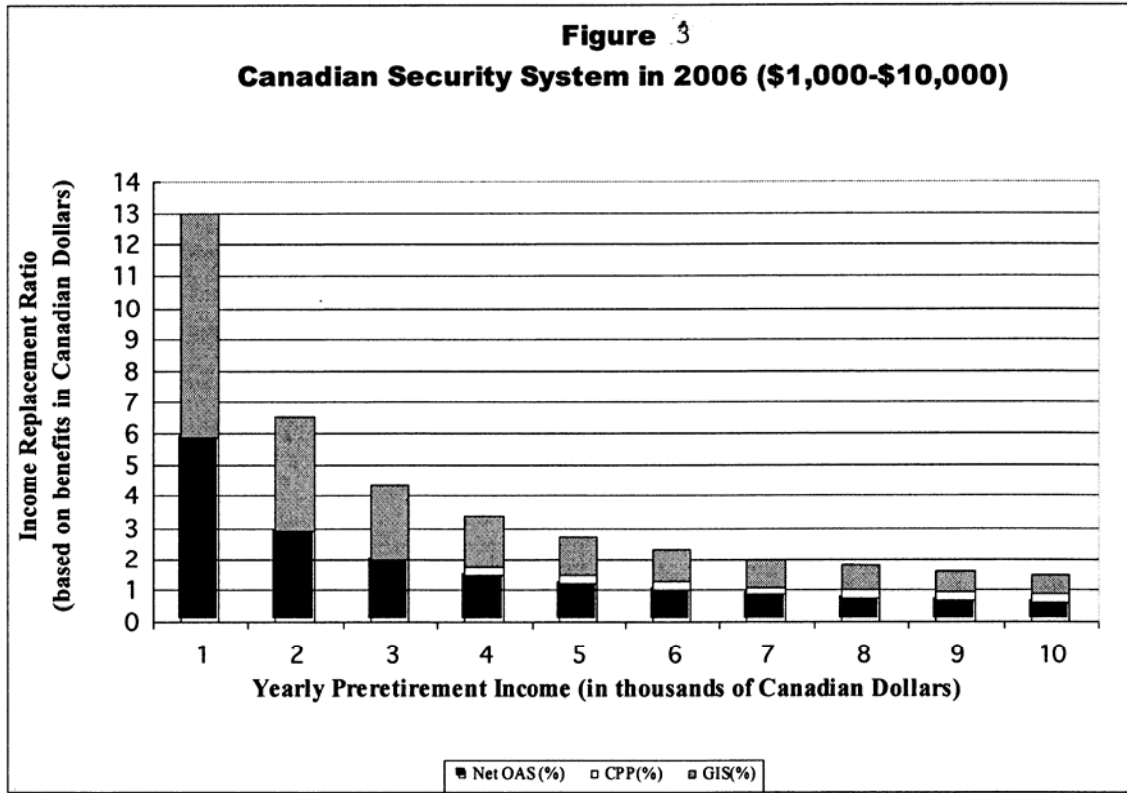
Figure 1 and Table 1 assume that if the government does not provide the worker with a 70% replacement ratio, then the worker will save privately to bring retirement income to that level.

Figure 1 shows how rapidly the GIS benefits are "clawed back" with its 50% reduction factor. For many Canadians the reality is even more stark. This is because some provinces (notably Ontario which has the largest provincial population) also pay welfare benefits to the elderly. Thus, for an Ontario citizen, one loses one's total welfare benefits (federal plus provincial GAINS) \$1 for \$1. Hence, it makes very little sense for most poor Canadians to save for retirement. This is a negative side effect that must be noted and understood in the design of any social security system.

The maximum benefit of the C/QPP will only replace 25% of earnings up to the Average Wage. Thus, there remain strong incentives for all but poor Canadians to continue to save for retirement within the private sector and for workers to strive for workplace pensions. In this regard, Canada

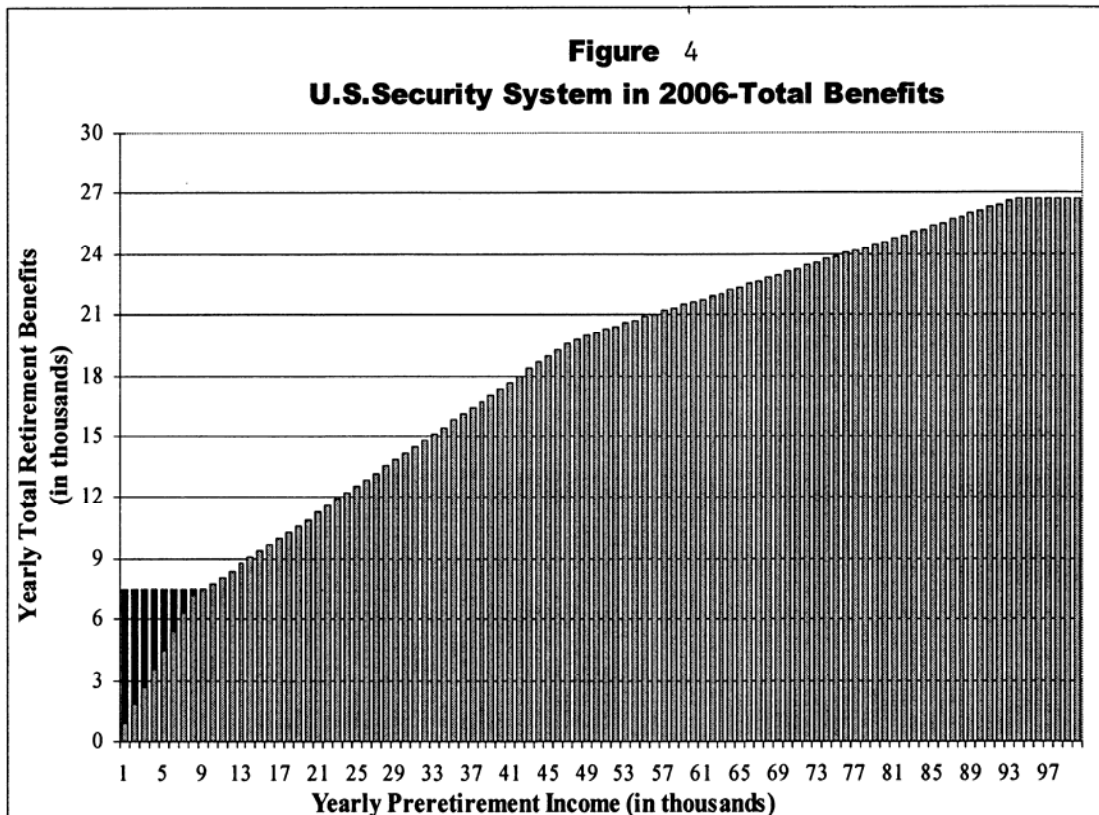
offers significant tax incentives to save for retirement. Within limits, and whether done as an individual or through a workplace pension, contributions (both employer and worker) are tax deductible, investment income accrues tax free, but benefits are income taxable (in full) when taken. There are also limits as to when you must start to take your retirement income and both a minimum and maximum amount that must be taken in any year. Annuitization is not mandated.





Figures 2 and 3 confirm just how focused the Canadian system is on the alleviation of poverty. All of the GIS benefit and much of the OAS benefit is targeted solely to the poor. This will be discussed more fully later in the paper.

As can be seen in Figure 4, the U.S. uses a two-pronged attack. First, there is a very small welfare scheme referred to as Supplemental Social Insurance (SSI—the black area) which is financed by general tax revenues. One can see that this is a minimalist program with a very sharp “claw back” of benefits. You lose one dollar of your SSI for every dollar of private income you have after some small exempt amounts (see http://www.ssa.gov/policy/docs/statcomps/oasdi_monthly/ for more details). Again, it should be noted that this probably discourages poor Americans from saving privately for retirement (but given the minimal size of the SSI, only very poor Americans)



Because SSI is so minimalist, OASDI has acquired a multiple personality. First, it must alleviate poverty for many of the poor elderly because SSI, by itself, will not do that. Second, it must create a replacement ratio that satisfies the need for some predictable standard of living post-retirement. Plus, it must create solidarity amongst all participants (which requires benefits for wealthier participants).

The OASDI system attempts to be all things to all people through a three-part benefit formula (see www.ssa.gov/OACT/COLA/Benefits.html).

OASDI also has stronger Survivor benefits than many other Social Security systems. This is probably a result of the timing of the design of the original OASDI system in the late 1930's. At that time poverty was a serious problem for many of the U.S. elderly, but was especially difficult for widows and females living alone. Thus, the original architects made sure that the spouses (normally wives) of OASDI worker participants got significant continuing benefits when the worker passed away. Figures 5 and 6 (which follow) can be used to compare the level of

targeting of benefits in the U.S. versus Canada (as in Figures 2 and 3).

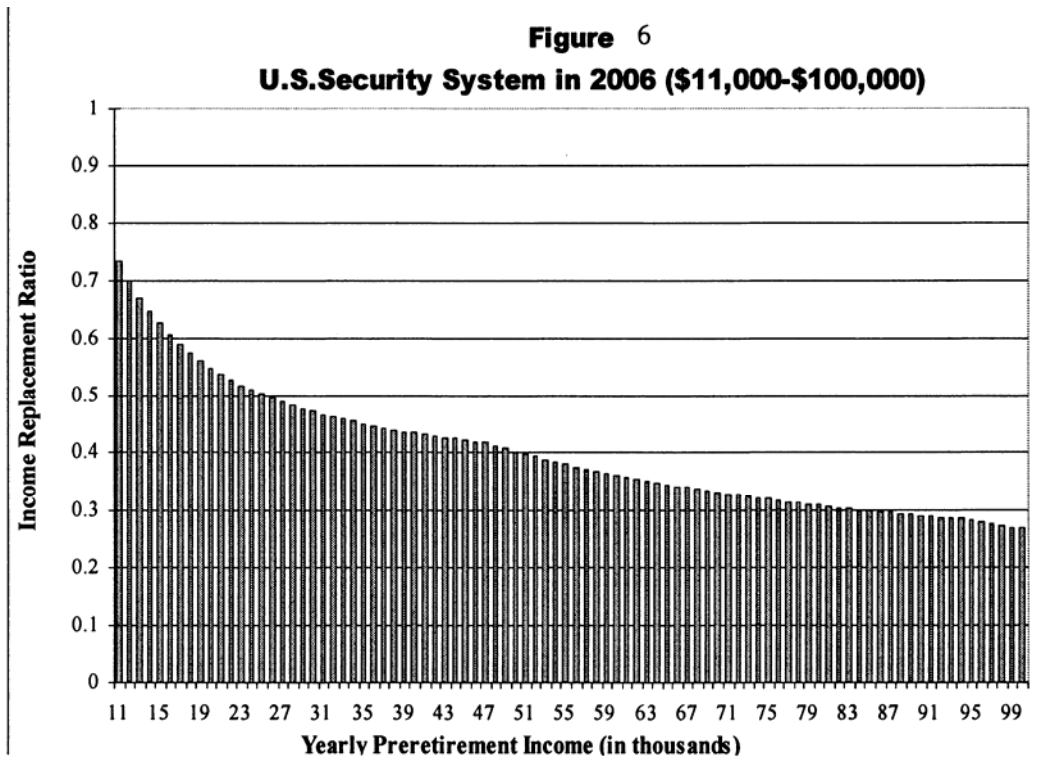
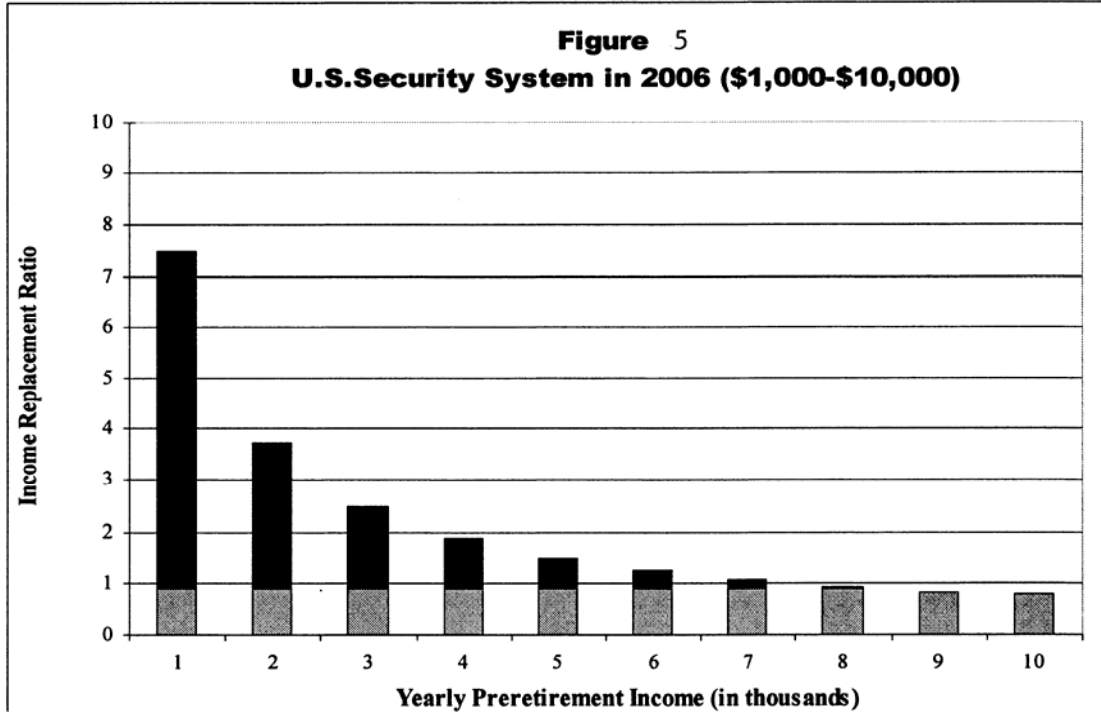


Table 1
Ratio of "Income Replacement Ratios of the U.S. System" to "Income Replacement Ratios of the Canadian System" in 2006

Pre-Retirement Income	Ratio
\$1,000	0.57416
\$5,000	0.54786
\$10,000	0.54417
\$15,000	0.62875
\$20,000	0.70652
\$25,000	0.84952
\$30,000	1.06107
\$35,000	1.07981
\$40,000	1.09560
\$45,000	1.15818
\$50,000	1.22952
\$60,000	1.32112
\$70,000	1.41272
\$80,000	1.50432
\$90,000	1.61078
\$100,000	1.78556

What one can sense from the previous Figures is now confirmed in Table 1. That is, the Canadian system is highly focused on poverty alleviation and less concerned about individual equity. The U.S. system is much less focused on alleviation of poverty and much stronger in terms of the principle of individual equity (benefits are a function of contributions). This will be discussed more in the next section.

The focus on "equity" versus "adequacy" has other effects. One might expect to experience more "solidarity" toward OASDI in the U.S. than to the C/QPP in Canada since the wealthy get more for their contributions in the U.S. than do similar workers in Canada.

On the other hand (as will be seen later) the Canadian system will probably do more to alleviate poverty than the system in the U.S.

Referring to Figure 1 (Canada) and Figure 4 (U.S.) it is clear that the total area under the curves represents the "cost" of Social Security (at least the Retirement Income portion) in the two countries. This cost can be paid by general tax revenues, earmarked contributions and investment income. Despite the fact that some portions are financed by general taxation, any designer of Social Security must be cognizant of the fact that workers will only pay so much for

income security for the elderly. This is true even if part of the cost is partially “hidden” in general taxation income.

How could one lower the overall cost of these systems?

First, one could make the welfare benefits (GIS/SSI) smaller by having a faster (steeper) claw back. However, given that we are already subjecting our poorest elderly to effective tax rates of 50 percent and above, this seems an unfair target. Further, this does not seem prudent since it discourages poor workers from saving for retirement.

As an alternative, one could lower the benefits paid to the wealthiest citizens. Surely they can fend for themselves if the government cuts back their publicly-funded protection. That may be possible, but it would also erode the solidarity inherent in the overall system. Would the wealthy continue to support the program if they reaped much smaller benefits? These are difficult questions and compromises will be required.

One also wishes to assure the public that the cost/benefit structure is sustainable. This is normally done through actuarial evaluations of the system that project many years into the future (e.g, 75). In this regard, both OASDI and the QPP face some long-term issues.

VI Maximum Benefits and the Impact on the Labor Force

In Canada, within the C/QPP, to achieve maximum benefits, you must have full contributions for a number of years established by the formula: $0.85(65-18)$. That is, you must have made full contributions for 85% of the years between age 18 and age 65. This works out to 40 years of required contributions.

There are some exceptions to this general rule. First, you can drop out years (within the bracket) when you are home, caring for children and years when you are collecting C/QPP Disability Income. The child-rearing drop-out requires that the child be under age 7 (verifiable with government birth records) and the carer’s income does not exceed a set level (verifiable through income tax records). This creates a small incentive for parents to leave the work force for a period of time when they have small children. Apparently there exists no literature that attempts to determine the overall impact of this feature on labor force participation rates. However, as stated before, an explicit drop out formula should be preferred to an overall short qualification period for full or significant benefits.

Another issue is the adjustment used if you retire early. Canadians can retire as early as age 60 and take their C/QPP benefits, but will incur an actuarial reduction of benefits of 0.5% a month. Thus, a worker who retires at age 60 will only receive 70% of the income they would have received at age 65. On the other hand, if you delay retirement until age 70 (the upper bound) a worker will receive a 130% benefit. (A CPP study states that the 0.5% adjustment is not a full actuarial adjustment and should be larger. The error gets larger as the age of retirement

advances. This creates a small incentive for earlier, rather than later retirement (Office of the Chief Actuary, 2003).

Another important issue is raised here. Are we better to have an “early retirement factor” equal to ½% a month (6% a year) that is easy to digest and remember or are we better to have “correct” actuarial adjustments (perhaps to several decimal places) that no one can comprehend or remember? The old adage “Keep It Simple, Stupid” may apply to these public plans.

But that is more generally true. To enhance transparency and comprehension, the overall benefit design of social security must be kept as simple as possible. If workers cannot comprehend the benefit structure, then attempts to affect changes in attitudes towards saving for retirement and age-at-retirement will inevitably fail.

Regardless of when one retires, there is very little benefit in the C/QPP retirement income one receives in working beyond 40 years (although it is possible to substitute years of higher income for previous years of lower income). This is especially true because, once you retire, you never make any more CPP contributions even if you go back to work (you do in the QPP). Thus, the C/QPP creates an incentive to leave the labor force after 40 years (and age 60). Internationally, this is actually one of the largest qualification periods used for this criterion. However, this is another important variable to consider in designing any social security system. That is, have you created incentives that discourage labor force participation?

Some countries use requirements less than 40 years to implicitly allow for time out of the labor force to care for children, the disabled or the elderly. As stated before, it is preferable to establish an explicit allowance (such as in Canada) especially when it can be verified without a large bureaucracy (again as in Canada) than to have a shorter contribution or participation requirement for all.

In the U.S., maximum benefits under OASDI can be achieved after 35 years of contributions (later years of higher earnings can be used to substitute for years of lower earnings if participation exceeds 35 years, however). Many papers have been written that indicate that this creates incentives for workers to leave the labor force after 35 years (see Shah et al, 2006).

VII Measures of Success

How can one measure the success of a Retirement Income Security system? In two recent papers Brown and Prus (2004, 2006) attempted to analyze the balance between adequacy and equity in the Retirement Income Security programs of several developed countries. These are competing goals. The more strongly the system ties benefits to contributions (resulting in individual equity) the less redistribution of wealth is available making the achievement of “adequacy” goals more difficult. Other papers on this topic in the actuarial literature include: Brown and Ip (2000), Knox and Cornish (1997).

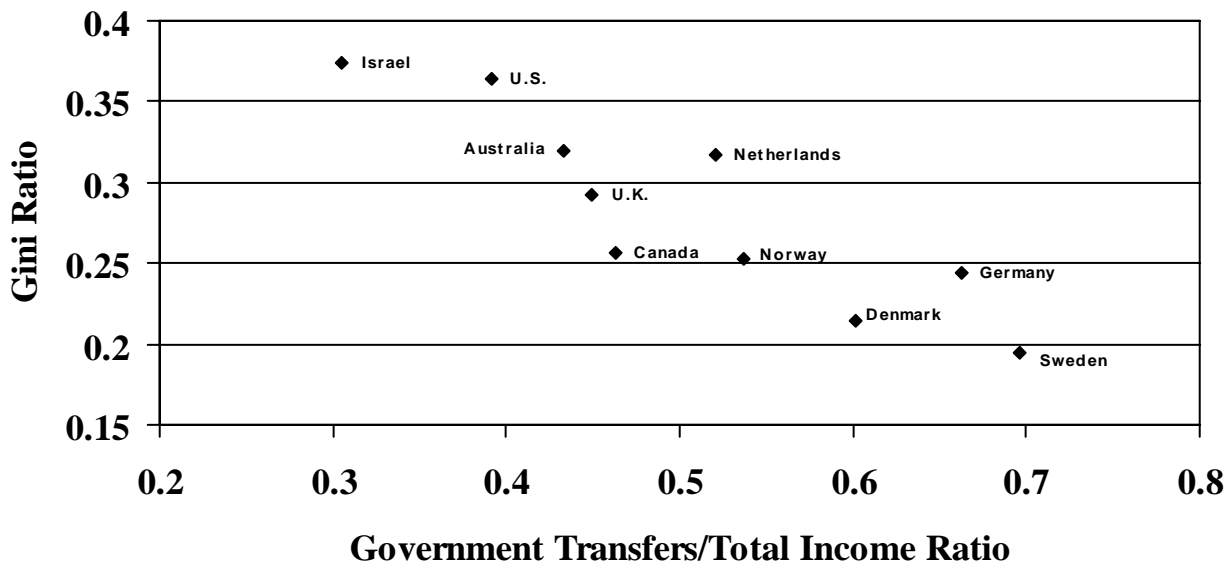
The Brown/Prus paper adds to the “adequacy and equity” criteria, the goal of attaining high

levels of security while still allowing for a strong private sector presence in the attainment of retirement income security. This may not be universally accepted, most actuaries would find this a laudable goal.

In their 2004 paper, Brown and Prus used Luxembourg Income Study (LIS) data to look at income inequality in the retirement income security systems of ten developed countries, juxtaposed with the proportion of retirement income security provided by government-sponsored systems. LIS data are a compilation of income survey data files from 30 countries that have been made comparable by rearranging and reclassifying income measures (Smeeding, 1991). The LIS aggregates country-specific income elements into internationally consistent income categories such as government transfer benefits. More information on LIS data and variable definitions and measurements is found at <http://www.lisproject.org>.

the 2004 paper shows (see Figure 7) that there is a strong negative correlation between the level of government sponsored income (ratio of government transfers to total income) and income inequality (Gini ratio, where the higher the Gini ratio the more inequality there is in income distribution) in old age.

Figure 7: Percentage of Household Income from Government Transfers by Gini Coefficient, for Selected Countries, Household Heads Aged 65+. (Brown and Prus, 2004, p35)



This Figure, allows one to conclude that Canada, Denmark and Sweden are reaching what appear to be optimal outcomes. What varies is the mix of government sponsorship (and control) of retirement income security and income inequality. If Swedes are politically happy with a system where the government provides 70 percent of post-retirement income, then that system also

provides a very high income security as evidenced by the Gini ratio (0.194). On the other hand, the Canadian government provides only 46 percent of their seniors' income and still achieves a Gini ratio of 0.256. Again, culturally, Canadians may be happy with that mix.

What can be said, however, is that the other seven nations analyzed could be doing a “better” job as to total retirement income security. For example, the Netherlands could clearly achieve more income equality (a lower Gini ratio) without increasing government control of the retirement income security system. Similar comments apply to the other nations who are not on the “optimal” frontier.

Other research has arrived at similar conclusions (e.g., Regie des rentes du Quebec, 2004; OECD, 2000; 2001). The 2001 OECD study bases its conclusions on two criteria which are referred to as fundamental objectives of retirement income policies: preventing unacceptable declines in income when people retire and guarding against very low incomes among older people (*ibid*, p21). Table 2, reproduced from this study, shows that general replacement ratios are very high, which seems to indicate that most systems are preventing unacceptable declines in income when people retire. Many authors have indicated that the types of replacement ratios cited here mean no dislocation in one’s standard of living at retirement (e.g., Palmer, 2001). These data also show that some countries like Canada clearly have government systems that are highly focused on poverty control in old age (i.e., guard against very low incomes), while such targeting of income benefits is not so clear in countries like Japan and the United Kingdom.

Table 2:

Disposable Income of the population aged 65 and over by Income Decile compared with the Population aged 18 to 64 in the same Income Decile, in Percentages, mid 1990s

Decile	Canada	Finland	Germany	Italy	Japan	Netherlands	Sweden	UK	US	mean	inter range
1	148	101	102	128	72	83	89	76	80	97.7	76
2	107	83	90	92	73	77	84	69	78	83.7	38
3	94	78	84	86	75	74	81	66	77	79.4	28
4	87	75	82	81	77	72	80	64	78	77.3	23
5	85	73	80	78	77	74	79	64	78	76.4	21
6	86	72	79	76	78	77	79	65	81	77.0	21
7	86	72	78	76	81	80	79	67	83	78.0	19
8	86	72	79	77	84	82	83	72	94	81.0	22
9	87	73	81	77	87	80	79	67	83	79.3	20
10	96	75	79	75	94	82	83	72	94	83.3	24
mean	96.2	77.4	83.4	84.6	79.8	78.1	81.6	68.2	82.6		
intra-range	63	29	24	53	22	11	10	12	17		

Source: OECD 2001 p24

In their second paper, Brown and Prus (2006) test two hypotheses. The first hypothesis states that levels of income inequality decline from working to retired ages. This is because public

benefits are more equally distributed than income generated in the labor market. A progressive public pension system, which becomes a key source of income for people as they enter old age, reduces the overall level of income inequality in old ages relative to middle ages. The second, and related, hypothesis states that because of the progressive nature of government benefits, countries with stronger public retirement income security programs are better able to reduce income inequalities from middle to old ages.

The analysis focused on OECD nations using the most recently available wave of LIS data (data from around 2000). Though the LIS has been designed to make cross-national comparisons possible, some differences between LIS datasets made it difficult to compare all OECD countries for the study. For example, gross income data in the Belgium dataset are not available, and Finland includes government-funded pension data in the occupational pension category. Only those OECD countries that have complete and comparable income data were used in this analysis. These countries were: Canada, Germany, the Netherlands, Norway, Sweden, the U.K., and the U.S.

The aim of this paper was to examine changes in levels of income inequality over the later part of traditional working ages to traditional retirement ages. The analysis was performed across the following age groups: 45-54, 55-59, 60-64, 65-74, and 75+.

Two issues about the analysis of these data were noted. First, while the study provided original insight into the relationship between age and income inequality, it is not possible with cross-sectional data to completely disentangle age from cohort effects. Second, there is a larger mix of retirees and workers at ages 55 to 64 compared to other ages. This makes it difficult to distinguish between the influence of public pension policies versus fluctuations in labor force status per se on changes in levels of income inequality during old age. To lessen this problem more narrow age groupings (i.e., 55-59 and 60-64), which are more homogeneous groups in terms of labor force status than the combined 55-64 group, were used.

The study used total annual money income of older-headed (45+) households as the income measure.

Total household income was divided by a household “factor” using an equivalence elasticity of 0.5 (i.e., household size raised to the power of 0.5) to adjust for household size. Then the household's equivalent income was assigned to each member of the household to get back to the individual level of analysis. Hence, weighted-adjusted-household income is the income measure, which is simply referred to as “household income.”

The paper then looked at income at the relative level (a household's share of total income), which permits direct international comparisons of within-country income distributions. Relative income inequality therefore refers to the share of the income pie allocated to different households at different points in the income distribution.

Income quintiles and the Gini ratio were used to measure the level of relative income inequality within this distribution. In an income quintile distribution, the first quintile (Q1) is comprised of

households with the lowest 20% of weighted adjusted household incomes, the second quintile (Q2) is made-up of households with the next lowest 20% of weighted adjusted household incomes and so on.

The Gini ratio provides a single number measure of relative inequality within a distribution, and ranges from zero (perfect equality) to one (perfect inequality). The formula for the weighted (i.e., assigning the household's adjusted income to each member of the household) Gini ratio (G^w), as provided by Crystal and Waehrer (1996), is:

$$G^w = 1 + \frac{1}{\sum_{i=1}^k w_i} - \frac{2 \sum_{i=1}^k \sum_{j=1}^{w_i} \left(j + \sum_{h=1}^{i-1} w_j \right) h_i}{\sum_{i=1}^k w_i \sum_{i=1}^k w_i n_i}$$

In this formula let $i = 1, k$ index individual observations in the data, where the data are ranked by income and k is the number of observations. The income and household weight of the i th observation are denoted by n_i and w_i respectively.

The paper's first hypothesis stated that levels of income inequality should decline from traditional working to retirement ages. Table 3 shows inequality rates in the distribution of disposable (after tax) household income by age.

Norway and Sweden generally had the most equal and the U.S. the most unequal distributions of income at any stage of the later life course. Looking at the trajectory of income inequality rates across the later life course, one of the most significant shifts is observed in Sweden -- the Gini coefficient increases by 27 percent between ages 45-54 and 55-59, then decreases by 15 percent from ages 55-59 to 60-64 and a further 5.3 and 13 percent from ages 60-64 to 65-74 and 65-74 to 75+ respectively. Along with Sweden, Norway and Canada are best able to reduce income inequalities during old age, although starting at ages 65-74 rather than 60-64 -- income inequality levels decline by about 20 percent from ages 60-64 to 65-74. The old age welfare systems in the Netherlands (13 percent), the United Kingdom (12 percent), and Germany (11.4 percent) also produce large declines in income inequality levels. These patterns generally continue from ages 65-74 to 75+, most noticeably for Norway and the United Kingdom. By contrast, income inequality levels change only slightly as households enter old age in the U.S.

Table 3: Gini Coefficients of Disposable Household Income for selected OECD Countries, by Age of Household Head ^a

	45-54	55-59	<i>Age</i> 60-64	65-74	75+
Canada	.301	.325(+ 8.0%)	.327(+ 0.6%)	.266(-18.7%)	.259(- 2.6%)
Germany	.239	.271(+13.4)	.289(+ 6.6)	.256(-11.4)	.254(- 0.7)
Netherlands	.261	.266(+ 1.9)	.277(+ 4.1)	.241(-13.0)	.238(- 1.2)
Norway	.255	.277(+ 8.6)	.284(+ 2.5)	.224(-21.1)	.209(- 6.7)
Sweden	.226	.287(+27.0)	.244(-15.0)	.231(- 5.3)	.201(-13.0)
U.K.	.339	.361(+ 6.5)	.342(- 5.3)	.301(-12.0)	.286(- 5.0)
US	.351	.383(+ 9.1)	.384(+ 0.3)	.375(- 2.3)	.370(- 1.4)

a. Percentage changes in Gini coefficients between subsequent age groups are in brackets.

Table 4 (next) shows the percentage of total disposable household income owned by each income quintile. Sweden and Norway's decline in income inequality in old age is the result of greater transference of income from the top quintile (Q5) to all other quintiles (Q1 to Q4) -- they acquire a greater share of total income at the expense of the top quintile. By contrast, in Canada, the Netherlands and the United Kingdom, the decline in income inequality from ages 60-64 to 65-74 stems from the change in income shares primarily from the top quintile to only the lowest quintiles, especially the bottom quintile -- that is, income inequality is reduced through targeted measures aimed at increasing the income position of the poorest citizens. Germany has the most stable distribution of income for all age groups. It is interesting to note that only in the U.S. do both the bottom and top quintiles experience improvement (albeit moderate) in relative income position from ages 60-64 to 65-74. Also, the U.S. has the greatest differences between Q5 and Q1 at all ages.

The second hypothesis of the paper stated that countries with stronger public income security programs would be better able to reduce income inequalities over traditional working to retirement ages. Tables 5 and 6 provided the data to test this hypothesis.

Table 5 shows the percent of total gross (before tax) household income from public (government transfers) and private (earnings, investments, and occupational pensions) sources. Households in the U.S. receive the smallest percentage of income from government sources -- from a low of 3.2 percent at ages 45-54 to 42.7 percent at ages 75+. Sweden generally has the highest reliance on

Table 4

Percentage Share of Total Disposable Household Income by Income Quintile Rank for selected OECD Countries by Age of Household Head

	Canada	Germany	Netherlands	Norway	Sweden	UK	US	Mean
45-54								
Q1	7.7	9.9	8.0	10.2	10.4	6.8	6.2	8.5
Q2	13.5	15.1	15.0	15.1	15.3	12.6	12.4	14.1
Q3	18.0	18.3	19.1	17.8	18.7	17.1	17.2	18.0
Q4	23.0	22.7	23.5	20.9	22.4	22.6	22.5	22.5
Q5	37.8	34.0	34.4	36.1	33.2	40.9	41.7	36.9
Q5-Q1	30.1	24.1	26.4	25.9	22.8	34.1	35.5	28.4
Q5/Q1	4.9	3.4	4.3	3.5	3.2	6.0	6.7	4.4
55-59								
Q1	6.6	8.7	8.5	9.1	9.3	5.3	5.2	7.5
Q2	12.9	13.8	13.9	14.7	14.1	12.4	11.4	13.3
Q3	17.9	18.1	18.2	17.8	17.3	17.1	16.8	17.6
Q4	23.1	23.2	22.7	21.1	21.0	23.5	22.7	22.5
Q5	39.4	36.2	36.7	37.8	38.3	41.6	43.8	39.1
Q5-Q1	32.8	27.5	28.2	28.7	29.0	36.3	38.6	31.6
Q5/Q1	6.0	4.2	4.3	4.2	4.1	7.8	8.4	5.2
60-64								
Q1	5.6	8.2	6.8	9.3	9.3	6.7	5.1	7.3
Q2	13.3	13.8	13.2	14.1	15.2	12.3	11.4	13.3
Q3	18.0	17.9	18.2	17.5	18.9	16.9	16.4	17.7
Q4	24.0	23.0	23.3	20.8	22.8	23.0	23.3	22.9
Q5	38.8	37.2	38.6	38.4	33.9	41.2	43.8	38.8
Q5-Q1	33.2	29.0	31.8	29.1	24.6	34.5	38.7	31.6
Q5/Q1	6.9	4.5	5.7	4.1	3.6	6.1	8.6	5.3
65-74								
Q1	9.8	9.6	10.2	11.0	10.8	8.8	6.0	9.5
Q2	13.7	14.5	14.7	14.9	14.7	13.2	11.3	13.9
Q3	17.4	17.8	17.8	18.3	18.0	16.7	16.2	17.5
Q4	22.6	22.5	22.7	22.3	22.4	22.3	22.5	22.5
Q5	36.5	35.5	34.7	33.5	34.0	39.1	44.1	36.8
Q5-Q1	26.7	25.9	24.5	22.5	23.2	30.3	38.1	27.3
Q5/Q1	3.7	3.7	3.4	3.0	3.1	4.4	7.4	3.9
75+								
Q1	10.7	9.7	11.2	12.3	12.4	9.2	6.6	10.3
Q2	13.8	14.4	14.1	15.1	15.7	13.5	11.2	14.0
Q3	16.9	18.1	16.7	17.7	17.8	17.2	16.0	17.2
Q4	21.6	22.6	22.3	21.8	21.4	22.2	22.2	22.0
Q5	37.0	35.2	35.7	33.2	32.7	37.9	44.0	36.5
Q5-Q1	26.3	25.5	24.5	20.9	20.3	28.7	37.4	26.2
Q5/Q1	3.5	3.6	3.2	2.7	2.6	4.1	6.7	3.5

public transfers. These are also the countries with the highest and lowest Gini coefficients respectively. Overall, cross-national differences in income inequality are significantly accounted for by differences in the percentage of government transfers in the composition of household income at all stages of the later life course -- the R^2 coefficient for the relationship between the "Gini ratio" as reported in Table 2 and the "percentage of income from government transfers" as reported in Table 5, after controlling for age, is 0.51.

Table 5: Percent of Total Gross Household Income by Source for selected OECD Countries, by Age of Household Head ^a

	Canada	Germany	Netherlands	Norway	Sweden	U.K.	U.S.
45-54							
Earnings ^b	89.0%	89.1%	89.3%	82.7%	84.0%	88.1%	90.5%
Investments ^c	5.0	3.5	1.7	9.0	3.4	3.4	5.2
Pensions ^d	1.1	0.4	0.2	0.6	0.4	1.9	1.2
Gov. Transfers ^e	4.9	7.0	8.8	7.7	12.2	6.6	3.2
55-59							
Earnings	80.1	83.5	75.6	79.1	73.4	76.8	84.4
Investments	6.6	4.4	4.0	10.0	10.9	6.0	7.4
Pensions	7.4	1.5	5.1	1.5	2.3	7.9	4.2
Gov. Transfers	5.8	10.6	15.2	9.4	13.3	9.3	3.9
60-64							
Earnings	58.2	60.8	35.1	64.4	56.1	55.5	72.2
Investments	9.1	6.5	6.7	10.5	6.6	8.6	8.2
Pensions	19.7	4.9	32.2	6.1	10.6	18.5	9.7
Gov. Transfers	13.0	27.8	26.0	19.1	26.7	17.7	9.9
65-74							
Earnings	20.1	17.5	5.3	28.2	14.9	18.9	39.2
Investments	11.8	7.5	6.2	7.7	8.9	12.5	15.1
Pensions	28.6	13.1	40.5	14.7	14.5	24.3	15.3
Gov. Transfers	39.5	62.0	48.0	49.4	61.8	44.3	30.3
75+							
Earnings	6.0	5.7	7.4	7.7	2.9	10.6	21.8
Investments	17.1	9.0	5.6	9.7	8.3	11.9	18.9
Pensions	28.8	16.1	33.3	15.2	11.8	19.7	16.6
Gov. Transfers	48.1	69.3	53.7	67.4	76.9	57.7	42.7

a. May not total exactly to 100% due to rounding.

b. Includes self-employment income.

c. Includes other income from private sources.

d. Private (occupational) pension income.

e. Government transfers (e.g., social security retirement benefits and means-tested old-age benefits).

Table 6 expanded these findings to show that there is generally a heavier reliance on government benefits for all income quintiles in countries with the lowest rates of income inequality. Public sources in Sweden make up 92.6 and 39.5 percent of the income of the bottom and top quintiles at ages 65-74; the comparable figures in the U.S. are only 81.8 and 14.7 percent. In Canada, which has a moderate level of income inequality, these figures fall between the Swedish and U.S. numbers -- 88.7 and 17.7 percent of income is from government transfers by Q1 and Q5.

Table 6: Percent of Total Gross Household Income from Government Transfers by Income Quintile Rank for selected OECD Countries, by Age of Household Head

	Canada	Germany	Netherlands	Norway	Sweden	U.K.	U.S.
45-54							
Q1	29.4%	30.4%	36.3%	31.0%	43.9%	53.3%	20.1%
Q2	9.0	10.3	15.4	11.6	17.5	11.6	6.1
Q3	4.6	7.2	9.2	7.2	13.1	4.7	3.2
Q4	2.9	4.6	5.5	4.5	8.6	2.9	2.6
Q5	1.1	2.1	3.3	2.2	3.6	1.0	0.9
55-59							
Q1	37.2	51.4	44.8	43.3	46.3	60.0	32.6
Q2	12.0	21.4	30.4	17.7	26.1	22.3	7.5
Q3	5.9	10.6	15.8	7.8	14.5	7.9	4.2
Q4	3.5	5.6	13.0	5.5	8.7	4.6	3.2
Q5	1.1	2.6	5.3	2.1	3.9	1.2	0.7
60-64							
Q1	60.1	86.9	72.3	69.2	71.1	73.0	52.9
Q2	25.1	67.5	40.3	37.0	43.9	50.1	23.6
Q3	15.7	39.6	38.5	24.5	29.3	19.0	13.0
Q4	10.9	19.4	15.2	12.7	22.2	12.1	8.5
Q5	3.8	6.6	16.5	3.9	10.5	3.6	2.9
65-74							
Q1	88.7	91.2	88.0	87.7	92.6	87.4	81.8
Q2	73.5	89.8	77.6	76.7	83.4	79.1	62.3
Q3	49.4	82.5	61.4	61.5	75.7	64.4	44.5
Q4	34.0	64.4	39.0	46.0	60.4	40.0	29.7
Q5	17.7	33.4	27.7	24.8	39.5	19.1	14.7
75+							
Q1	91.2	93.8	94.7	93.4	94.9	91.2	85.6
Q2	81.4	90.0	87.7	87.6	89.4	85.3	80.8
Q3	65.6	85.3	76.4	80.6	86.3	79.7	65.7
Q4	46.0	73.5	43.0	69.8	82.2	64.1	44.9
Q5	22.6	44.6	28.8	44.0	58.4	28.4	21.3

VIII Conclusion

The paper suggests that policy-makers and their actuarial advisors, when designing (or re-designing) a social security system, need to keep all of the following principles in mind:

- Benefits will be paid for by a combination of taxes, contributions and investment income. Regardless of the financing source, the total cost of the system must be affordable and sustainable.
- The system and its inner workings should be understandable and comprehensible to a large proportion of the population. This also supports the goal of transparency.
- It is preferable to have explicit drop-out provisions for contingencies such as caring for children or disability than to offer a significant benefit with only a short work-force attachment.
- The benefit/contribution structure should not encourage workers to evade participation by not admitting to earnings or by entering the cash economy.
- The removal of welfare benefits as participants enter higher wealth zones should not be so rapid as to create large effective marginal tax rates that will then create incentives so that workers will not save for retirement.
- It may be necessary to provide significant benefits to wealthy participants to guarantee the solidarity of these workers in the support of the system as a whole.
- The benefit/contribution structure should not encourage workers to leave the work force early. For example, a 40-year work history is required in Canada before full benefits can be paid.

These are all very important principles. They are also often in conflict among themselves. It will be extremely difficult to achieve all of the goals outlined above (e.g., total cost versus steep claw backs).

One must also be cognizant and sensitive to the local culture and history in designing social security systems.

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