Actuarial Metrics for Monitoring the Sustainability of the US Social Security System

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Introduction

Social Security systems are the focus of much public policy debate due to concerns over demographic changes and financial sustainability. The actuarial profession can contribute to these public policy issues by informing policymakers and the public about suitable objective actuarial assessments of financial stability, solvency and sustainability. While several countries publish meaningful actuarial metrics for their national Social Security systems, it would appear that many of these countries could enhance the scope of published actuarial metrics for their various Social Security systems so as to provide greater clarity and insight into the reporting and understanding of financial sustainability. Since there is no established or recognized international standard for the actuarial assessment of sustainability for Social Security systems, it is reasonable to explore the types of actuarial metrics that might be useful for this purpose.

This paper addresses the issues of the US Social Security system's financial stability, solvency and sustainability as a case study and as a potential role model for other countries. Various suitable actuarial metrics are presented that are derived from the official published data contained in the annual trustees' reports, together with an analysis of historical data relating to long-range actuarial projections of the financial condition of the system. The paper represents a continuation of previously published research by the author.[1, 2, 3]

The US Social Security System

The US Social Security system was created in 1935 when the US Congress passed the Social Security Act. Initially, the system, which became effective in 1937, comprised the Old-Age and Survivors Insurance (OASI) program, providing retirement income benefits to workers age 65 and older. The system was expanded in 1939 to cover dependents and survivors. The Disability Insurance (DI) program was added in 1956 to provide income to disabled workers, and in 1958 it was extended to provide benefits to dependents of disabled workers. The US Social Security system is financed mainly by payroll taxes assessed equally on employers and employees. For 2014, OASI payroll taxes are set at 5.30% for a combined rate of 10.60% of earnings up to a limit of US$117,000. The corresponding DI payroll tax rate for 2014 is 0.90% for a combined rate of 1.80%, making the total tax rate 6.20% or a combined employer and employee OASDI tax rate of 12.40%.

Overview of Key Metrics for the US Social Security System

The financial condition of the US Social Security system, including the OASI and the DI trust funds, is presented in the annual reports[4, 5] of the Board of Trustees. Each year, the trustees present a report on the financial operations of the trust funds, including assumptions about the future, and the results of three alternative deterministic projections of the future financial status of the system. The trustees present the results

of long-range actuarial estimates, extending up to 75 years, of the annual income rates, cost rates and balances for the OASI trust fund, the DI trust fund, and the combined OASDI funds. For the purpose of preparing the long-range actuarial estimates, the Social Security actuaries utilize various demographic assumptions and methods relating to mortality, fertility and immigration to develop total population estimates. They also utilize economic assumptions relating to productivity, inflation, average earnings, real-wage differentials, the labor force, unemployment, gross domestic product and interest rates. In the introduction to the annual reports, the trustees state: "Although, in general, a greater degree of certainty can be presumed for projections encompassing the next few years than for a period as long as the next 75 years, any estimation of future experience is uncertain. Therefore, three alternative sets of demographic, economic, and program-specific assumptions are used to show a range of possible outcomes for all projections. An intermediate set of assumptions reflects the trustees' best estimate of future experience, a low-cost set is more optimistic, and a high-cost alternative set is more pessimistic for the trust funds' future financial outlook." The trustees' reports also include results that are produced by the application of stochastic projection methodology together with a comparison of the results from the stochastic projections to the three traditional deterministic projections. According to the trustees' reports, the intermediate estimates correspond to the 50^{th} percentile of the stochastic projections and the low-cost and high-cost estimates correspond to values within the upper and lower 5% tails of the stochastic distribution results.

After projecting the system's income, expenditure and assets at various future points of time within the next 75 years, the Social Security actuaries present the results in terms of annual income rates, cost rates and balances. The annual income rate is the ratio of income from revenues, comprising payroll tax receipts and income from the taxation of benefits, to the OASDI taxable payroll for the year. The annual cost rate is the ratio of the cost, comprising outgo and expenditures for benefits, administrative expenses and other disbursements from the program, to the taxable payroll for that year. In this context, the balance is simply the difference between the income rate and the cost rate for a specific year.

The next step in the process for preparing the results of the 75-year projections is the development of summarized income rates, cost rates and balances. The summarized rates represent the projected annual rates on a present-value basis for various periods within the overall 75-year projection period. Results are presented for 25-year, 50-year and 75-year projection periods, representing cash flows from income and outgo, without having regard to the initial trust fund balance, any minimum target level for the trust fund assets, or the adequacy of the trust fund to meet scheduled benefit payments. The next procedural step involves modifying the summarized income rates to include the effect of the initial trust fund balance; this generates the actuarial asset-income cash flow metrics, which for the purpose of this paper are denoted as M1(25), M1(50) and M1(75) and actuarial liability-outgo cost rate metrics M2(25), M2(50) and M2(75). These rates are shown below as reported in the 2002 and 2013 trustees' reports.

M1 and M2: ASSET-INCOME AND LIABILITY-OUTGO RATES (PERCENT OF COVERED PAYROLL)

PROJECTION PERIOD	PROJECTION BASIS 2002 LOW COST	2002 INTERMEDIATE	2002 HIGH COST	PROJECTION BASIS 2013 LOW COST	2013 INTERMEDIATE	2013 HIGH COST
	ASSET-INCOME PROCEEDS			ASSET-INCOME PROCEEDS		
	%	%	%	%	%	%
25YEARS	14.17	14.21	14.28	14.66	14.77	14.84
50 YEARS	13.74	13.82	13.92	13.94	14.08	14.21
75 YEARS	13.60	13.72	13.87	13.70	13.88	14.06
	LIABILITY-OUTGO CASH FLOW			LIABILITY-OUTGO CASH FLOW		
	%	%	%	%	%	%
25YEARS	11.39	12.42	13.71	13.83	15.40	17.27
50 YEARS	12.73	14.53	16.81	13.89	16.07	18.75
75 YEARS	13.05	15.45	18.68	13.76	16.45	19.82

The trustees also modify the M1 rates to maintain a minimum target trust fund balance equal to one year's outgo for benefits and expenses at the end of the projection period. The difference between the summarized income rates and summarized cost rates with these trust fund adjustments is referred to as the actuarial balance. This is an official measure of the surplus or deficit in the system and is widely regarded as the principal quantitative measure of the adequacy or financial viability of the system. However, for the purpose of assessing solvency, it is not necessary to include the requirement for maintaining the minimum balance at the end of the projection period in the trust funds. While the level of the actuarial balance reported by the trustees is a well-established measure of the financial viability of the US Social Security system, it does not give any indication of the extent of the solvency of the system, i.e. the degree to which the actuarial value of asset-income cash flow proceeds is projected to be available to meet the actuarial value of liability-outgo cash flow requirements for scheduled benefits and expenses. A direct comparison of the M1 and M2 metrics provides an actuarial measure of solvency. The ratio M1 divided by M2 and expressed as a percentage is defined as the solvency metric M3 and is shown in the following table for 2002 and 2013. The M4 and M5 rates that represent the absolute amount of decline in solvency over the period 2002-2013 and the equivalent annual rates of decline are also shown in the table below.

M3: SOCIAL SECURITY SOLVENCY RATIOS						
	PROJECTION BASIS			PROJECTION BASIS		
PROJECTION PERIOD	2002 LOW COST %	2002 INTERMEDIATE %	2002 HIGH COST %	2013 LOW COST %	2013 INTERMEDIATE %	2013 HIGH COST %
25YEARS	124.41	114.41	104.16	106.00	95.91	85.93
50 YEARS	107.93	95.11	82.81	100.36	87.62	75.79
75 YEARS	104.21	88.80	74.25	99.56	84.38	70.94
	M4: AMOUNT OF DECLINE 2002-2013			M5: ANNUAL RATE OF DECLINE 2002-13		
	LOW COST %	INTERMEDIATE %	HIGH COST %	LOW COST %	INTERMEDIATE %	HIGH COST %
25YEARS	18.41	18.50	18.23	1.47	1.62	1.76
50 YEARS	7.57	7.49	7.02	0.66	0.75	0.80
75 YEARS	4.65	4.42	3.31	0.42	0.47	0.42

The trustees routinely report the calendar year in which the trust fund is projected to become “exhausted.” In more conventional actuarial terms, this is the end year of the period for which the system is at least 100% solvent according to the M3 metric. The latest available 75-year projections on the intermediate basis indicate that, although the system is at least 100% solvent over 20 years, there is a potential long-range deficit beyond 20 years. If the intermediate assumptions prove accurate, then in order to sustain the system in its present form with its scheduled benefits, it will be necessary to modify the payroll tax rate so as to achieve 100% solvency. The incremental amount to be added to the payroll tax rate in order to re-establish the equilibrium of the system to a 100% solvency position is 50% of the difference between the M2 and M1 metrics; this adjusted rate would be payable by both employer and employee.

Economic Cost Concept

There are limitations to the concept of measuring costs of social security systems in relation to the active labor force. Two of the major secular demographic trends that impact sustainability are increasing life expectancy and declining fertility rates; these trends are typically communicated by means of the dependency ratio that relates the number of elderly persons to the number of persons of working age. This metric is often cited as evidence of unsustainable conditions for the US Social Security system as the ratio is projected to increase over time due to demographic trends. However, this type of metric does not address the economic cost or actuarial aspects of the system. The true underlying cost of a social security system is represented by the projection of future expenditures for benefit payments and administration; this economic cost is generally quoted as a percentage of Gross Domestic Product (GDP) on an annual basis. This is a

more meaningful economic metric that puts social security costs into a proper economic perspective and context and is a useful guide in making policy decisions concerning the allocation of national resources. Only when long-range projections of costs associated with national priorities such as health, education, welfare, social security, environmental protection and national defense have been made, can the appropriate policy decisions be taken as to how the available economic resources should be allocated between the various national priorities. The series of projected annual economic costs will indicate the effects of demographic changes over time, including the aging of the population. This economic cost for the US Social Security system is projected to rise from 5.0% in 2012 to 6.2% by 2035 and then decline gradually, stabilizing at about 6% thereafter. Because of this inherent upward trend in economic costs, policymakers have attempted to introduce some degree of stability into the manner in which these economic costs are financed in practice.

Sustainability in Relation to Stability and Solvency

The topic of Social Security sustainability has been widely discussed in recent years and is receiving increasing attention from policymakers as well as economists, actuaries and other experts. Sustainability is a particularly complex topic that is influenced by several factors including demographic, economic and financial considerations. Sustainability is typically assessed in broad general terms of projected demographic changes and their likely effects on financial stability and affordability. As mentioned previously, the US Social Security system is mainly financed by a payroll tax that is set at a fixed rate of 6.20% of covered earnings for both employer and employee. This method of financing was adopted in an attempt to stabilize the incidence of the financing costs over a period of 75 years so as to produce equilibrium between the actuarial value of economic and financing costs. In effect the financing method generates excess funds in the early years of the projection period that are offset by projected deficits in the later years. Regrettably, this approach to achieving stability does not work in the long run. It is not possible to set a permanent fixed rate of payroll tax to finance a Social Security system that, by its very nature, requires financing to be responsive to emerging secular changes, whether due to demographic or economic conditions. The economic costs as a percentage of covered payroll in the years beyond the initial 75-year projection period are greater than the established 6.20% stable payroll tax rate. These “out-years” should require a modestly escalating financing cost from year-to-year in order to maintain solvency and sustainability over the long run beyond 75 years. As a result of freezing the payroll tax rate at 6.20%, a moderate step-up in the financing costs will be necessary at some point before the accumulated surplus is dissipated. An increased payroll tax rate of 7.49% is required at present in order to achieve solvency over the next 75 years, comprising the existing stable rate of 6.20% plus an adjustment of 1.29%, representing 50% of M2(75) minus M1(75).

Solvency Metrics

It is clear that without additional revenue inputs, there will be a point in time at which the equilibrium test of 100% solvency will not be met and that the solvency percentage will fall below 100% beyond that point. This measure of solvency is essentially a measure of the adequacy of the 6.20% payroll tax rate to meet the projected scheduled benefits. The 100% solvency test is satisfactorily met over the next 20 years from 2013. The solvency ratio M3 is projected at 95.91% over 25 years, 87.62% over 50 years, and 84.38% over 75 years. Subject to approval by the US Congress, an increase in the payroll tax rate would be required to restore the 75-year solvency ratio to 100%. This aspect of social security financing brings attention to important policy issues regarding the affordability of any payroll tax increase. There exists a real policy challenge in finding acceptable solutions to providing the requisite financing in relation to other national priorities, so as to meet the projected economic costs of around 6.0% of GDP over the long run.

Sustainability Metrics

A recent World Bank paper[6] stated "Sustainability may be compromised in the basic design of the program if the parameters lead to actuarial imbalance. The capacity to calculate and report both the short and long term financial status of the program is an important component and necessary to inform policy. This capacity, and even the basic information system to produce the required information, is often missing or underdeveloped." The fixed 6.20% payroll tax rate for the US Social Security system is such a parameter that compromises sustainability. In order to monitor more closely the secular trend of the solvency ratios under the fixed payroll tax regime, it is helpful to produce a matrix of solvency ratios that is both dynamic (over various projection periods) and stochastic (indicating a range of plausible outcomes). This matrix of solvency ratios, when constructed on a secular basis over a period of several years, gives a much clearer indication of the extent of the solvency and sustainability issues that need to be addressed in order to maintain the integrity of the commitment to provide scheduled benefits over the long run. Once the results of the solvency calculations are available in the M3 format, there are several ways in which the solvency matrix may be further analyzed, modified, and applied to monitoring the sustainability of the system. As an illustration, the preceding table, based on the solvency matrices derived from the 2002 and 2013 trustees' reports, also presents the results of this further analysis. The differences in the solvency ratios over the period from 2002 to 2013, denoted as M4, indicate the extent of the decline in the solvency of the system and the corresponding compound annual rates of decline represented by these differences, denoted as M5, give a clear indication of the impact of the weakening solvency position on the sustainability of the system. For the 75-year projection period on the intermediate basis, the decline in the solvency percentage over the period 2002-2013 from 88.80% to 84.38%, amounts to 4.42% and represents a compound annual rate of decline in the solvency metric of 0.47%.

An alternative method of monitoring sustainability may be provided by computing the matrix of the requisite equilibrium payroll tax rates at various points such as 2002 and 2013, denoted as M6, computing the amount of the increases over the period, denoted

as M7, and converting to the corresponding annual compound rates M8. These supplemental metrics are also presented in the following table. For the 75-year projection period on the intermediate basis, the equilibrium payroll tax rate is 7.49%, amounting to an increase of 0.42% from 7.07% for 2002; this increase over the period 2002-2013 represents a compound annual rate of increase in the payroll tax rate of 0.53%.

M6: SOCIAL SECURITY SOLVENCY EQUILIBRIUM PAYROLL RATES

PROJECTION PERIOD	PROJECTION BASIS 2002 LOW COST %	2002 INTERMEDIATE %	2002 HIGH COST %	PROJECTION BASIS 2013 LOW COST %	2013 INTERMEDIATE %	2013 HIGH COST %
25YEARS	4.81	5.31	5.91	5.79	6.51	7.42
50 YEARS	5.69	6.55	7.65	6.17	7.19	8.47
75 YEARS	5.93	7.07	8.61	6.23	7.49	9.08

	M7: AMOUNT OF INCREASE 2002-2013 LOW COST %	INTERMEDIATE %	HIGH COST %	M8:ANNUAL RATE OF INCREASE 2002-13 LOW COST %	INTERMEDIATE %	HIGH COST %
25YEARS	0.98	1.20	1.51	1.70	1.87	2.09
50 YEARS	0.48	0.64	0.82	0.74	0.85	0.93
75 YEARS	0.30	0.42	0.47	0.45	0.53	0.48

Conclusion and Recommendations

This paper has presented a series of eight actuarial metrics that, when measured over a period of time and viewed together, provide a clear indication of the level of solvency and sustainability of the US Social Security system.

- M1: value of asset-income cash flow proceeds
- M2: value of liability-outgo cash flow
- M3: solvency ratio percentage
- M4: amount of secular decline in solvency ratio percentage
- M5: annual rate of secular decline in solvency percentage
- M6: equilibrium payroll tax rates
- M7: secular difference in equilibrium payroll tax rates
- M8: annual rate of secular increase in equilibrium payroll tax rates

For each of these metrics, nine separate values are computed, representing values for 25-year, 50-year and 75-year projection periods on each of three different projection bases (low-cost, intermediate, and high cost), with each set of results for M1, M2, M3,

and M6 being calculated at the beginning and end of the observation period of eleven years from 2002 to 2013. In total, the system of eight metrics produces 108 numerical measures to form a clear profile of the extent of the stability, solvency and sustainability of the US Social Security system. These metrics serve the important purpose of focusing on the magnitude of the evolving trends on a secular basis in solvency and sustainability, measured over various future time horizons of 25, 50 and 75 years on a quasi-stochastic basis, where the three separate deterministic projections are approximate representations of the stochastic distributions around the 5th, 50th, and 95th percentile. Ideally, the deterministic projections should be replaced by the corresponding stochastic projection results. A detailed description of the stochastic projection methodology and an explanation of its advantages are provided in the author's 2007 paper[3] *Stochastic Projection Methods for Social Security Systems.* Although an appendix to the trustees' reports does provide a certain amount of information from the results of the stochastic projections, these published results are not as comprehensive as the published results for the deterministic projections. The trustees' reports also contain a limited amount of information relating to long-term projections beyond 75-years; these projections are intended to convey the probable outcome over an infinite horizon. While these "infinite horizon" results may be indicative of an ultimate scenario, it is generally agreed that by their very nature, the results are highly speculative, have little credibility, and do not merit serious consideration for policymaking purposes. Nevertheless, if they serve the purpose of motivating policymakers to pay greater attention to the challenges of maintaining solvency and sustainability, then they may be considered as a useful, but not necessarily reliable, supplement to the 25, 50 and 75-year projections.

To the extent that the compilation of these metrics may help policymakers and the public gain a better understanding of the challenges of maintaining solvency and sustainability for the US Social Security system, it is also recommended that this profile, comprising the set of eight actuarial metrics, might also prove useful as a role model for the Social Security systems of other countries.

References

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