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Beyond GDP: Recalling and Rejuvenating Sir Richard Stone's System of Social and Demographic Statistics (SSDS)

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Abstract

Sir Richard Stone, in the 1960s and after the success in creating the System of National Accounts, became concerned about the imbalance where the focus of official statistics was primarily on the macro economy, to the neglect of broader socio-economic aspects of populations, and more disaggregated dynamic patterns. As a result, he championed a new and complementary System of Social and Demographic Statistics (SSDS). His SSDS was published by the UN in 1975. However, it has languished, in part due to its complexity – it used transition matrices and therefore required longitudinal data, and in part because the socio-economic characteristics on which it focused simply were not public policy priorities. However, half a century later, concerns with the overly narrow ambit of the SNA and its key summary indicator, GDP, have increased dramatically, signaled by the release in September 2009 of the Stiglitz / Sen / Fitoussi report commissioned by French President Nicolas Sarkozy, as well as the OECD's project on Measuring the Progress of Societies.

While interest in Stone's SSDS has generally vanished, a number of important developments since that time enable it to be revisited and rejuvenated. One of these developments is the dramatic improvement in computing. Another is the increasing availability of microdata, including multivariate longitudinal data on individuals and families. Further, there have been major advances in multi-state life table methods in demography, time based accounting ideas from Juster and Land's discussion of demographic versus time-based systems of social accounts, time use diary survey data, and computer microsimulation methods. In parallel, contemporary public policy increasingly takes an integrated view of individuals – in their family contexts, in their time spent in leisure and unpaid as well as paid work, and in their interactions with major government institutions such as schooling, health care, taxes and cash transfers. Moreover, policy-related information needs, as well as those of the general public, include both broad summary indices and detailed distributional patterns.

The core idea of Stone's SSDS was to track individuals through their lives, and then construct a suite of aggregates by tabulating various of their socio-economic characteristics such as family status, education, and paid labour. However currently, there is no widely accepted and integrated framework for socio-economic statistics that spans these domains, particularly one based on explicit and coherent microanalytic foundations.

This paper contributes by articulating a new framework for tracking economic well-being in a multi-dimensional manner. This framework includes a summary index for measuring social progress, a generalization of the very well-known life expectancy indicator – Good Life Time (GLT). The GLT framework is analogous to and complements the System of National Accounts, but uses time rather than money as the fundamental metric. It builds on and generalizes Stone's SSDS, and brings together three major life domains or attributes – the confluence of good health, adequate income, and the time to enjoy them. The result is a coherent set of indicators all derived as decompositions of the widely used life expectancy indicator into portions of the life cycle at various levels of GLT. A principal conclusion is that for most people, the periods of the life course when they have the most leisure time, for example, they typically have either lower incomes or poorer health (e.g. the elderly). This kind of result points to possibly important gains in social welfare from a more fundamental re-examination of the way societies structure work and leisure over the life course.

Introduction

There is a pervasive interest in contemporary societies to know how well things are going, to have indicators of performance. These range from the commonplaces of sports scores and blockbuster movie revenues, to financial market indices, and to measures for entire societies like GDP per capita and life expectancy. However, there is also a continuing malaise with regard to the standard national-level indicators. The predominance of GDP and related measures, while useful for economic matters, lacks balance as a reflection of the diversity of social activity, and what is generally considered important in life. Similarly, the ubiquity of national health measures based only on mortality rates, taking no account of health status among the living, is clearly inadequate for social measurement.

As a reflection of dissatisfaction with conventional socio-economic indicators, there is almost as long a history of search for alternatives. Among the various proposals, there was a resurgence, certainly in North America, of work in developing specific indicators, or *ad hoc* collections (e.g. OECD 1982; Sustainable Seattle, Redefining Progress). The OECD (1998b) brought an illustrative collection of indicators together for social affairs ministers because "the need for a system of social indicators has recently become more pressing" (p2). In the mid-1990s, the cover of the Atlantic Monthly magazine headlined, "If the economy is up, why is everybody down?" when introducing an article on the Genuine Progress Indicator (GPI). The GPI was a *de facto* broadside criticism, albeit highly flawed, of the SNA and its summary index, GDP.

More than a decade ago, the OECD launched a major process on Measuring the Progress of Societies. (Hall; OECD no date), followed shortly thereafter by French President Sarkozy who was "unsatisfied with the present state of statistical information about the economy and the society" and therefore formed a "Commission on the Measurement of Economic Performance and Social Progress [with the aim] to identify the limits of GDP as an indicator of economic performance and social progress, including the problems with its measurement; [and]. to consider what additional information might be required for the production of more relevant indicators of social progress" (Stiglitz, Sen, Fitoussi, 1999). In general, the objectives of the OECD project and the Sarkozy Commission have been to achieve a better balance between social and environmental indicators and the narrower market economy focus of the SNA.

The most ambitious social indicator proposals, notably, involve more than *ad hoc* collections of indicators. These are proposals for an integrated framework for socio-economic statistics – such as Juster and Land's discussion of time-based and demographic systems of accounts (1981), Richard Stone's System of Social and Demographic Statistics (Stone, 1973; UN, 1975), the System of National Accounts (UN et. al, 1993) and others' discussions of Satellite Accounts and Social Accounting Matrices or SAMs (e.g. Vanoli, 1994; Keunig,1994; Pyatt, 1990)

Such integrated frameworks – when compared to *ad hoc* collections of a few diverse indicators – have the disadvantages that their indicators, because they are also part of a framework, may be more difficult to understand; and they also have at least the appearance that they are far more costly to implement. On the other hand, indicators embedded in a statistical framework have the benefits of a well articulated conceptual foundation, logical consistency, coherence, and (ideally) a capacity to "drill down" to find additional detail as needed. They may also, if properly designed, yield more reliable statistical measures.[1] And in the end, they may be no more costly than a wide-ranging collection of *ad hoc* indicators, especially when account is taken of the range of underlying data collection vehicles required.

This paper proposes, and illustrates with Canadian data, such an integrated framework for assessing and reflecting social progress. It is based fundamentally on time (life years), rather than money, as the basic numeraire, and on the very widely used concept of life expectancy. The framework provides a single "headline indicator" we refer to as Good Life Time or GLT, analogous to (rhymes with) GDP as the summary index within the SNA framework. It also provides an articulated set of tables and a family of more detailed component indicators, again analogous to the SNA.

The SNA is in essence a structured family of measures with articulated tables, culminating in the summary index GDP. However, unlike the SNA which, while based on myriad microdata surveys, exists in final form only at the aggregate (or semi-aggregate) level, the GLT framework is based fully on explicit microdata foundations (ideally as should the SNA as well). Indeed, the GLT framework is based on longitudinal microdata on the lifetime socio-economic trajectories of a representative sample of the population. This framework builds on the LifePaths microsimulation model which has been developed at Statistics Canada (Wolfson, 1997). It builds on and generalizes in particular key ideas of Sir Richard Stone's System of Social and Demographic Statistics (SSDS), Thomas Juster's time-based accounts (1981), the core ideas of multi-state life tables from demography, Guy Orcutt (1976) and Richard and Nancy Ruggles' (1973, 1975) work on microanalytic (rather than macro) approaches to data and analysis, and Sullivan's (1971) creation of an index of health-adjusted life expectancy, and is in the spirit of Seers' (1977) call for "life expectancy as an integrating concept in social and demographic analysis and planning".

The GLT framework and summary index differ, however, from the SNA and GDP not only in having explicit microdata foundations, but also in the basic accounting framework and units of measure. We start not with double entry bookkeeping, and money as the numeraire, but rather with the very well-established concept of life expectancy (LE), and its underlying life table. We also build on several generalizations of the basic life table to encompass multiple states, beyond simply being alive or dead -- including working life tables in economics, marital status life tables in demography, and the increasingly popular measure, health adjusted life expectancy or HALE in the health domain. In all of these cases, generalizations of life tables constitute a coherent framework for social accounting upon which we can erect measure(s) of social progress.

For GLT, we combine three fundamental life domains – how much money people have, how healthy they are, and how much discretionary or leisure time they have. Until now, in virtually all national statistical systems, statistics and indicators for these life domains are disjoint, the products of siloed statistical programs. We show how these life domains can be combined within a single coherent and principled statistical framework, using methods covering a range of technical complexity, and at the same time avoiding the arbitrary weighting typically used to construct other composite indices.

General Concept

The core idea is to start with people and how they live their lives, with a focus on those socio-economic and health factors which are most important to people's overall well-being. This concept is only feasible because of the rich history of previous intellectual efforts in this area, and due to a number of prescient data developments by Statistics Canada.

The core concept involves:

- focusing on complete individual lifetimes or life cycles;
- from the perspective of a representative and realistically heterogeneous population; and

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[1] Reliability in the SNA is enhanced by "data confrontation", specifically the fact that GDP is estimated both from the expenditure and the income sides of the accounts, and these two methods should yield equal results. The difference is referred to as the "residual error of estimate" and if large is a signal that there is an error in the data underlying one or other of the two methods of estimation. Analogous data confrontations can be built into the GLT framework developed here.

- using time spent, or durations, as the unit of measure.

In the case of life expectancy, the durations in question are the expected lengths of life in the population. These vary because individuals die at different ages. Life expectancy is simply the average of these life lengths. The GLT concept generalizes the concept of life expectancy to a coherent family of measures of how long individuals can expect to live in various socio-economic conditions -- specifically good health, having adequate income, and having sufficient leisure or discretionary time to enjoy their health and income.[2]

One of the main innovations is to bring together into one framework these three otherwise disparate socio-economic domains. Many countries have data available on each of these areas of life, but they each tend to have their own approaches to measurement and styles of indicators. This is fine, and indeed highly useful. But what has been lacking is an overall index, analogous to GDP for the economy, that can be used to track multiple facets of socio-economic well-being for a population.

Note that we are talking here of a framework, and not just an indicator. A summary index (one kind of indicator) is highly useful from the viewpoint of parsimony, and communicating with a broader public. But as with GDP in relation to the SNA, more sophisticated users will always want to be able to "drill down" to see what factors underlie observed changes in the summary indicator over time, or to see whether some population groups are having the same experiences as others, or whether there are important disparities.

Figure 1 begins developing the core ideas. Life expectancy (LE) is simply the area under a survival curve, (divided by the size of the starting population, 100,000 in this case). By the 65-69 age range, about 90,000 women are still alive, and about 83,000 men. Since these mortality rates are all coming from one year's data, no actual birth cohort will face them. In general, age-specific mortality rates have been falling in Canada from one year to the next, and this is expected to continue. The LEs for men and women based on the survival curves in Figure 1 are therefore hypothetical, called *period* LEs, i.e. the average length of life if the population were in a steady state where age-specific mortality rates were unchanging.

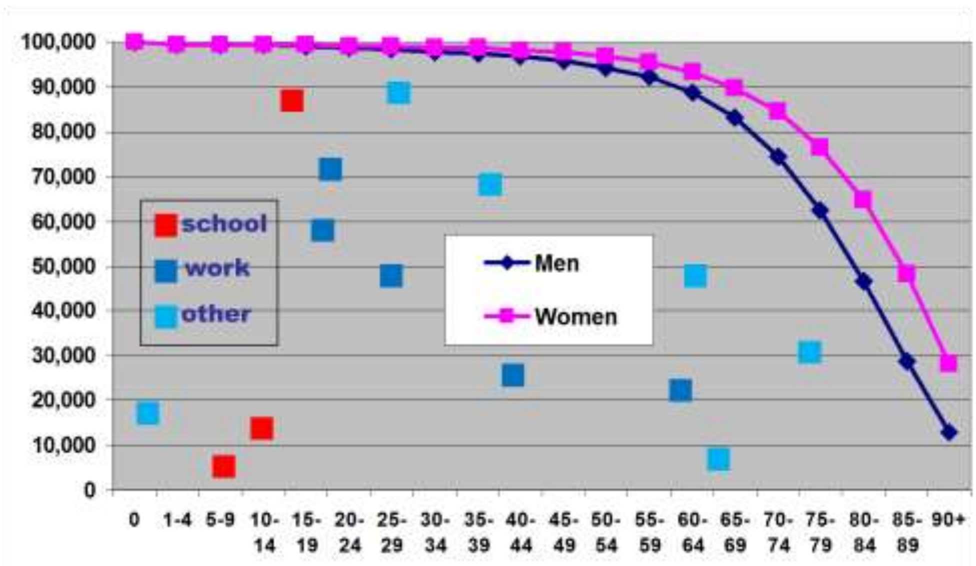

Figure 1 – Survival Curves and an Illustration of the Decomposition of Person-Years (PYs) Lived

The simple but key idea is to classify each person-year of life in this cohort by some major socio-economic or health characteristic. For example, if the characteristic is "main activity", some people are in school at a

[2] Note that we intend the word "enjoy" in a somewhat broader sense than simply the derivation of pleasure from activities like entertainment. It should also be taken to include, for example, the opportunity for the broader range of activities captured in Maslow's (1943, 1954) concept of "self-actualization"

given age, others are in the paid labour force (“work”), while everyone else is neither (“other”). This is illustrated by boxes of 3 different colours (not to scale, and not all of the area is covered). Just as life expectancy is simply the sum of all the person-years (PYs) under the survival curve divided by the starting population (the radix of the life table), three coherent subtotals can also be readily computed – total numbers of PYs for this cohort spent where the main activity is either school, work or “other”. These subtotals effectively partition or decompose LE exhaustively into three disjoint components by main activity. In stochastic process terms, the subtotals are the “sojourn times” in each of these three “main activity” states, and the total of the three sojourn times is exactly LE.

This partitioning or decomposition of LE into the portions of a representative population cohort’s life time spent in various socio-economic / health states is the core concept of the GLT framework. In the following sections we first develop this idea with the example of working life, then show how this concept also nests as a special case Sir Richard Stone’s SSDS proposal, and then turn to GLT – time spent over the life course with adequate time, money and health.

A Brief Note on Methodology

Before developing these illustrations, it is important to note that they will be based on a variety of methodologies. The discussion of partitioning LE above relied implicitly on a single decrement life table. The working life table estimates in the following section draw initially on the widely used extension of this method to increment-decrement life tables, plus the use of synthetic cohorts from cross-section data to infer transition probabilities. Some of the results use the Sullivan (1971) method to combine simple life table results with data from other sources decomposing activities or socio-economic and health states by age and sex.

Finally, the Statistics Canada LifePaths microsimulation model is used extensively (Wolfson, 1997; Spielauer, 2013). LifePaths is a continuous time, discrete event model where the unit of analysis is a single individual (plus his or her lifetime partners and children). LifePaths simulates (i.e. synthesizes) a large representative sample of individuals’ life course biographies, using a wide variety of data -- as often as possible longitudinal data. The data are used to derive rich multifactorial statistical descriptions of transition dynamics, usually represented as conditional waiting time distributions. In turn, these waiting time distributions (e.g. fertility, conditional on age, parity and educational attainment, or labour force entry, conditional on age, educational attainment, fertility history, marital status, and previous labour force status) are used to synthesize an individual’s biography of his or her socio-economic states, first recursively from one life time event to the next until death, and then repeating this process to generate millions of individual cases, using Monte Carlo microsimulation.

Working Life as an Example of Life Expectancy Decomposition

Life table methods have been used for decades to examine the working phase of the life course – how much of individuals’ lifetimes are expected to be spent in the paid labour force. The first such estimates for Canada were Denton and Ostry (1969), in turn updated by Gnanasekaran and Montigny (1975). Table 1 shows the latter’s series of “working life table” estimates for Canada, as well as a subsequent and more sophisticated set of estimates by Bélanger and Larrivée (1992). The focus is on the average ages at three major life transitions – from school to work, from work to retirement, and finally death.

	Average Age at			Number of Years	
Year	LF Entry	Retirement	Death	Working	Retired
1921	17.5	62.7	67.6	45.2	4.9
1931	18.0	63.0	68.4	45.0	5.4
1941	18.2	63.1	69.1	44.9	6.0
1951	18.5	62.9	70.4	44.4	7.5
1961	19.2	63.0	71.2	43.8	8.2
1971	19.8	62.3	71.3	42.5	9.0
1986a	20.0	65.5	73.8	44.6	8.3
1986b	20.0	60.3	73.8	39.4	13.5

Table 1 -- Historical Stationary Male Life and Working Life Expectancies

Source: Adapted from Gnanasekaran and Montigny for decades 1921 to 1971 (Tables 2.1 and 12, 1975), and Bélanger and Larrivée for the two 1986 rows (Tables 1 and 2, 1992)[3]

The message conveyed in Table 1 is very dramatic – over a 50 year period, there was a doubling of years spent in retirement, accompanied by a decline in working years-- with obvious implications for the "affordability" of public pensions and other age-sensitive government programs, especially health care.

These figures also indicate generally unexplored implications for assessments of social progress. For example, in the immediate post-war period in developed economies, there was speculation whether we were heading toward the "leisure society", where this was often conceived as a much shorter work week for those of working age. But these data show that to the extent that there has been a major trend toward the leisure society, most of the increased "leisure" is apparently being taken at the end of life. (The later age at entry to the paid labour force shown in Table 1 is preceded mainly by increased years of schooling, some portion of which may count as leisure ☺ .)

Beyond the substantive results shown in Table 1, the underlying methodology is also important. The results for 1921 to 1971 are based only on cross-sectional age-specific labour force participation and mortality rate data, since these were the only data available over this period. As a result, the Gnanasekaran and Montigny (1975) life tables included just two living states – working, and not working. Transitions between these states were then based on two key assumptions: (1) that *gross* flows into and out of work exactly equaled *net* flows – an individual could only enter and leave the labour market once over their entire lifetime, and (2) that overall, labour force participation rates first rise monotonically to an age where they are at a maximum, and then fall monotonically. Thus, up to the age of the maximum participation rate a* (around age 30 in 1971), the rate of entry to the labour force at each age was assumed to equal the difference in the participation rate between ages a-1 and a (plus the mortality rate). After age a*, only exits from the labour force were assumed, again equal to the difference in the participation rate between ages a-1 and a (also assuming mortality rates are independent of labour force status). In effect, they used the cross-sectional labour force data, plus a steady state assumption, to form synthetic cohorts in order to infer the transition rates needed for their life table analysis.

The subsequent increment-decrement life table methods used by Bélanger and Larrivée (1992) relaxed this restrictive gross = net flow assumption by using longitudinal microdata from Statistics Canada's Labour Market Activities Survey (LMAS). The LMAS data allowed *gross* flow transition probabilities to be estimated directly -- rather than inferring them based on an assumed equality with *net* flows, in turn derived by first-differencing age-specific participation rates. As a result, multiple exits and re-entries to the labour force over a lifetime are not ruled out *a priori*, as in the earlier Gnanasekaran and Montigny working life tables.

Specifically, the last two rows in Table 1 give Bélanger and Larrivée's alternative working life estimates for 1986. The row labeled "1986a" used the older gross = net flow assumption, while the last row, 1986b, used the observed gross transition probabilities. Bélanger and Larrivée estimate an average of 2.6 labour force entries for men over their lifetimes using the gross flow approach, compared to 0.94 using the net flow approach (0.94 being the maximum participation rate at age a*). The rather large 5.2 year difference in expected working life in these last two rows reflects the sensitivity of these kinds of results to detailed

[3] In all cases, 100% survival to age 15 is assumed. The Bélanger and Larrivée results were given only at age 16; age 15 results have been extrapolated. Working life expectancy is taken from their Table 2 for both the active and inactive populations for the 1986b row. Also, they have only estimated the average age at death, and the expected number of working years, so the average age at retirement and number of years retired were derived based on the simple assumption that the average age at labour force entry was exactly 20. There also appears to be an inconsistency in the Gnanasekaran and Montigny results for 1971 average number of years working in comparison to all their other estimates, so this figure has been adjusted. The Bélanger and Larrivée definition of "working" is having worked at least one hour in a reference week in September of each year. The Gnanasekaran and Montigny definition for 1971 was essentially working or looking for work in the week prior to census enumeration, but then excluding summer students.

assumptions on transition rates, while the difference between the 1921 to 1971 trend and the 1986a result indicates further sensitivity to other factors, including the data set being used (LFS versus LMAS).

However, various important assumptions are still embodied in the Bélanger and Larrivée increment-decrement life table analysis. In the next two sections, we focus on the population base for these kinds of estimates, and the granularity of the time accounting.

Population Base

One question in constructing working life tables specifically, and the generalizations we shall be developing for the GLT framework, is the population base of the estimates. The easiest starting point is to ignore life tables and steady-state assumptions and use cross-sectional population data directly. This is shown in Figure 2a based directly on data from the population census and including the main activity breakdown.

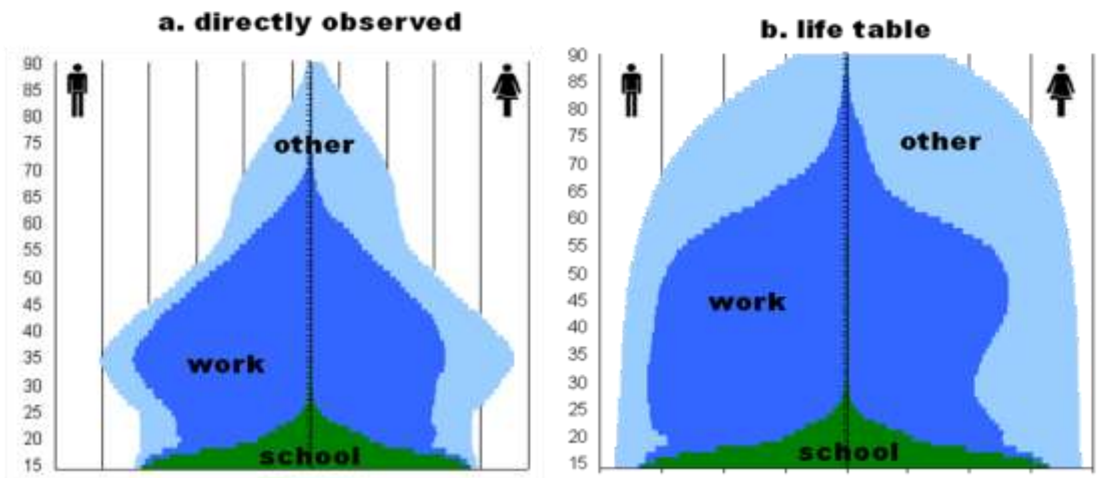

Figure 2 – Canadian 1990s Population Pyramids by Main Activity and Method

In contrast, the working life table results just shown use period LEs as the starting point, i.e. LEs based only on the series of age-specific mortality rates in a given year plus the assumption the rates are constant, hence steady state. Analogously to the breakdown shown in Figure 2a, these person-years (PYs) can be disaggregated by the same main activity classification. This is shown graphically in Figure 2b which is an empirical estimate of the idea in Figure 1 (also converted to a conventional population pyramid, with age along the vertical axis, and males and females shown separately on the left and right respectively).

The main disadvantage of using directly observed cross-sectional data as in Figure 2a comes when building up a time series. The baby boom bulge in the population pyramid is clearly visible in Figure 2a centred around age 35. Any changes over time in the proportions of the population whose main activity is school, work or other will thus be confounded with changes in the age structure. In contrast, using the steady-state population in Figure 2b will not encounter this problem, though the much slower changes in LE will still be mixed into the results of any time series of “working life time”, as they were in Table 1.

As a further refinement of the life table approach in Figure 2b, we can also use historical and projected mortality rates in these calculations to generate LEs, thereby eschewing the steady state assumption embodied in period life table estimates. This approach would use, for example, the 1940 infant mortality rate for individuals born in 1940, the 2000 mortality rate for 60 year olds born in 1940, and a projected 2020 mortality rate for 80 year olds born in 1940. The resulting LEs for three 20 year wide birth cohorts are shown in Figure 3. These LEs are *cohort* rather than *period* LEs because they are not based on a steady state assumption, but rather use mortality rates embedded in actual calendar time, i.e. time-varying mortality rates for each individual as he or she ages. For example, LE is projected to increase by over 6 years from 81.9 years to 88.1 years for the cohort born in the 1980s and 1990s compared to baby boom women born in the 1940 – 1959 decades.

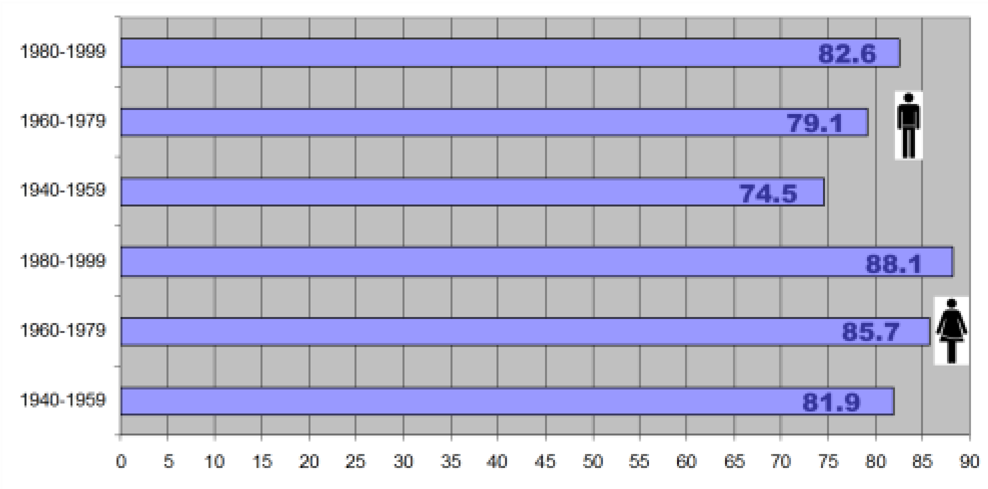

Figure 3 -- Life Expectancy by Sex for Three Birth Cohorts, Canada

While cohort LEs provide more accurate reflections of the likely experiences of individuals born in different years, they are somewhat more difficult to construct, since the mortality rates being used involve not only historical data, but also projected rates. Period LEs, while based on a simplifying steady-state assumption of constant mortality rates both in the past and into the future, and often misunderstood as being cohort LEs, are far more widely used as social indicators because of their relative simplicity, and because their trends over time track reasonably well the corresponding trend results for cohort LEs.

Time Granularity

The results show in Figures 2a and 2b are based on population census data, where the "main activity" question is very simple. In contrast, Statistics Canada's General Social Survey (GSS) periodically conducts a detailed Time Use survey, where respondents are asked to reconstruct, down to 15 minute intervals, all their activities during the previous 24 hours. This time diary of activities provides far richer detail, though only for one day at a time. By merging the GSS time use data with the population census data, it is possible to build up a picture of "main activity" that is a much more detailed and accurate reflection, as shown in Figure 4b.

Figure 4a is the same as Figure 2a above, with the breakdown by "main activity" based on the coarse population census question. But this turns out to provide a misleading picture of what Canadians were doing with their time over a typical year in the 1990s. The more accurate picture shown on the right uses much more detailed time diary data from the GSS "merged" with the census population data. Essentially, the 1992 time use survey was post-stratified so that its sample weights matched the 1991 census population disaggregated first by the joint distribution of age and family size, and second by the joint distribution of labour force participation, age and sex.

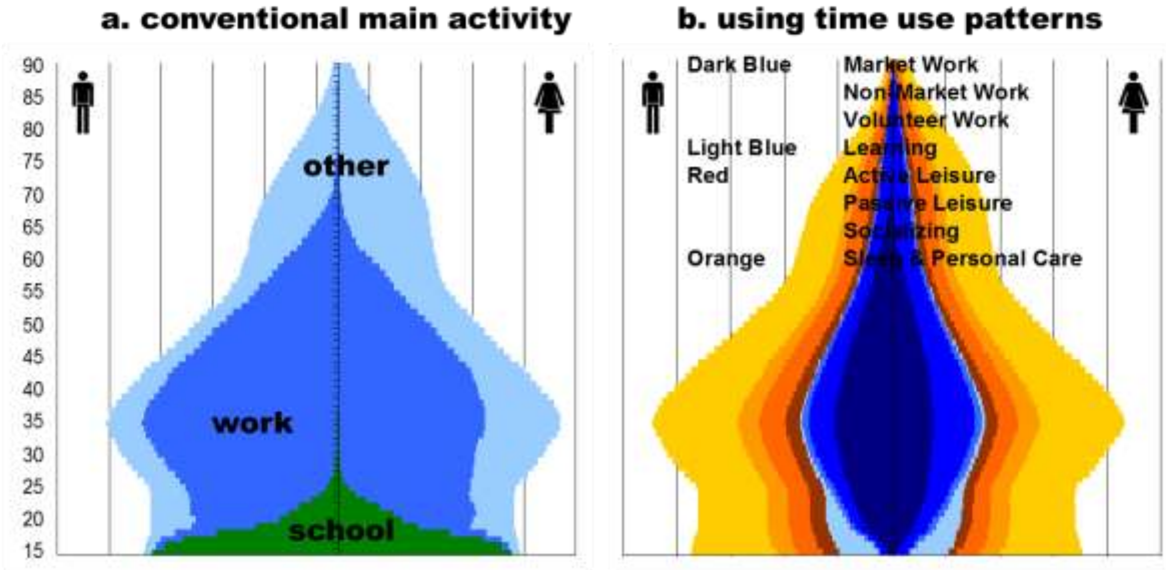

Figure 4 – Canadian 1990s Population Pyramids by Main Activity and Time Granularity

Perhaps the most dramatic difference in these images is in the amount of time spent in paid work. It is far smaller when time is more accurately classified minute by minute and day by day than by year. The largest amount of time throughout the life cycle, perhaps not surprisingly, is spent in sleep and personal care (the outermost band of colour). Comparing the innermost dark and next band of lighter blue, women clearly spent less time than men in market (i.e. paid) work, and more time in unpaid work. The band for volunteer work is almost invisible; time spent "learning" is concentrated at younger ages, mostly under age 25. And leisure time, comprising active and passive leisure plus socializing, is on the same order as unpaid work in individuals' daily lives.

A similar issue with time granularity emerges with the conventional (demographic) dependency ratios. The old age dependency ratio is defined as the ratio of the population age 65 or more to the so-called "working age" population in the 18 to 64 age range, while the total (demographic) dependency ratio is the sum of the old age and the youth (age 0 to 17 divided by the 18 to 64 populations) dependency ratios. From the perspective of any economically meaningful notion of dependency, these ratios are very naïve, yet they are among the most widely used indicators, particularly in the context of public policy discussions of the projected adverse impacts of population aging on the costs of government programs.

Figure 5a shows the two conventional "body count" demographic dependency ratios. The arrow labeled "1" indicates almost a doubling of the old age demographic dependency ratio to almost 23% in over the 20 years from 2011 to 2031 as the trailing edge of the baby boom birth cohort attains age 65 – in line with many prognostications of "demo doom" for public finances. There is, of course, an offsetting reduction in the proportion of the population under age 18, so the total "body count" demographic dependency ratio, shown by the arrow labeled "2" increases by about half as much. Of course, from a public finance perspective, more of the costs of children are borne privately by families, while government plays a much larger role for those over age 65, so the total demographic dependency ratio tends to get less attention than that for old age.

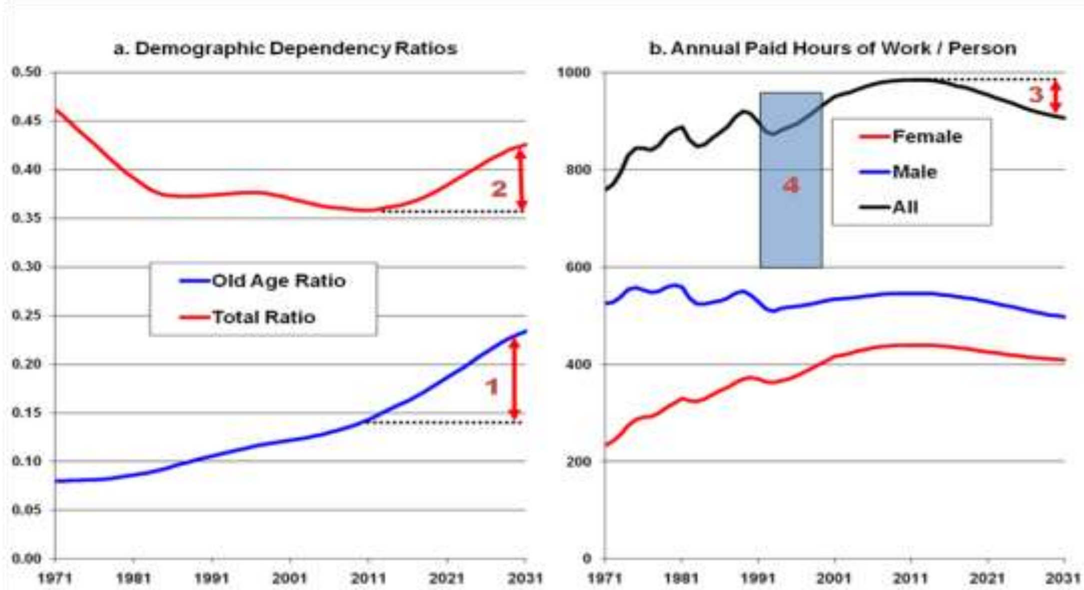

Figure 5 – Conventional Demographic Dependency Ratios and LifePaths Estimates of Paid Working Hours Per Capita

But similar to the discussion of time granularity for years spent "working" in the context of the working life table estimates in Table 1 above, the simple body counts used in demographic dependency ratios are just as naïve. Among those age 18 to 64, some individuals work full-time and full-year, but many others work part-year or part-time, and yet others over-time; and many are not in the paid labour force at all. Figure 5b therefore shows a much more appropriate index – hours of paid work (at whatever age) per capita. (n.b. this idea for an alternative dependency ratio derives from Jane Falkingham in a non-internet accessible LSE working paper in the early 1970s) This index was estimated using the LifePaths model, and draws on detailed time use diary data as well as census, labour force, and other more conventional data.

Unlike the scary statistic that the old age demographic dependency ratio will almost double to about 23% by 2031, the more fine-grained paid hours per capita measure is projected to fall by less than one-tenth, as indicated by the arrow labeled "3". To place this one-tenth figure in context, the projected 900 hours of paid work per capita in Canada in 2031, when all of Canada's baby boom will have attained age 65, compare the the shaded band labeled "4". It indicates estimated hours per capita in the 1990s amongst rich EU countries that already had conventional body count demographic dependency ratios of about 25%. Thus, Canada will end up with paid labour inputs in 2031 as much as one-third higher than peer countries already have had with even slightly higher old age demographic dependency ratios. This failure to use more carefully constructed and valid indicators – specifically more detailed granularity for time accounting of the population's activities – continues to give rise to no end of "demo doom" policy scare mongering.

Relationship to Sir Richard Stone's System of Social and Demographic Statistics (SSDS)

It turns out that working life tables and the kinds of extensions with regard to time granularity that provide the foundation for the GLT framework also nest, as a special case, the seminal work of Sir Richard Stone and his proposed System of Social and Demographic Statistics (SSDS; UN, 1975). While Stone received his Nobel Prize for earlier work in developing the SNA, he later became disillusioned with its narrow focus on the market economy, and the lack of a similarly ambitious and coherent framework for socio-economic measures relating to the population. The SSDS was his attempt to outline a correspondingly rich statistical framework focusing on individuals and their socio-economic circumstances and dynamics.

There are several reasons why the SSDS failed to achieve the same success as the SNA. The SNA was given tremendous impetus by the depression of the 1930s and Keynes' General Theory (1936), as well as the need for Britain and the U.S. to understand the economic implications of mobilizing for World War II. In the 1950s and 1960s, in contrast, when Stone was developing his ideas for the SSDS, there was no such sense of crisis with regard to socio-economic circumstances. Further, the SSDS required major new kinds of data, especially longitudinal person-level microdata, in order to provide the estimates of the transition probabilities that were central. And influential individuals were more often intimidated by the notion of transition probabilities than the conventional accounting concepts that were the basis for the SNA. As Stone himself put it in an interview, "the system did not catch on in the way the SNA had. I think I can see the reasons why. Unlike the SNA, it had not been introduced in gradual, easily digestible stages. From the point of view of official statisticians, it was long and full of unfamiliar stuff, the taxonomic proposals were very elaborate, and there was a lot of mathematics, which is still apt to turn people off. … I think it fell between three stools, that is between the three specialisms of economics, demography, and sociology." (Pesaran, 1991)[4]

As a result, Stone's SSDS has been largely forgotten. However, the growth of modern computing has enabled both more complex data collections, especially longitudinal household surveys and longitudinally linked administrative data such as those from income tax returns, and more sophisticated statistical analyses where the estimation of dynamics is central. More fundamentally, the option of basing a statistical framework explicitly on microdata foundation, rather than aggregate tables, has opened possibilities that were never contemplated when Stone was developing his ideas.[5] As a result, it is now much easier to revisit and indeed implement many of the core ideas of Stones' SSDS. For example, Figure 6 focuses on the 1940 – 1959 birth cohort from Figure 3 above. It shows two decompositions of this pair of *cohort* LEs which are essentially summaries of the two central tables of Stone's SSDS – his "active sequence" and "passive sequence" .

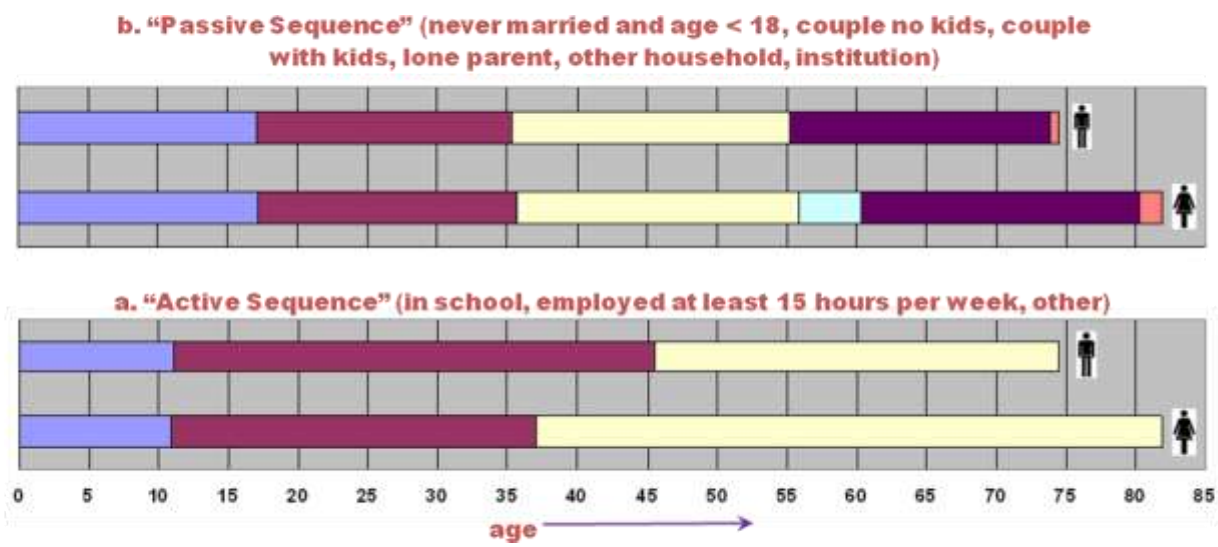

Figure 6 – 1940 – 59 Cohort Life Expectancy by Main Activity and Demographic Status

Figure 6a displays graphically working life table statistics similar to those in Table 1 above. However, the estimation method is very different. These are based on cohort rather than period mortality rates. Furthermore, the transition probabilities into and out of the labour force are no longer first order Markov,

[4] This paragraph also reflects personal conversations in the mid-1980s with some of the individuals involved, including Richard and Nancy Ruggles, Thomas Juster, Graham Pyatt, Michael Ward, and Hans Adler. Additionally, Vries (2001) argues that the SSDS was overtaken by the ideas of Social Accounting Matrices (SAMs), which were more closely aligned and hence compatible with the mainstream SNA, and growing concerns about bringing environmental factors into the ambit of the SNA, e.g. Keunig's (1994) SESAME. Further, Seers (1976) offered serious critiques of the SSDS from the development economics perspective. Bartelmus (1987) argued that, "the absence of a natural numeraire which permits aggregation and the lack of a comprehensive theory (such as Keynesian macroeconomics in the case of SNA) soon led to the abandonment of the system."

[5] While Guy Orcutt, the father of microsimulation, did work with Stone in the late 1940s and early 1950s, this was before Orcutt became disillusioned with aggregate macro-econometric models (Wolfson, 2009).

conditional only on age, sex, and labour force status in the year. Rather, the estimates in Figure 6a have used the LifePaths microsimulation model where, for example, the observed dependence of labour force participation in any given year on a wide range of factors, including educational attainment, marital status, and fertility, as well as how long the individual has already been working, are all taken into account.

Moreover, the co-evolution of marital status and fertility is also included. So the co-evolving empirically observed dependencies of (a) fertility on marital status, and (b) marital status on labour force status and history have also been included. As a result, it is equally straightforward from the LifePaths microsimulation framework to decompose the cohort LEs by these demographic characteristics, as shown in Figure 6b. These two decompositions of cohort LE, by labour force status and by demographic status, thus summarize Stone's "active sequence" and "passive sequence" respectively. And they do so in a coherent manner, because they are no more than tabulations of the same underlying birth cohort where both labour force and demographic characteristics have been tracked for everyone in the (very large, albeit synthetic) individual-level mirodata sample.

In other words, the LifePaths-based GLT framework successfully encompasses the essential elements of Sir Richard Stone's SSDS.

The GLT Concept – Adequate Money and Health, and Time to Enjoy Them

So far, we have built on the notion of working life tables to decompose LE, distinguished period and cohort LEs, highlighted the importance of the time granularity for measuring the durations of various activities, and shown results for various ways of partitioning lifetime activities. These partitions, though, have only been one at a time, primarily the main activity (school, paid work, other) as in Stone's SSDS "active sequence", and in the previous section also showing results for Stone's "passive sequence" based on demographic status.

The next step in the GLT concept is tracking more than one kind of decomposition at a time, and looking at their joint impacts. This is shown in figure 7 in terms of a Venn diagram, where we focus on the three domains that are central to GLT, namely adequate money and health, and time to enjoy them.

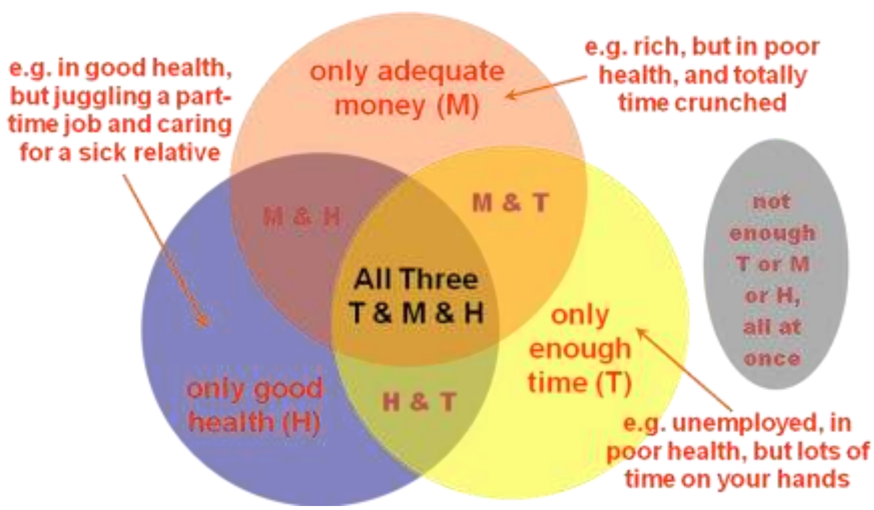

Figure 7 – Adequate Time, Money and Health – the Focus of the GLT Framework and Index

Of course, individuals' well-being depends on more than their income, health, and available or discretionary time. Still, it is hard to imagine anyone saying their well-being is high if they are severely lacking in any one of these domains.

Any statistical framework contains elements of judgment, features where choices have to be made that are inherently not easily grounded in a clear conceptual choice. In the case of the GLT framework and summary index, there are several major elements of judgment. One is the specific choice of the three domains which are the focus. A second is the choice of a specific measure or continuum to represent each of the chosen domains. The third is where the threshold is placed along each of the continua to distinguish adequate from inadequate.

On the first point, it could be argued that literacy and social cohesion, for example, are at least as important contributors to well-being as time, money and health. Our focus only on time, money and health is therefore a limitation. But at the least, it is an excellent starting point for the GLT framework, and is clearly a significant advance on GDP or GDP per capita, currently the most widely used measures of economic well-being, rivaled in international statistical ubiquity only by life expectancy. Furthermore, the GLT framework is sufficiently flexible, in a word "extensible", that other domains can be added straightforwardly, given appropriate data. Indeed, literacy would be a prime candidate for extending the GLT framework presented here to a fourth domain – both because of its obvious importance, and the availability of appropriate data.

The GLT framework by focusing on time, money and health is an advance on GDP first in terms of its breadth, since it covers time and health as well as money. Second, it is also an advance in the way the economic component, income, is measured. As argued in the Stiglitz et al report (2009), a major reason for the loss of credibility of GDP as a broad index of social progress is its disjunction with the direct experiences of individuals and households. One major reason is that GDP takes no account at all of income inequality. Stiglitz at al. therefore recommended that the priority indicator for economic well-being be median family disposable income (adjusted using an equivalence scale for family size). Family size-adjusted disposable income is precisely the income measure used in the GLT framework.

In the case of the broad domain of health, there are several possible measures. One of the simplest and most widely available is the often used self-assessed health status question – "how would you rate your health – excellent, very good, good, fair or poor?" However, there are significant concerns about the cross-cultural validity of this question – individuals in different countries and with different languages tend to answer differently in ways that do not concord with other health indicators (Murray et al., 2001). Another widely available kind of health data is the prevalences of chronic diseases, such as heart disease and cancer. However, this kind of bio-medical data has several major defects from the perspective of the GLT framework. One is that unlike income, there is no ready metric or way of combining different kinds of chronic diseases into a single scale for each individual and each of his or her person-years of life. Another is that when these data are elicited from a personal survey, there may be important artifacts and biases related to how aggressively individuals seek care (since the survey questions are typically of the form, "Have you ever been diagnosed by a health professional with … ?"), and how well they recall their diagnoses. On the other hand, if the data come from clinical data sets produced by health care providers (e.g. hospital records, doctor visits), they are difficult if not impossible to link at the individual level to the other GLT components – time and money. They are also influenced by individuals' propensities to seek care, as well as the availability of different kinds of health care services.

The preferred measure of health status is a QALY (quality-adjusted life year), or HRQoL (health-related quality of life) index. These are carefully constructed sets of questions that capture an individual's capacity to function, and are accompanied by an empirically derived valuation function that yields a health index for each PY of an individual's life. QALYs are the required measure of health status in health economics and technology assessment guidelines (CADTH, 2017). Two of the best known of these generic health status measures are the EQ-5D (Kind et al. 1996) and the McMaster Health Utility Index (HIU, Feeney et al., 1995). Fortunately, the HUI has been included on a number of key Statistics Canada surveys since 1990, so this is the measure of health status that is preferred for the GLT index for this analysis.

The third domain in the GLT framework, time, has received far less attention from the research community than money and health. As a result, there is less consensus as to the best measure. Conceptually, the average number of hours per day of leisure time seems most straightforward and appropriate. What is the point of having good health and adequate income if the individual is working or otherwise committed such that they have no discretionary time to *enjoy* their money and health?[6]

[6] Recall that "enjoy" is being used in a broader sense than only deriving pleasure, and includes for example the possibility for Maslow's (1943, 1954) concept of "self-actualization". Further, it is useful to note Becker (1993), "Actions are constrained by income, time, imperfect memory and calculating capacities, and other limited resources…. Different constraints are decisive for different situations, but the most fundamental

While this concept on the face of it seems reasonable, there are several pieces of evidence suggesting that it may not be so straightforward. One is self-reports of "time crunch". Figure 8 shows data from the 1998 GSS Time Use survey, where a series of time crunch questions[7] were asked, as well as the time diary questions enabling the estimation of daily leisure time (vertical axis; with the "boxes and whiskers" and plus signs indicating median, 25th and 75th percentiles, extreme values, and means of leisure time). Interestingly, while there is some negative correlation, as should be expected, between self-reported time crunch and minutes of leisure time, the correlation is not very strong.

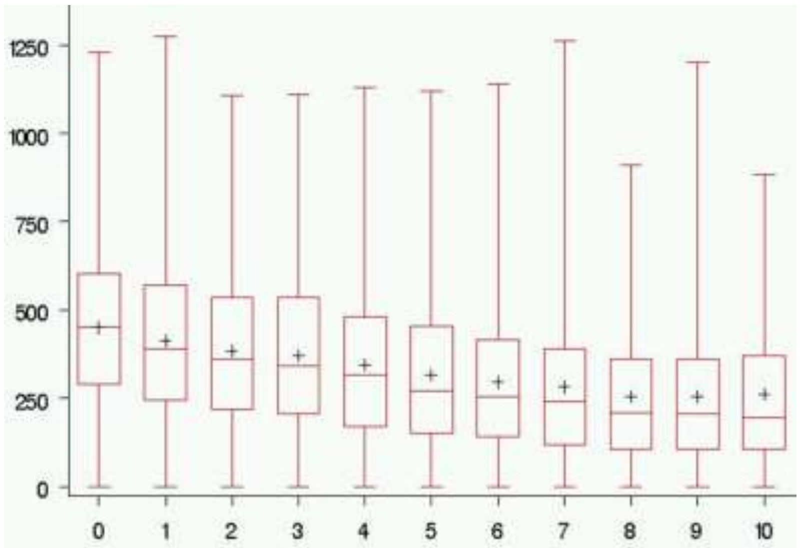

Figure 8 – Minutes of Leisure Time by Severity of Time Crunch (no. of "yes" responses)

Another caveat with regard to the use of leisure as the measure of available time to enjoy money and health is shown in Table 2. The 1998 GSS, in addition to the main time use diary questions, and the time crunch questions shown in Figure 8, also asked respondents to rate their enjoyment of each of a selected set of activities on a five point scale. (The bolded cells highlight sex or age groups where the average level of enjoyment of the activity is discrepant with the overall average. For example, 15 -24 year olds rate watching movies at the top, while those age 65+ enjoy paid work the most of any activity.)

While the leisure time activities of having supper at home and dining out ranked first and second overall, paid work was third, ahead of a number of other leisure time activities including movies and plays, attending

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constraint is limited time. Economic and medical progress have greatly increased length of life, but not the physical flow of time itself, which always restricts everyone to 24 hours per day. So while goods and services have expanded enormously in rich countries, the total time available to consume has not. Thus wants remain unsatisfied in rich countries as well as in poor ones. For while the growing abundance of goods may reduce the value of additional goods, time becomes more valuable as goods become more abundant."

[7] Time Crunch Questions (administered in random order):
Do you plan to slow down in the coming year?
Do you consider yourself a workaholic?
When you need more time, do you tend to cut back on your sleep?
At the end of the day, do you often feel that you have not accomplished what you had set out to do?
Do you worry that you don't spend enough time with your family or friends?
Do you feel that you're constantly under stress trying to accomplish more than you can handle?
Do you feel trapped in a daily routine?
Do you feel that you just don't have time for fun any more?
Do you often feel under stress when you don't have enough time?
Would you like to spend more time alone?

social events, and watching TV. This observation apparently conflicts with the premise that leisure time is a complementary contributor to well-being along with income and health. However, further research and analysis is needed. For example, the enjoyment levels shown in Table 2 are, for each individual, their "average" level for each activity; the questions did not tap the enjoyment individuals would gain from an extra 10 minutes or hour of that activity, i.e. their marginal enjoyments. Also, the enjoyment attached to paid work may derive primarily from its social aspects – interacting with a social network of co-workers, and feelings of satisfaction from being a contributing member of society, or being valued by peers as such. This may be particularly important for those age 65+ where enjoyment of paid work was the most highly rated of all the activities queried.

				Age Groups			
	all*	males	females	15-24	25-44	45-64	65+
Cleaning	2.4	2.2	2.6	2.1	2.4	2.5	2.8
Groceries	2.7	2.5	2.8	2.6	2.6	2.6	2.9
Maintenance	2.9	**3.3**	**2.5**	2.6	2.9	3.0	3.1
Other Shopping	3.0	**2.5**	**3.4**	**3.5**	2.9	2.7	2.9
Commuting	3.0	3.0	3.0	2.8	3.0	3.2	**3.8**
Clubs	3.1	3.0	3.1	3.4	3.1	2.9	3.0
Volunteering	3.3	3.0	3.5	3.1	3.2	3.4	3.5
Cooking	3.3	3.1	3.4	3.1	3.3	3.3	3.3
TV	3.3	3.3	3.2	3.4	3.2	3.1	3.6
Social Events	3.5	3.3	3.7	3.8	3.5	3.3	3.2
Movies / Plays	3.7	3.7	3.7	**4.3**	3.9	3.4	**2.9**
Paid Work	3.8	3.8	3.8	3.7	3.7	3.9	**4.2**
Dining Out	4.0	3.8	4.1	4.0	4.1	3.9	3.7
Supper at Home	4.0	4.1	4.0	3.8	4.1	4.1	4.1

* basis for sorting

Table 2 – Levels of Enjoyment[8] by Selected Activity, 1998 GSS Time Use Survey

Still, and notwithstanding the discrepant ordering of paid work, leisure time activities are the ones most enjoyed. So for the time component of GLT, we shall use hours of leisure time.

GLT – A First Approximation

Given the GLT concepts, and specific measures for each of the time, money and health domains, one simple way to proceed is analogous to the population pyramid in Figure 2a above, relying on directly observed data. The best source in this case is the series of GSS time use surveys. These surveys have the best measures of leisure time. They also have reasonable measures of income, but only the self-rated health question.

Figure 9 shows, for men (top row of graphs) and women (bottom row of graphs), the proportions with "adequate" money, health, and time in each of the first three graphs from left to right (labeled M, H, and T) respectively, and then their intersection in the rightmost column of graphs (labeled GLT). In all graphs, age in five year groups (from 20-24 to 85+) runs across the horizontal axis.

The different lines in each graph correspond to the 1986, 1992, 1998 and 2005 surveys. In general, the results over this twenty year period are very similar. Note that especially at higher ages, some portion of the fluctuations is due to sampling variability.

[8] Based on a five-point scale with 1 being "dislike a great deal" and 5 being "enjoy a great deal".

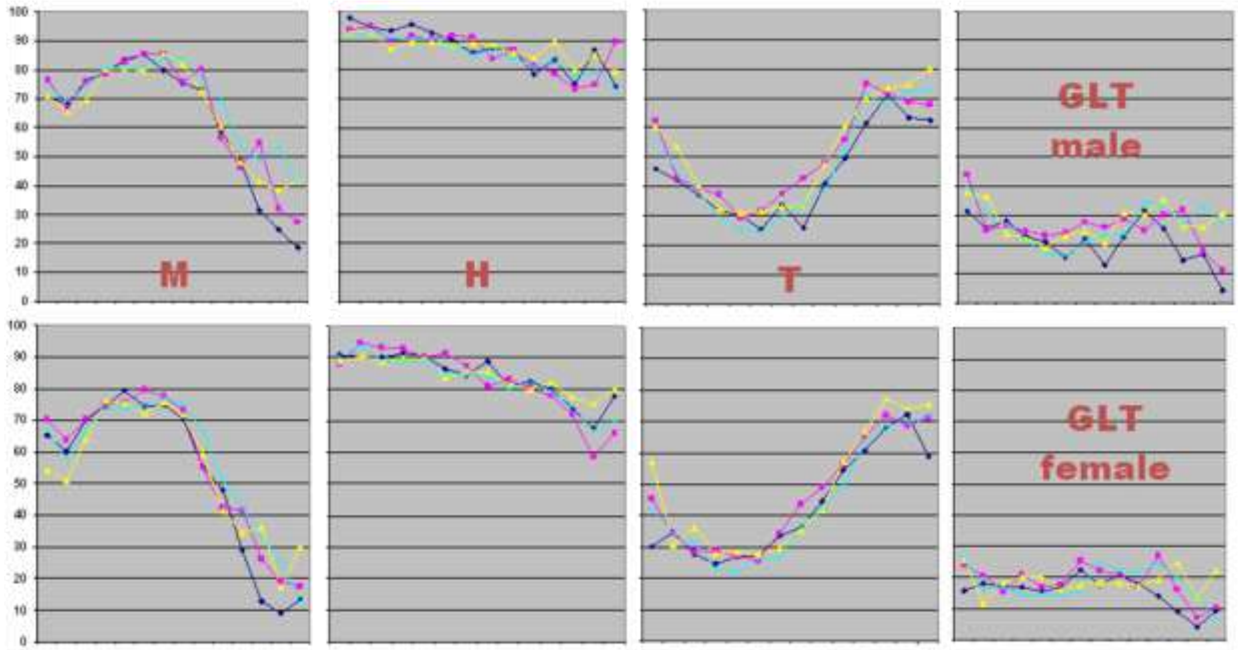

Figure 9 – First Approximation to GLT based on Four Time Use Surveys

Of course, a critical step in producing these estimates is setting a cut-point on each of the three domains that defines the threshold of "adequate". There is a long history of defining just such a cut-point in the case of income, with the widely used notion of a poverty or "low income" line. For purposes of the GLT estimates, we have chosen two-thirds of the equivalized median family income. This is a judgment, but the idea of "adequate" income intended here is not as high as a "comfortable" income. For health, the graphs show the proportions reporting excellent or very good health. And for leisure, the graphs are based on a cut-off of at least three hours per day.

The patterns shown in these first three graphs are as one would expect. The proportions with adequate income as defined declines substantially with age. While Canada has amongst the best low income supports for seniors among OECD countries in its public pension system. these supports tend to result in incomes just over half the median equivalized family income, but not higher than the two-thirds threshold used here. Self-reported health status is generally very high in Canada, but again as expected, declines with age. In contrast, the proportion of the population with at least three hours per day of leisure time increases with age, again in line with expectations.

Unfortunately, the periods of the life cycle with adequate income are those with inadequate leisure, and vice versa. As a result, GLT as measured in this very simple way is quite low – about 20% for women have all of adequate time, money and health most of their lives, and up to 30% for men.

Digression on Arbitrariness and Judgment in Statistical Frameworks

As already noted, the selection of the three major *domains* for the GLT framework – time, money and health – is to some degree arbitrary. There are other possibilities. Furthermore, the specific *measures* chosen for each domain, and the *thresholds* used to define adequacy within each of the three domains, are also matters of judgment. While arbitrary, though, the selection of thresholds is not necessarily that problematic. First, the use of arbitrary thresholds is widely accepted, the most prominent example being the income threshold embodied in a poverty line, the results of which are among the most widely used and popular social indicators. One reason is that the cut points used are transparent and easily communicated to journalists and the general public, so they can form their own views as to whether or not they are plausible (have face validity). Another reason is that data on the underlying full distribution of income is available so that more probing analysis is always possible; more sophisticated analysts are able to "drill down" to explore the underlying distributions in their own ways. The GLT framework and index are analogous in this regard to low income lines and estimates of the prevalence of poverty – "drilling down" and disaggregating is fully supported, for example to explore in greater detail inequalities in GLT and how they relate to current widely felt concerns about income inequality.

Moreover, the other major statistical framework, the SNA and its summary index, GDP, are also not immune from such arbitrariness. Obvious examples include where to draw the "production boundary" (e.g. including imputed rental income from owner-occupied housing, but not imputed homemaking services), splitting returns to capital and to labour for self-employed business, treating "regrettables (e.g. oil spills) as a positive contribution to economic output, choice of method for constructing price deflators and purchasing power parities, selecting a depreciation rate for R&D "capital", and measuring the "output" of the public sector by its inputs. Still, sophisticated users of the SNA understand these areas where judgment calls have a major impact on the resulting figures. And the producers of SNA statistics strive for consistency in their estimates over time, and across countries. As a result, the statistics are still widely considered to be useful.

Thus, while the GLT framework and summary index have important areas of arbitrariness, this need not detract from their potential usefulness.

GLT – More Sophisticated Estimates

For many countries, even time use surveys are infrequent or non-existent. This is a statistical gap that was highlighted by Stiglitz et al. (2009). Without a time use survey, one of the three components of the GLT framework would be missing, so the first priority for any country that wanted to produce GLT estimates would be conducting such a survey. And if the survey also included a minimum of health and income questions, then results like those just shown in Figure 8 above would be possible. Even better would be a time series of these cross sectional time sue surveys so that trends could be followed. (Recall that the ideas and international agreements for the SNA pre-dated complete data collection in many OECD countries by decades, and for many other countries the underlying data for estimating the standard accounts are still incomplete.)

Even though we have not spent any time focusing on the variations over the twenty year period in the results in Figure 8 (in part due to sampling errors, but also due to some changes in question wording across the four surveys), Table 1 above and its results on working lifetimes strongly suggest that important trends would be revealed.

Sullivan Method – However, exactly as in the discussion of Figures 2a and 2b, changes based only on the directly observed survey data would confound trends in GLT with changes in the age structure of the population. Thus, the first extension of the direct "first approach" method of Figure 8 would be to combine the time, money, health (henceforth T, M, and H respectively) and joint GLT status data with period survival curves. The easiest way to think about this method is as one where the original survey microdata, which have sample weights such that they represent the actual population, are re-weighted so that the population represents the steady state life table population by sex and, say, five year age groups, as was done for Figure 4b above. Alternatively, the method could start with the survival curve envelopes as in Figure 2b, and then within each five year age group, impute the distributions of TMH and GLT for men and for women using a spreadsheet.[9] In either case, the result will be a population pyramid like Figure 2b from which sojourn times like those in Table 1 and Figure 6 can readily be computed.

It is worth noting that this approach, especially in the second manner just described, is exactly the Sullivan (1971) method widely used to estimate health-adjusted life expectancy (HALE, e.g. Wolfson, 1996; McIntosh et al., 2009, WHO, 2016). Hence, the H portion of the GLT framework nicely nests what is becoming the most widely agreed primary population health indicator, supplanting LE as more countries develop the required data..

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[9] The reweighting approach is microanalytic, while the spreadsheet approach is semi-aggregate. The former is far more flexible, while the latter is representative of most current practice. It is unfortunate that more researchers do not approach these kinds of analyses microanalytically.

Synthetic Matching – A second improvement is to combine data from several cross-sectional surveys at the microdata or unit record level. Ideally, for GLT analysis, we would want a single survey that had the best microdata on all three of the domains jointly. But typically, the income and health questions on a time use survey are not as detailed as those on health and income surveys respectively; while income and health surveys virtually never include time use diary data. Thus, it is likely that better data on each of time, money and health will remain available only from separate non-overlapping surveys. But what is needed is the joint distribution of these characteristics at the individual or microdata level. Synthetic matching is a well-developed methodology for merging the three separate surveys. (Indeed, methods have become increasingly sophisticated, e.g. Iacus et al., 2012, though see UN, 1979 for an early statement).

Microsimulation – Finally, a considerably more sophisticated approach to constructing the GLT Framework, and to estimating the summary index and all its coherent family of underlying statistics, is via microsimulation. To convey the main idea, suppose there is the ideal longitudinal survey, with exactly the data needed for every year of life for each of millions of individuals in a representative sample of the population. More specifically, within each of those years we have good measures of their income, health status, and time allocation across activities. This data set can be represented by a "data cube" for the population, as shown below. The horizontal axis is age, the vertical axis represents each individual's "state space" for the three attributes of well-being, and the two together represent, in a 2-D plane or slice, a kind of summary statistical biography of the individual. Finally, the third dimension of the data cube, going back into the page, indicates numerous individuals in a large representative sample.

As already noted, life expectancy is simply the average of the life lengths in the population. Analogously, we can compute "life expectancy with adequate income", "life expectancy with adequate health", and "life expectancy with adequate leisure time". Finally, we can ask how many years each individual can expect to live where they have all three at once – being alive with adequate income and health and time, or GLT = good life time.[10]

Since the summary index is derived from a full underlying data cube with the levels of income (measured in dollars), health (measured in some sort of QALY or HRQoL score), and leisure time (measured in average hours per day), any interested user is able to "drill down" to generate any of a coherent family of companion indicators, including:

- GLT by age group (as well as sex);
- life expectancy with adequate levels of each of the three domains one at a time;
- life expectancy with adequate levels of at least two of the three domains; and
- life expectancy with "barely" or "fully" adequate levels – based on lower or higher cut-points, as a sort of distributional or sensitivity analysis;

Of course, such a longitudinal survey does not exist, nor is it likely. Fortunately, Statistics Canada's LifePaths model could be fairly easily adapted, and this is the basis for our final GLT estimates.[11]

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[10] Recall that the actual analysis uses continuous time, not discrete years, for example, though discussion is simplified by talking in terms of years.

[11] Unfortunately, Statistics Canada ceased funding LifePaths after 2010. Efforts are underway to restore its funding.

GLT Results Using LifePaths

Figure 10 shows the results for each of the three GLT domains separately, each as a partition of cohort LEs, analogous to Stone's active and passive sequences shown in Figure 6 above, correspondingly estimated using the LifePaths microsimulation model

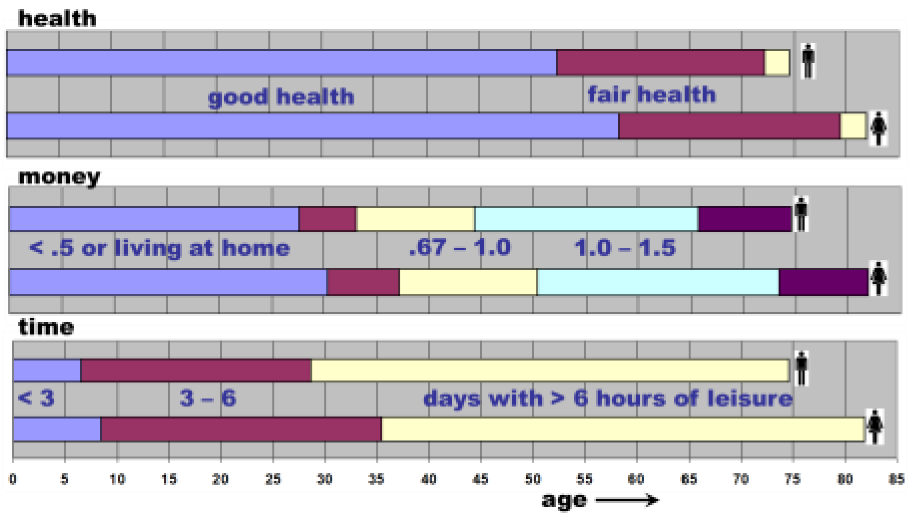

Figure 10 – Time, Money and Health Sequences for the 1940 – 59 Birth Cohort

The bottom pair of bars show male and female LE for the 1940 – 59 birth cohort broken down by the numbers of weeks when the population can expect to have various average amounts of leisure time, defined as the sum of active leisure, e.g. playing sports, passive leisure – e.g. watching TV or movies, and socializing, e.g. dining out with family or friends.[12] We take as our main cut point at least 6 hours a day – averaged over both weekdays and weekends. In other words, the results are based on a week by week count of when there is an average during the week of at least 6 hours per day of leisure as just defined.[13] The bottom pair of bars in Figure 9 shows the resulting breakdown amongst categories of at least six hours of leisure per day, 3 – 6 hours, and less than 3 over their lifetimes. In general, things look rather good, with well over half the lifetimes of this cohort spent having "adequate" average weekly leisure (as defined).

The middle pair of LE bars show the numbers of days over a lifetime spent in families at various family size-adjusted disposable income levels – all expressed as percentages of the median.[14] The income data underlying these LifePaths simulations are derived from a variety of sources including the labour force

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[12] While age is shown along the horizontal axis, this actually represents the overall proportion of the cohort's life expectancy spent in one of the categories of GLT status. In other words, person-days spent in one of the categories at any age by any individual in the birth cohort are summed and then put together as a "lump" of time over the cohort's life cycle.

[13] Note that the 6 hour cut-point, in contrast to the 3 hour cut-point underlying Figure 8, is due to the fact that we now have much richer time use data. In the Figure 8 data, information was only available for each sampled individual for a single day, most of which were weekdays rather than weekends. However, with the LifePaths simulation model, we have used the data for different days of the week to build up synthetic biographies as if the time use survey has been conducted every day for a seven day stretch, four times a year (to account for seasonality). Thus, with a mix of weekend days and weekdays, it is more appropriate to take a weekly average of daily leisure time, and 6 hours in this context was chosen as a more appropriate cut-point.

[14] Note that children under age 20 are put in with the bottom income group, since we do not have data on their parents' incomes.

survey, the population census, and personal income tax returns. Not surprisingly, most people, once they leave the parental home, can expect to live with incomes above two-thirds of the median.

Finally, the top pair of bars show the same 1940-59 birth cohort's LE broken down by their health status as measured by the McMaster health utility index. This is a widely used metric for health evaluation such as cost-effectiveness studies. It is an index where one represents full health, and zero represents death. We use a cut-point of 0.9, but also show results for a cut-point at 0.5. Again a substantial majority of this cohort's LE is expected to be spent in good health.

Taking each of the GLT's three life domains *one at a time*, over half of the person-years of life in the 1940 – 59 birth cohort have been or will be spent in good health, with "adequate" income, and with weeks averaging 6+ hours of leisure per day.

But what about having adequate time, money and health all at once? Table 3 shows the results for the 1940 – 59 birth cohort, focusing on the age 25+ population (to avoid the problem of parental incomes for those 25 and under living at home). The table shows all the possible combinations in the Venn diagram in Figure 7 above. The GLT index, defined as the intersection of adequate time, money and health, or TMH in the notation of the table, is shown in the bottom row, and is about one-quarter – 23.1% of women's and 28.0% of men's LEs after age 25 are GLT.

	Females	Males
t m h	3.2	2.1
t M h	9.2	9.5
t m H	8.8	6.2
T m h	5.2	4.1
t M H	30.4	27.3
T M h	10.4	13.1
T m H	9.7	9.5
GLT = T M H	23.1	28.0

Table 3 – Percentage Distribution of 1940 – 59 Birth Cohort PYs at Ages 25+ Across TMH States

("t" denotes less than an average of 6 hours leisure / day, "T" ≥ 6 hours leisure / day, "m" < 0.67 median income, "M" ≥ 0.67 median income, "h" < 0.9 health index, and "H" ≥ 0.9 health index.)

Interestingly, the largest decrement to GLT is individuals who do not have enough time (tMH, fifth row) – 27.3% for men and 30.4% for women. This suggests an important gap in most countries' social policy agendas. Health care and health policy are major concerns in virtually all OECD countries, as is income adequacy. Both broad policy domains have at least one government ministry with income or health as their main focus. But notable by its absence is any policy focus on how much time people have to enjoy their lives.

To some extent, this is understandable – in mixed market economies, the allocation of time across activities has typically been an area left to individual choice. However, government policies in other domains will often have important impacts on committed and discretionary time (e.g. daycare, urban design and commuting times) – yet there is no comprehensive social accounting framework for monitoring and analysing these phenomena. The GLT framework does support such analyses, and at the same time does so in a way that coherently encompasses income (e.g. employment, pension policy) and health policy domains at the same time.[15]

Sensitivity Analysis – As already noted, the specific cut-points used for dividing each of leisure time (T), income (M) and health (H) into levels that are adequate or not is intrinsically arbitrary. It is straightforward to explore the sensitivity of these results to alternative cut-points.

For example, instead of M at two-thirds, we can try 0.5 as the lowest level (i.e. a widely used poverty line), and 1.0 and 1.5 as higher levels. Correspondingly, we can look at the 3-6 hour range for leisure (L), and the 0.5 to 0.9 range for health (H), for example.

There are a great number of possible combinations, so we will focus on four alternative summary GLTs (as an index, not the overall framework):

- very poor: at least one domain is at the lowest level: < 3 hours per week of leisure time, < half the median family income (adjusted for family size), and a health index < 0.5;
- passable: at least 3 to 6 hours leisure time, at least two-thirds median income, and health index at least 0.5 (but not "ok" or "good");
- ok: at least 6 hours per day weekly average leisure time, income between 1.0 and 1.5 median, and health index at least 0.9; and
- good: not only "ok", but also income above 1.5 median.

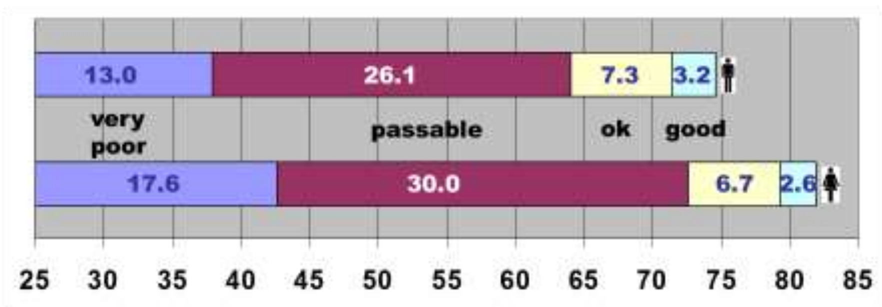

Figure 11 – Sensitivity Analysis of GLT to Alternative Cut-Point Combinations for "Adequate"

Figure 11 shows the results in the same LE terms as before, again starting at age 25 (to avoid the data problems of children living in the parental home). As "bottom line" indicators, over two-thirds of men and women in Canada's baby boom cohort can expect lives with "passable" or better GLT. But not much over one-tenth of the baby-boom cohort's years, in aggregate, will be spent in "ok" or "good" GLT.

Discussion

An obvious challenge, given these results, is how this situation can be improved. Recalling Table 3, the largest gap contributing to low GLT was a lack of leisure time. As just noted, public policies, reflecting broad public concerns, have long focused on questions of income adequacy and health. But in general, public policy has not focused on patterns of time use. The few exceptions, like respite care for individuals looking after ill family members, actually make the point. Other than France with its recent experiment with a shorter working week, the major changes in usual hours of work occurred in the first half of the 20th century, and the largest change in the amount of time spent working for pay has been the increase for women in the second half of the last century. Another change is that modern life demands more time for activities like commuting

[15] Stat Can has developed policy simulation models in both the health and income domains that in fact have provided the foundations for this GLT analysis, e.g. for pension policy analysis see Wolfson (2011) and for health policy see CPAC (no date).

to work, which goes in the opposite direction of the beneficial effect the introduction of mechanical washing machines and refrigeration of foods had on women's free time in the first half of the 20^{th} century.

In the spirit of the OECDs project on measuring the progress of societies, and the Stiglitz / Sen / Fitoussi commission's phrase, "you get what you measure", the failure to measure time use patterns, and bring them into the broader framework of social accounting, is a major lacuna.

There are two main caveats with regard to the GLT results so far presented. One is that time trends, even if we had sufficient data to use our more sophisticated LifePaths methodology, might not appear that large. The other is that with current data, sampling variability likely swamps our ability to detect reliably various trends.

One response to the first caveat is that to be serious about detecting trends in GLT and its components, we will need to invest more in time use surveys, as well as have synthetic matching across surveys become a more standard procedure at national statistical offices. Microsimulation models like LifePaths will also have to become part of mainline statistical programs.

One way to put the challenge here is to ask about the "sensitivity" of the GLT indicator and its family of component indices to important socio-economic trends. At the high frequency end, items like the unemployment rate are tracked quite well on a monthly basis. But their socio-economic correlates, like income, and other events with potentially similar sized impacts at the same frequency, like seasonal or pandemic flu, are not regularly captured. A higher frequency measure like Good Life Month (GLM) in principle could reveal these impacts.

Certainly on a longer multi-year or decadal time scale, there are many trends at work where we clearly lack a coherent sense of their effects that GLT (or GLY = Good Life Year) measures could offer – such as the movements from TV and movies to internet and computer games, declining fertility, later marriage, increasing female labour force participation, increasing educational attainment, later entry to paid work, availability of childcare and elder care services, the scope of urban public transit, chronic disease trends, and changing retirement ages.

These more slowly moving trends will not generate the same kinds of news headlines that high frequency daily or monthly economic indicators do. But there is much more to explore than only time trends. The trend toward increasing income inequality almost certainly has important correlates that would render GLT inequalities of great general and public policy interest – whether these distributions in GLT or GLY measures were examined by income group, city, occupation, fertility history, education, or any of a wide range of other socio-economic variables.

Concluding Comments

This paper has resurrected and elaborated Sir Richard Stone's seminal but unfortunately largely forgotten System of Social and Demographic Statistics (SSDS; UN, 1975). The first part was to develop the concept of a time-based accounting framework, amenable to "articulation" as in the System of National Accounts (SNA), and having a headline index at its apex, the "good life time" summary index and its GLT statistical framework. This GLT framework nests Stone's SSDS as a subset of its articulated tabular results. It also responds to many of the widely held concerns about the unduly narrow ambit of the SNA and its headline indices GDP and GDP per capita.

The GLT framework heads in a somewhat different direction than the OECD's measuring progress (OECD Better Life web site), and the Stiglitz / Sen / Fitoussi report (2009) with its tripartite and generally separate foci on improving measures of income, subjective well-being, and environmental impacts of human activity. Instead, the GLT framework is more akin to the SNA in being a single coherent framework, with a common numeraire, capable of producing a range of related measures of a population's economic and social well-being. The key differences are that the GLT uses time rather than money as the numeraire, and is based on clear and explicit micro foundations.[16]

A range of methods for constructing GLT measures have been illustrated or discussed, starting with fairly simple approaches using multi-state life tables, a series of repeated cross-sectional household time-use surveys or a series of synthetically matched income, health, and time use surveys. The survey approach enables much more fine grained results, including distributional and inequality analyses of various sorts. Finally, we have presented results based on the LifePaths microsimulation model. This approach, while more complex, enables not only distributional and inequality analyses and time trends, but also taking better account of the correlations among various of the GLT components and their key covariates, such as the co-evolving relationships between family demography and work and income.

GLT (rhymes with GDP) is in our view a worthy candidate as a complementary and co-equal statistical system to the SNA. Moreover, because GLT is based on a computer simulation model (as well as a very extensive number of underlying data sets), the GLT framework and the LifePaths style of simulation model on which it is based can also support research and policy analysis with their capacity to answer “what if” questions.

Similarly to the SNA as the other major integrative statistical framework in wide use, the GLT framework and LifePaths model rely on an extensive network of data feeder systems. And like the SNA at its inception, there are major problems of data availability. The challenge is that the GLT framework and LifePaths model build on richly multivariate longitudinal microdata on individuals and their socio-economic circumstances. While these kinds of data are still relatively uncommon, there is also a growing consensus that these data are of high priority for a variety of analytical and public policy purposes. Indeed, as national statistical offices have to shift increasingly to the use of administrative data, longitudinal microdata should become increasingly available. Thus, the GLT framework and LifePaths model not only fit in well with the developing appreciation of the needs for data on the micro-level dynamics of individual behaviours, they also provide a major rationale and integrating framework for such data.

Indeed, GLT can act as the conceptual framework for the design of networks of surveys and other data collection vehicles and, analogously to the role played by the SNA in national statistical offices, give the impetus for the common concepts and definitions that are fundamental to maintaining coherence and consistency in the statistical system. As such, the GLT framework and LifePaths model represent, finally, the realization and substantial generalization of of the UN (1975) and Stone’s (1973) proposed System of Social and Demographic Statistics.

While the full GLT framework and underlying LifePaths model are rather complex, we have also shown that there are simpler and more direct methods for estimating GLT. Thus, many countries, even if they do not have extensive longitudinal microdata sets should, as long as they have the basic cross-sectional data on time use, household incomes, and health status, be able to produce estimates of the GLT index.

In terms of the results presented, the GLT framework and LifePaths model highlight the value of a more integrated while multi-faceted view of individuals in society. A full life-course perspective is essential. It is also important to bridge information on domains that up to now have been disparate. For example, it is obvious to the general public that having a good income is not of much benefit if one has neither the time nor the health to enjoy it.

Furthermore, when we take this kind of integrated view, we see that there are serious “mismatches” in the availability of time, money and health – both over individuals’ lifetimes, and between individuals. This general point lies at the core of such differing and possibly conflicting policy suggestions as mandating shorter work weeks, shifting health care from hospital to outpatient and home care, raising the age of

[16] The GLT framework starts with three domains, time, money, and health. It could clearly be broadened to include other major life domains, e.g. literacy, housing, and subjective well-being.

entitlement to public pensions, and forcing or encouraging employers to adopt more "family friendly" policies especially to accommodate the needs of children in families where both parents are working. In the private sector, the market for many products (e.g. entertainment, vacations) is often constrained more by prospective consumers' lack of time than by lack of money (Linder, 1970, Becker, 1993).

Indeed, the ideas of Matilda White Riley (1986) are worth recalling in this context. She emphasized that with increasing life expectancy, there were increased opportunities for more variegated roles over the life course, and the interplay of these roles with social structure. But she worried that our social structures were seriously lagging these implications of increasing longevity.

The GLT framework and LifePaths model provide a statistical framework and simulation tool with which to inform and analyze these kinds of policy options and to track the underlying social changes.

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