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The Development of Indicators for Human Capital Sustainability

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Abstract

This paper is divided into two major parts. The first provides an overview of how the issues of health and education can be incorporated into a framework that tracks the sustainability of human capital. The paper reviews the concepts of human capital and sustainability, builds a framework for organizing indicators of human capital in the areas of health and education and develops a definition of sustainability based on the framework. A key distinction is made between outcome and input indicators. Both types of indicators are in turn divided into summary and specific indicators. Sustainability is defined when the outcome indicators (or a composite index of the indicators) remain constant or improve over time, with unsustainability defined as a deterioration in outcome indicators. Weak sustainability requires only constancy or improvement in summary outcome indicators while strong sustainability requires constancy or improvement in all summary and specific outcome indicators. This section also discusses the linkages between human capital and natural capital and human capital and economic capital.

The second part of the paper proposes a framework for tracking the economic sustainability of the education and health components of human capital. It makes the case that the two most appropriate summary human capital indicators in the education area are average educational attainment and literacy levels based on international testing and in the health area health-adjusted life expectancy and self-reported health status. Average educational attainment can be expressed in monetary terms. The valuation of the other three indicators is much more difficult, although theoretically plausible. The paper finds that the development of estimates of these four summary indicators of human capital to track economic sustainability is feasible. However, the paper notes that the sustainability of human capital represents considerably less of a challenge than the sustainability of certain ecosystems and that the more important challenge in the human capital area relates more to Canada's ability to improve the quality of our human resources, relative to our competitors, than to sustain them at the existing level.

The Development of Indicators For Human Capital Sustainability¹

This paper is divided into two major parts. The first provides an overview of how the issues of health and education can be incorporated into a framework that tracks the sustainability of human capital. The paper reviews the concepts of human capital and sustainability, builds a framework for organizing indicators of human capital in the areas of health and education and develops a definition of sustainability based on the framework. The second part of the paper proposes a framework for tracking the economic sustainability of the education and health components of human capital. It makes the case that the two most appropriate summary human capital indicators in the education area are average educational attainment and literacy levels based on international testing and in the health area health-adjusted life expectancy and self-reported health status.

I The Concepts of Human Capital and Sustainability

Human capital

The formal concept of human capital was developed in the 1960s by a group of economists associated with the University of Chicago (see Becker, 1964; Mincer, 1966) although the idea that investment in education has a long-term economic and social payoff for the individual and society at large goes back to Adam Smith if not earlier.

Human capital is defined as the aggregation of investments in such areas as education, health, on-the-job-training, and migration that enhance an individual's productivity in the labour market, and also in non-market activities.

Some definitions of human capital (e.g Laroche, Merette, and Ruggeri, 1999) include the innate abilities as well as the knowledge and skills that individuals acquire throughout their lifetimes. It is argued that since the number of skills individuals acquire through their lifetime depends partly on their initial abilities, this potential is an important aspect of the human capital concept.

Laroche, Merette, and Ruggeri (1999) identify five aspects or characteristics of human capital that merit attention. They are

- human capital is a non-tradeable good embodied in human beings, although the flow of services generated by human capital is marketed;
- individuals, particularly the young, do not always control the channel or pace by which they acquire human capital;

¹ This paper was originally prepared by the Centre for the Study of Living Standards for the National Round Table on the Environment and the Economy (NRTEE) Environment and Sustainable Development Indicators Initiative (ESDI).

- human capital has a qualitative as well as a quantitative aspect reflecting the quality of the educational inputs;
- human capital can be either general in nature or specific to a firm or sector; and
- human capital generates individual and social externalities.

The Concept of Sustainability

The issue of sustainability is now central to academic and public discussion and debate on the environment, including natural resources and ecosystems (defined as the support capacity for life on the planet).

The term sustainable development was coined in 1980 by the environmental non-governmental organization International Union for the Conservation of Nature and popularized by the 1987 Brundtland report *Our Common Future*, which defined sustainability in terms of intergenerational equity as follows²:

“humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effect of human activities”

In this case, the needs refers to basic needs such as food, energy, water and sanitation. Although the concept of environmental limits is implicit, limits are understood by the Brundtland report not so much as physical limits (carrying capacity), but rather as technological and organizational limits. According to Crabbé (1997:10-11):

“The Brundtland Commission was less interested in defining some ecological objective as it was in fulfilling some socio-economic objectives such as access to resources and equitable distribution of the costs and benefits of development. It wanted human population to be stabilized at a level consistent with the productivity of the ecosystems. It also wanted economic growth to be revived in both the industrial and developing countries. However, this had to be a new type of growth—sustainable, equitable, integrating environment, economic and social development”

² Another definition (Reed, 1996) of sustainable development is “improving the quality of human life within the carrying capacity of supporting ecosystems”

It is important to note that sustainable development has ethical, societal, institutional, environmental as well as economic aspects. One reason that the concept is difficult to pin down is that the ethical values pertaining to development, quality of life and respect for nature are multiple and overlapping (Thomas, 1990). The political process has to resolve the “bounded conflicts” among people who hold different and sometimes conflicting values.

In recent years, the World Bank has highlighted the concept of sustainability in its work. It has broken down sustainable development into economic, environmental and social components and developed estimates of physical, natural, human, and social capital for a large number of countries for 1994 (World Bank, 1998). According to the World Bank, weak economic sustainability requires that the value of all types of capital as an aggregate be maintained so it allows substitution among the different types of capital. Strong sustainability requires that the value of natural capital be maintained as it assumes that natural capital (or at least the carrying capacity or ecosystem components) are essential for life and have no substitutes.

The concept of sustainability can also be related to the sustainable yield concept used in resources economics literature. A sustainable yield is the rate of harvesting of a renewable resource that leaves the size of the stock of the resource physically intact indefinitely. Sustainability in effect requires that only the net growth (defined in value or physical terms) be harvested. For non-renewable resources, the concept of sustainability can be expanded to include substitutes for the resource or “backstop technologies” in the definition of the resource.

It is important to recognize that the Brundtland definition of sustainability is not rigorous. There has been much debate about what actually constitutes sustainable development. These issues include:

- at what geographical level should the concept of sustainability apply (world, continent, country, state/province, county, municipality, community)?
- to what degree should the concept of sustainability allow for the substitutability between natural resources or does it strictly apply to specific resources? For example, is development sustainable if conventional oil resources are declining, but overall energy resources are rising due to additions to natural gas reserves?
- given the uncertainty about trends in the ecosystem and the factors behind these trends, to what degree should the precautionary principle influence decisions about actions and policies that may influence these trends to ensure sustainability?

The concept of sustainability was first applied to natural resources and ecosystems. There is currently much interest in applying the concept beyond the environment. This paper applies the concept of sustainability to human capital in both the health and education areas.

Based on the Brundland definition of sustainable development, a general working definition of sustainable human capital in health would be that the health needs of the current population are being met without compromising the ability of the next generation to meet its needs. Equally, a general working definition of sustainable human capital in education would be that the education needs of current population are being met without compromising the ability of the next generation to meet its needs.

However, there is a major difference between natural capital, to which the sustainability concept originally applied, and human capital. Natural capital is finite and non-reproducible while human capital is infinite and reproducible. From this angle, the concern about the depletion of natural resources and the degradation of eco-systems from the perspective of future generations, which is what motivated the development of the concept of sustainability, does not apply in exactly the same manner to human capital.

We run down natural resources by exploiting them and use the eco-systems (air, water, land, etc.) in the production process. We cannot accumulate natural capital (although the measured economically feasible natural resource component of natural capital can be augmented though technological change, new discoveries, and higher relative prices). On the other hand, we accumulate educational human capital by educating the population and accumulate human capital in the health area through medical and public health advances that increase the overall health of the population. Of course, we can in principle run down these two types of human capital through failure to make the appropriate investments but we do not do so in the normal course of the production process, as is the case for natural capital.

Despite the above differences between natural and human capital in terms of their reproducibility and exploitability, the concept of sustainability does have relevance for human capital. By tracking single indicators and aggregate indices of the human capital in the education and health areas, one can gauge their direction of change.

The rest of this paper develops a set of indicators that would constitute human capital in the education and health areas and develops an operational definition of sustainability.

II A Framework for Indicators of Human Capital in the Health and Education Area

This section of the paper develops a framework for indicators of human capital. These indicators are divided into two basis types, outcome indicators and input indicators. Outcome indicators are in turn broken down into a small number of summary outcome indicators and a much larger number of specific outcome indicators. Input indicators are also broken down in such a manner.

Sustainability in terms of human capital can be defined in terms of the *constancy or improvement in outcome indicators*. Weak sustainability is defined as a lack of decline

in summary human capital indicators (or a composite index of the summary indicators). Strong sustainability is defined as a lack of decline in all summary and specific human capital outcome indicators.

Different criteria can be used in the choice of summary and specific outcome indicators for the tracking of the sustainability of human capital. For example, one could emphasize indicators that are forward looking, or that focus on the current situation, or are amenable to private and public policy responses and hence relevant for decision makers.

Education Indicators

There are two basic types of indicators for human capital, outcome indicators and input indicators. Outcome indicators measure the actual outcome of investments in this type of human capital while input indicators capture the magnitude and quality of the investments.

Outcome Indicators

In terms of summary outcome indicators, the most relevant indicator of human capital is the general and specific knowledge and skill sets of the population, although quantification and aggregation in any absolute sense of heterogeneous knowledge bases and skills across the population is difficult. Standardized literacy and numeracy tests are useful for comparisons across countries and over time. Another summary outcome indicator of human capital is the educational attainment of the population, which can be measured by the number of years of formal schooling of the average person. A third outcome measure that would reflect the inadequacy of human capital formation in a country is the appearance of generalized skill shortages, which can lead to migration flows.

While educational attainment may in certain cases not directly translate into usable or relevant knowledge and skills, the knowledge and skills base of the population is generally correlated with average educational attainment. Another advantage of the use of educational attainment as a summary outcome measure of human capital is that its value can be quantified in dollars, either in terms of the cost of reproducing the aggregate education attainment of the population or in terms of the discounted value of future earnings that the educational attainment will generate.

Official statistical agencies such as Statistics Canada do not produce estimates of the value of human capital, as they do for physical capital and certain components of natural capital (Statistics Canada, 1997). Private researchers have however developed estimates for human capital. For example, Jorgenson and Fraumeni (1989) found that the value of human capital exceeded the value of physical capital 11 times over the 1948-84. Osberg and Sharpe (2000) found that the value of human capital also well exceeded the value of economic and natural capital, but not by as much as the Jorgenson-Fraumeni estimates.

There are a large number of educational human capital outcome indicators specific to age groups or to particular types of skills and knowledge. These indicators are determinants of the summary indicators of the current and future knowledge and skills base of the population. Specific outcome indicators include:

- test scores in various subject areas and for different age groups;
- high school completion rates;
- university and community college completion rates;
- educational completion rates by socio-economic characteristics;
- skill shortages in specific areas; and
- net in-migration or out-migration of persons with specific skill sets.

Sustainability in terms of educational human capital can be defined in terms of the constancy or improvement in outcome indicators. If the average educational attainment falls, society will have difficulty to reproduce itself to the same level of achievement. Equally if a country's education and training system cannot fill generalized skill shortages, human capital is not sustainable. Weak sustainability might be defined as a lack of decline in summary human capital indicators or a composite of summary outcome indicators. Strong sustainability might be defined as a lack of decline in all summary and specific human capital outcome indicators.

Input Indicators

The quantity of human capital a society possesses is determined by a number of factors or inputs including the quality and accessibility of the education and training system and individual choices regarding the use of the system (which are often constrained by the environment in which a person developed). Again summary input indicators for education human capital can be defined as the total resources devoted by government and/or individuals to all forms of education and training (in per capita and real terms) and enrolment rates in postsecondary education.

Specific education human capital input indicators include

- educational infrastructure;
- student-teacher ratios;
- teaching materials;
- incidence and length of workplace training;
- extent of government training and retraining programs;
- extent of post-secondary educational opportunities;
- enrolment rates in specific programs; and
- importance of a life long learning culture.

While input indicators are obviously important and should be closely monitored, there are not strictly speaking indicators of trends in the sustainability of the education capital of the population. Indeed, it is the outcome indicators which fill this role.

Consequently, a decline or deterioration in an input indicator may not necessarily lead to decline in educational outcomes, particularly if resources are being used more effectively or if the marginal contribution of the resources has reached the state of diminishing returns.

Health Indicators

Unlike education, a stock of health capital is somewhat less defined as we do not accumulate health capital like we accumulate human capital through schooling. Consequently, it is much more difficult to place a monetary value on the stock of health human capital. But it is still meaningful to talk of a stock of health capital and we can add to this stock by improving the health status of the population. The stock of health capital can be approached on both a total population and an average person basis.

Outcome Indicators

In terms of summary outcome indicators, the most relevant indicators of health capital is self-reported health status reported in population health surveys. Research shows that this is an excellent indicator (e.g. proportion of the population who rate their health as very good or better) of the true health status of individuals.

A second key summary health outcome indicator is the average life expectancy at birth of the population. Related summary indicators include the years of health-adjusted life expectancy (HALE) or years of life that are disability free, which is somewhat less than average life expectancy and years of potential life lost (PYLL), with potential life defined as 75, the average life expectancy for men.

There are a large number of health outcome indicators specific to age groups or to diseases or health conditions. These indicators are determinants of the two summary indicators of health status and life expectancy. Specific health outcome indicators include:

- infant mortality rates;
- incidence of low birth rate babies;
- morbidity rates;
- incidence of obesity;
- incidence of arthritis;
- incidence of diabetes;
- incidence of chronic pain;
- incidence of depression;
- incidence of cancer;
- incidence of heart disease;
- incidence of suicide;
- incidence of accidents or unintentional injuries or deaths;
- incidence of HIV/AIDS;

- work absentee rate;
- health status and life expectancy by socio-economic groups;
- the risk of financial insecurity from illness; and
- incidence of persons with activity limitation.

Sustainability in terms of health capital can be defined in terms of the constancy or improvement in outcome indicators. Weak sustainability might be defined as a lack of decline in summary health indicators or a composite of these indicators. Strong sustainability might be defined as a lack of decline in all summary and specific health outcome indicators.

Input Indicators

Health status and life expectancy is determined by a number of inputs including the quality and accessibility of the health system, the state of medical knowledge, public infrastructure affecting health (roads, water facilities, sewage treatment), the state of the environment, and individual life styles (which are often shaped and constrained by the environment in which a person has developed). Again summary input indicators can be defined as the total resources devoted by government and/or individuals to the health system, resources devoted to the advancement of medical knowledge, and resources devoted to infrastructure affecting public health. A summary indicator for lifestyle is more difficult to develop as such choices cannot be aggregated in terms of dollars like the other summary indicators.

Examples of specific health input indicators in five areas include:

Quality and accessibility of the health system

- proportion of medical procedures covered by universal health system;
- proportion of the population covered by a universal health care system;
- proportion of disposable income devoted to private health costs;
- number of doctors and other health care professionals per capita at the national level and at the regional level, including remote regions;
- hospital beds per capita;
- MRIs and other advanced medical equipment per capita; and
- waiting time for health services

Advancement of medical knowledge

- resources devoted to medical research in Canada and elsewhere;
- number of medical researchers in Canada and elsewhere; and
- number of significant medical advances in Canada and elsewhere

Public policy decisions affecting public health

- expenditure on improving roads and highways;

- expenditure on sewage treatment facilities;
- expenditure on water treatment facilities; and
- regulatory framework for workplace health and safety.

Environmental determinants of health

- state of workplace health and safety;
- air quality; and
- water quality.

Individual lifestyles

- incidence of smoking;
- incidence of heavy drinking;
- incidence of physical activity and fitness;
- incidence of teen births;
- incidence of breastfeeding; and
- incidence of extreme stress.

In principle, greater resources devoted to health, as captured by summary health input indicators, should improve health outcomes. This is not always the case, particularly across countries. This may be because the resources are deployed ineffectively or because there is no actual link between the health inputs and health outcomes. For example, the United States devotes a far greater proportion of GDP to health than other developed countries yet has average life expectancy significantly below many of these countries.

While input indicators are obviously important and should be closely monitored, there are not strictly speaking indicators of trends in the sustainability of the health capital of the population. As noted above, it is the outcome indicators which fill this role. Consequently, a decline or deterioration in an input indicator may not necessarily lead to decline in health outcome, particularly if resources are being used more effectively or if the marginal contribution of the resources to health has reached the state of diminishing returns.

Russia in the 1990s shows that the sustainability of a country's health capital cannot be taken for granted. In the past decade the life expectancy of Russian men has suffered the steepest plunge yet recorded in an industrialized country in peacetime with life expectancy now below 60 years (York, 2000). This situation reflects a massive deterioration in the health inputs. The health care system has collapsed and dire economic conditions have led the Russian population to find relief in life styles harmful to their health. Two third of Russian men smoke, one of the highest rates in the world. Alcohol consumption has risen dramatically, fuelled by the cheap price of vodka. The death rate has increased 34 per cent since 1985 and the birth rate has declined just as sharply. This situation has produced a decline in the population of three million persons from 148 million to 145 million in the past eight years. Russia's state statistics committee forecasts that the population will shrink by a further 11 million in the next 15 years. The long-term

projections are even worse, with one demographer projecting a population fall to 40 million by 2045.

III Linkages Between Human Capital and Other Types of Capital

Human Capital and Natural Capital

There are complex two-way linkages between natural capital, defined as natural resources and the world's ecosystems, and human capital, defined to include education and health. First let us enumerate some of the impacts of human capital on natural capital.

- A population with high knowledge and skill levels can expand the natural capital base by finding additional resources, exploiting more efficiently the existing resource base with new techniques, and developing substitutes for resources in short supply.
- A population with high knowledge and skill levels has the ability to develop technologies to address environmental problems threatening the world's ecosystems.
- More indirectly, human capital accumulation increases national income which provides the resources to address environmental problems, in many cases even with current technologies.
- A healthy population, particularly if it is growing in size, will consume more non-renewable natural resources, resulting in the depletion of existing stocks. It may also increase pressure on the environment, through pollution of the air, water and land and through the destruction of plant and animal species.
- A healthy population, particularly if it is growing, can extract more resources from the natural resource base.

Natural capital is the sine qua non for the reproduction of human capital. For example,

- Natural resources are essential for the sustenance and shelter of the population.
- Ecosystems are essential for the survival of life on this planet and therefore are essential for the health of human beings.

Health and education human capital indicators can illustrate well the linkages between natural and human capital. For example, an accumulation of educational capital in the field of solar energy may make this energy source more cost effective and reduce use of fossil fuels, contributing to a reduction in CO₂ emissions and hence in global warming.

Human Capital and Economic Capital

Just as there are complex relationships between human and natural capital, so too there are similar reciprocal relationships between human capital and economic capital, defined as physical assets (machinery and equipment, structures, housing, consumer durables). First let us enumerate some of the impacts of human capital on physical capital.

- A population with high knowledge and skill levels has the ability to develop technologies to produce better capital goods.
- More indirectly, human capital accumulation increases national income which increases demand for capital goods.
- A healthy population, particularly if it is growing, can produce more capital goods.
- Physical capital has a very positive effect on human capital in the education and health areas.
- New technologies are generally embodied in capital goods so new medical equipment (e.g. MRIs) can improve health status and raise life expectancy
- Education and training does not take place in a vacuum, but requires building and equipment, which is part of physical capital. .

Health and education human capital indicators can illustrate well the linkages between economic and human capital. For example, an accumulation of educational capital in the field of computer science can foster the production of more economic capital as computers become more powerful and useful and contribute to productivity growth.

Summary

This paper has so far developed a framework for the tracking of the sustainability of human capital. The framework lays out a number of indicators in the area of education and health, identifying sustainability with outcome indicators as opposed to input indicators. Weak sustainability is defined as the constancy or improvement in key summary indicators or a composite index of these indicators. Strong sustainability is defined as the constancy or improvement of all summary and specific indicators. In the author's view it is possible for education and health to be incorporated into a set of sustainable development indicators that focus on natural, economic, and human capital.³

³ Indeed, work has already been done to this end. For example, the Index of Economic Well-being, developed by the Centre for the Study of Living Standards (see Osberg and Sharpe, 1989, 1999, and 2000) includes life expectancy in the consumption component of the index and human capital (defined as the cost

IV Proposed Framework on Human Capital Indicators

Human Capital and Link to Economic Sustainability

The framework document produced by Statistics Canada (Smith and Simard) for the National Round Table on the Environment and the Economy's (NRTEE) Environment and Sustainable Development Indicators Initiative (ESDI) employs a capital approach to economic sustainability. As noted by the document, "the essence of sustainability is that we wish economic production to continue for the benefit of the future." To do this, the means of production, that is capital, must be maintained intact over time since capital embodies all that which is necessary to create the flows of services and materials for economic production today and in the future.

In my view, this sustainability of capital perspective can be quite easily extended to human capital, both in terms of education and health. Indeed, human capital can be thought of as the labour analogue to produced capital. The concept of human capital can be described as the capabilities or capacities, both innate and derived or accumulated, embodied in the working age population that allow it to work productively with other forms of capital to sustain economic production. The term human capital has traditionally applied to education broadly defined and includes the knowledge and skills that the working age population (or more narrowly the labour force) accumulates through formal educational attainment, training, and experience.

Without these skills, the population could not successfully harness the produced capital and natural resources to successfully engage in economic production. Although less likely than the collapse of a natural resource stock or an ecosystem, one can imagine a scenario where the education and training system deteriorates to such a point where the knowledge and skills base no longer allows for the reproduction of a workforce that can maintain the absolute level of economic production. Under such a scenario, economic sustainability in an absolute sense⁴ is impeded by the failure to renew the educational capital of the workforce.

of the population acquiring its formal education) in the wealth component. This wealth component (which also includes economic and natural capital) forms the sustainability dimension of the index and signals for future generation the stock of wealth that will be inherited from the current generation.

⁴ While economic sustainability is generally thought of in an absolute sense, one might also think of it in a relative sense, where sustainability is defined as the state of keeping up on a variety of economic indicators with other countries. Take a case where a country falls behind its comparators in terms of real income despite the lack of any absolute decline in the standard of living or any other key sustainability variable. One might consider such a country not to be economically sustainable, particularly if the emergence of these gaps with other countries leads to a migration of people and capital from the lagging to the more dynamic country. Under this relative definition, there are similarities between the concepts of economic sustainability and competitiveness. In this discussion, however, economic sustainability will only be used in the absolute sense.

The concept of human capital can also be applied to the health of the working population (or labour force). Just as investments in the education and training system increase the stock of human capital in the education area, so investments in the health system can increase the stock of capital in the health area. Again, unless healthy, the population cannot harness the produced capital and natural resources to successfully engage in economic production. One can imagine a scenario where the health of the working population deteriorates to such a point where the absolute level of economic production cannot be maintained because of absenteeism and forced retirements caused by health problems. Under such a scenario, economic sustainability is jeopardized.

Work Assessing Trends in Human Capital

Through international comparisons, countries are able to recognize strengths and weaknesses in their education and health systems and to assess to what extent differences in experience are unique or reflect differences observed elsewhere. To paraphrase the OECD (2000:5), governments are paying increasing attention to international comparative analysis in searching for effective education and health policies that enhance individuals' social and economic prospects; to provide incentives for greater efficiency in schooling; and to help to mobilize resources in order to meet rising demands for education and health.

The OECD has made a major effort in recent years to strengthen the collection and reporting of comparative statistics in the field of education. Since the early 1990s the OECD has set out to identify and measure a range of educational outcomes, initially through the International Adult Literacy Surveys conducted by the OECD and Statistics Canada in 1994-97, and more recently through the Program for International Student Assessment (PISA). This latter survey represents an instrument to compare the quality of outcomes produced by school systems, rather than just the numbers of people processed (educational participation) or internal effectiveness (curriculum-based tests).

One example in terms of an assessment of trends in education is the recent OECD (2000a) study *Investing in Education: Analysis of the 1999 World Education Indicators*. This document represents the first report of the World Education Indicators pilot program that began in 1997. It sheds light on the comparative performance of education systems, with an analysis that extends to the financial and human resources invested in education, how education and learning systems operate and evolve, and to the returns to educational investment.⁵

The flagship OECD publication in the education area is *Education at a Glance: OECD Indicators* (OECD, 2000) which provides a rich and up-to-date array of

⁵ The report assesses the education system of 16 countries under the headings of managing the growth of educational participation and mobilizing resources and encouraging efficiency. Under the former heading are studied patterns of demand and potential to respond, progression and completion, and school types and participation. Under the latter heading are analyzed investment in education, and trade-offs and investment choices in the classroom.

indicators representing the consensus of professional thinking on how to measure the current state of education internationally.

The OECD has also made major efforts in recent years to strengthen the collection and reporting of comparative statistics in the field of health and the assessment of health systems. The OECD produces a CD-ROM on health data containing 1200 health indicators across 29 countries for the period 1960-99. The OECD has also recently developed a manual of the System of Health Accounts (OECDc, 2000) that provides a set of comprehensive, consistent and flexible accounts to meet to needs of government and private-sector analysts and policy makers. These accounts constitute a common framework for enhancing the comparability of data over time and across countries and suggest links with non-monetary indicators. The OECD has recently released an occasional paper (Hurst and Jee-Hughes, 2001) that compares and contrasts the key indicators of performance of health systems in selected OECD countries.

The World Bank also has done considerable work in assessing the health of the world's population. For example, a recent study entitled *Measuring Countries Performance on Health: Selected Indicators for 115 Countries* (World Bank, 1999) provides comprehensive data on health to assess trends in most countries in the world.

Much work has also been done in Canada, particularly in recent years, to assess the health and education components of human capital. In terms of health, the most important sources of information and analysis are Statistics Canada and the Canadian Institute for Health Information (CIHI). The joint flagship publication of these two organizations, *Health Care in Canada: a First Annual Report, 2000* (Cat. 82-222), provides a comprehensive assessment of the changing face of Canada's health system. A detailed source for data on the health system is Statistics Canada's 1999 publication *The Statistical Report on the Health of Canadians* (Cat. 82-570).

Statistics Canada produces on a regular basis two additional publications that are very useful for the assessment of trends in the health area. The first, *Health Indicators* (cat. 82-221), provides information for all health regions on the overall health status of the region's population, how this status compares to other regions in the province and country and how it is changing over time; the major non-medical determinants of health in the region; the health services received by the region's residents; and the characteristics of the community or the health system that provide useful contextual information. The quarterly periodical *Health Reports* (cat. 82-003) provides analysis of different aspects of health trends and determinants in Canada. Many of the articles are based on data from the National Population Health Survey, a key source of information on the health status of Canadians.

Statistics Canada through the Centre for Education Statistics (Statistics Canada, 1997) is also the major source for information and analysis on Canada's education system. The Centre's publication *Education Indicators in Canada 1999* (cat. 81-582) provides a comprehensive set of statistical measures or indicators describing the education systems in Canada in terms of students, teachers, finances and outcomes. The

Centre has also published the *Education Quarterly Review* (cat. 81-003) since 1994, which provides: analytical articles in the areas of accessibility; alternatives forms of education delivery; education data sources; education funding; the relationship between education and the labour market; student flows, mobility and transitions; student participation and performance; teacher issues; and technology and learning.

Statistics Canada, working with the OECD and Human Resources Development Canada, has pioneered the international assessment of literacy through the International Adult Literacy Survey (IALS). The publication *Literacy in the information age: final report of the International Adult Literacy Survey* (cat. 89-571) provides the world's first reliable and comparable estimates of the levels and distribution of literacy skills in the adult population drawn from 20 countries over the first three cycles of data collection from the IALS.

Statistics Canada has developed a monograph series based on the IALS data authored by literacy scholars in Canada and the United States. One study of particular note is *Benchmarking Adult Literacy in North America: An International Comparative Study* (Tuijnman, 2001). Other studies have dealt with the disparity between literacy in Canada between francophones and anglophones (Corbeil, 2000); schooling literacy and individual earnings (Osberg, 2000); health and literacy among seniors (Roberts and Fawcett, 1998); inequalities in literacy skills among youth; literacy utilization in the workplace; employee training; and literacy and economic security.

Potential Indicators

The first part of this paper developed a framework for organizing indicators of human capital in the areas of health and education and advanced a definition of sustainability based on the framework. A key distinction was made between outcome and input indicators. Both types of indicators are in turn divided into summary and specific indicators. Sustainability was defined when the outcome indicators (or a composite index of the indicators) remain constant or improve over time, with unsustainability defined as a deterioration in outcome indicators. Weak sustainability requires only constancy or improvement in summary outcome indicators while strong sustainability requires constancy or improvement in all summary and specific outcome indicators. The paper also provided a list of both summary and specific outcome and input indicators.

This section of the paper now proposes an approach to human capital indicators consistent with the ESDI Initiative framework's overall goal of tracking economic sustainability. Specifically, it proposes two summary indicators be adopted to track the sustainability of human capital in the education area and two in the health area.

Indicators of Human Capital in the Education Area

In the education area, it is suggested that the average educational attainment of the working age population (or labour force) be adopted as the first summary indicator of the sustainability of human capital in the education area. Additional years of education

normally produce more knowledgeable and skilled workers, so a situation where average educational attainment is declining is not consistent with the sustainability of human capital. It is true that years of education has certain characteristics of an input indicator rather than an outcome indicator of human capital and that the effectiveness of a certain number of years of schooling may vary across countries and over time due to differences or changes in educational quality. But the problems associated with adopting an input indicator such as educational attainment as a proxy for sustainable human capital are much less severe than would be the case if a true input indicator such as educational expenditures was adopted.

The advantages of the use of years of average education attainment as an indicator of trends in human capital sustainability include its transparency; its wide availability over space in Canada from the national level to census tracts as well as internationally for almost all countries and over time for many decades; and its accessibility from a large number of sources, including censuses, household surveys, and administrative records. As already noted, one disadvantage of average educational attainment as an indicator of human capital sustainability is possibility of declining quality of educational credentials. A high school diploma in 2001 may or may not represent the acquisition of as much knowledge as it did 50 years ago.

The second proposed indicator of human capital in the education area is the standardized test results for literacy and numeracy such as the International Adult Literacy surveys pioneered by Statistics Canada and the OECD. A decline in the test scores of the working population (or labour force) would indicate a fall in the average quality of human capital and hence an unsustainable situation.

The advantage of literacy tests is that they represent a true outcome indicator of human capital quality over both time and space. Disadvantages include the lack of historical data for Canada; the small number of countries for which comparable data are available; the limited possibilities for disaggregation of the population because of small sample size; and the high cost of obtaining the data.

Indicators of Human Capital in the Health Area

The first indicator proposed as a proxy for the sustainability of human capital in the health area is the Health-Adjusted Life Expectancy (HALE) of the total population (calculation of a HALE for only the working age population or labour force poses statistical problems). A decline in the HALE would be an indication that the size of the current population may not be sustainable. Such a situation has recently developed in Russia.

The HALE is a classic summary outcome indicator. Its great strength is that it captures the impact on the population of all the determinants of health. One disadvantage is that unlike life expectancy, it is relatively difficult to calculate as it requires detailed data on health status to make the disability or health adjustment. Therefore it may not be available for long time periods and on a consistent basis for a large number of countries.

However, as trends in the HALE appear similar to that of overall life expectancy, for periods and countries where the HALE is not available, overall life expectancy may possibly be used as an approximation. Data on overall life expectancy are available for almost all countries for long time periods.

The second indicator proposed to track the sustainability of health component of human capital is self-reported overall health status. Like the HALE, a decline in health status of the working age population of labour force indicates a deterioration in the ability of this population to engage in economic production and hence represents a decline in human capital and a trend toward unsustainability.

Self-reported health status is an outcome indicator. Research shows that it is an excellent indicator of the true health status of individuals. The proportion of the population who rate their health as very good or good approximates the proportion who in fact have few health problems. One disadvantage of self-reported health status is that this information requires health surveys of the population so there may be limitations on the availability of comparable data over time and across space.

Key Issues

Aggregation and Monetization

There are two key issues in the field of indicators research related to aggregation and monetization. First, should the indicators selected as most appropriate be aggregated or rolled up into one composite indicator index or left as a set of indicators? Second, if a composite indicator or index is to be constructed, should the aggregation be made in terms of a common numeraire such as monetary units or should the indicators be aggregated through a weighting procedure?⁶

In terms of the first issue, the great advantage of the composite indicator or index approach is that it produces a bottom line that can capture public attention. In addition, since no information is lost through the aggregation procedure, one can easily identify the variables that are driving the index since any policy response to trends in the index most focus on specific variables.

In terms of the second issue there are advantages and disadvantages of both approaches. The major advantage of the monetary unit approach to aggregation, in addition to its transparency, is that under competitive conditions the valuation (whether market or imputed) placed on the various variables in theory correspond to the valuation society places on them. The major disadvantage of this approach is that for many variables there is no market value and it is difficult to impute a monetary value. The problem is particularly severe for the appropriate valuation of eco-systems.

⁶ This is not necessarily an either/or decision as an index can combine the two approaches, aggregating certain variables with dollars and using weights for others. This is the approach adopted by the Index of Economic Well-being developed by Osberg and Sharpe (1998).

The major advantage of the weighting approach to aggregating a set of indicators into an index is its simplicity. The major disadvantage can be the subjective nature of the weighting scheme, which may reflect the biases of the constructors of the index. This problem can be overcome by developing a set of weights that reflect societal values and preferences through surveys.

It is in theory possible to impute monetary values on the four indicators proposed in this paper to track the economic sustainability of human capital in the education and health areas. However, it is not clear that it is necessarily appropriate to do so because of the conceptual and data problems associated with estimating these values.

The monetary value of the average educational attainment of the working age population (or labour force) can be estimated from either a supply-side cost of production approach or a demand-side future earnings approach. In terms of the first approach, the total cost of educating the population at this point in time is derived from the current average cost of a year of education at the various levels of education and the distribution of the population among the various levels of educational attainment.⁷ In terms of the second approach, the value of human capital attributable to formal educational attainment can be calculated by estimating the stream of future earnings of the population arising from that education and calculating the present value of this earnings stream with a discount rate.

The monetary value of the literacy level of the working age population (or labour force) is conceptually more difficult to calculate than the monetary value of human capital accumulated through formal education. Certainly, the cost-of production approach cannot be used. If earning data are available for the various literacy levels, then the demand-side future earnings approach may be used.

It is difficult to place a total value on Health-Adjusted Life Expectancy (HALE) just as it is difficult to place a value on life. It is easier to put a value on changes in the HALE. By the use of contingent valuation techniques or other methodologies, one can value how much people would be willing to pay for an additional year of healthy living. Equally, these techniques can be used to value changes in self-reported health status.

Substitutability

A key issue in the sustainability debate for natural capital is the substitutability among the various components of natural capital. For example, weak sustainability is defined as a state where the monetary value of total stock of natural capital is maintained. The exhaustion of certain types of natural resources can be offset by the discovery of other resources as all natural resources are substitutes for one another in generating income. Strong sustainability is defined as a state where the value of all components of natural capital are maintained.

⁷ See Osberg and Sharpe (1998) for application of this methodology to estimate the value of human capital in Canada for the 1971-96 period.

The weak sustainability framework based on substitutability is appropriate for natural resources as they are in fact substitutable. None are essential for sustainability. The strong sustainability approach is more relevant for the eco-system component of natural capital as many eco-systems may be essential for the continuation of life as we know it on this planet. There are no substitutes for such eco-systems to ensure sustainability.

The concept of substitutability is not particularly relevant to the four indicators of human capital suggested in this paper. First, human capital will always be essential for economic production and cannot be replaced by natural and produced capital. Second, the four indicators proposed are summary or aggregate indicators of human capital so substitution in the production process is not possible as it may be for more disaggregated components of human capital (e.g. labour of different skill levels).

Population Covered by the Indicators

An issue in the development of indicators of economic sustainability is what population is the appropriate reference. If it is the overall sustainability of the planet, then the total population is the relevant group. If the sustainability of economic production is the issue, then one may want to restrict the coverage of the indicators to the working age population (either the 15 and over or the 15-64 definitions) or the labour force (which excludes persons not looking for work),⁸ as it is this population that is engaged in economic production.

It is unlikely that this choice of the reference population will have a significant effect on trends in economic sustainability for human capital indicators in the education area. It may be relevant for human capital in the health area as the trends in the health status of the 25-64 population may vary from those for the 65 and over population.

Conclusion

The measurement issues associated with the four indicators of human capital in the education and health areas suggested in this paper, particularly when estimated in non-monetary terms, are in my view much less severe than the issues associated with the capital represented by ecosystems. Consequently, the development of estimates of these four summary indicators for Canada and other countries in order to track the economic sustainability for human capital is a feasible exercise.

In my view, the absolute sustainability of human capital, including both the education and health components, represents considerably less of a challenge than the sustainability of certain ecosystems. It is unlikely in Canada (although certainly within the realm of possibility) that the educational attainment and literacy level of the

⁸ One problem with a focus on the labour force is that many persons of working age move in and out of the labour force both during the year and over their life cycle. Annual estimates of the labour force thus underestimate the number of persons in the labour force over the course of the year.

workforce could decline or that the life expectancy of the population could fall. It is possible that the health status of the working population could decline, but whether such a development would seriously threaten economic production seems unlikely given the sedentary nature of most jobs.

The challenges in the human capital area relate more to Canada's ability to improve the quality of our human resources, relative to our competitors, than to sustain them at the existing level. Fortunately, the human capital indicators proposed in this paper can equally be used for this purpose as comparisons, both in level and growth rate terms, can be between Canada and other countries.

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