Report of Main Methodological Findings Based on Research Conducted as Visiting Researcher at the Gund Institute for Ecological Economics

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Introduction

This report aims to summarize main findings from the research conducted during a 4 month assignment as a research assistant and instructor for a graduate course on alternative indicators of progress at the Gund Institute for Ecological Economics, University of Vermont, in 2014. Research and development of many of the original ideas described in this report are on-going. This report summarizes of the key findings concluded during the sabbatical period.

Research into alternative indicators of progress requires building upon a conceptual framework as the basis for selecting and defining variables and for setting the scope for the project. For this research, the framework behind the Genuine Progress Indicator (previously known as the Index of Sustainable Economic Welfare, or ISEW) was adopted as the organizing framework for compiling an extensive collection of data series (more than 100 indicators compiled for each of the 50 U.S. states and the District of Colombia) and for reviewing the potential key indicators and their integration into a single metric for assessing sustainable economic progress. The empirical work conducted was used for testing the feasibility and reliability of the framework and associated indicators as alternative indicators of progress of societies.

The purpose of analysis in this report is to scrutinize the methodologies developed and tested through this research. The literature on the Genuine Progress Indicator (GPI) is disparate and inconsistent on some particular variables and issues. There is no single GPI construction or clearly defined and universally agreed conceptual scope for its measurement. Therefore, one of the objectives for this research was to further develop the indicators towards an agreed set of measurement principles defining the GPI as an alternative indicator for assessing progress of societies around the world that is measured consistently and comparably across studies. A general conclusion that could be drawn from this report is that the development of a coherent GPI measurement framework remains a work-in-progress. However, this should not be discouraging because the GPI contains several unique features and contains indicators raise issues that otherwise tend to be overlooked in the literature on alternative approaches to measurement of progress.

Although the empirical dimension of the research focused on compiling values at the U.S. state level, the methodologies and concepts described in this report are applicable at different scales of analysis from national to regional and also for other countries of all levels of development. Moreover, GPI is not an alternative the so-called "dashboard" approach of selecting a list of key indicators for monitoring within a single database. The GPI is a dashboard of indicators, but with the added benefit of a conceptual and statistical framework for integrating those measures so that analysts can understand their relationships and

their relative impact on the overall well-being of a society and to produce a new broad aggregate indicator of economic welfare to complement GDP. GPI has the potential to be a unifying framework for integrating information across many different indicators that are related but otherwise are only presented disparately and for which there are currently no other existing analytical frameworks that integrate the information for producing alternative indicators that take into account the same scope of facets dimensions of development progress.

This report singles out a selection of some of the indicators particularly important to this research for the methodological or conceptual conclusions resulting from this research.

Personal Consumption Expenditure (PCE)

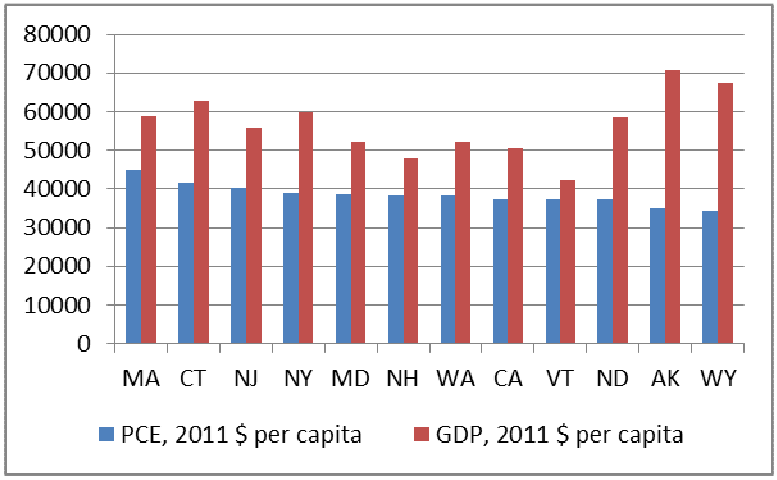
GPI adopts the generally accepted assumption that, on average, individuals increase their well-being through the voluntary use of income for consumption of goods and services. Accepting this assumption does not preempt the fact that individuals also increase well-being by other means, and many other such benefits, which are not accounted for as goods and services within the boundaries of national income accounting, are included as variables within this framework as described below. Additionally, since consumption expenditure and other flow indicators of flows from the national accounts measured in gross terms) do not inherently reflect the sustainability of these flows, further adjustments are considered, some of which are discussed in the following sections of the report, to account for sustainability of the consumption choices of individuals in each state, country, or region.

However, the starting point for the GPI framework, upon which all other additions or subtractions are considered, is consumption expenditure by resident households on economic goods and services as defined by national accounting. The measure for consumption by residents is based on the valuation of the concept household actual consumption expenditure as described in detail in the System of National Accounts (SNA). However, for the United States, the Bureau of Economic Analysis (BEA) reports an indicator that is technically different in details as compared to the accounting recommendations of the SNA. The BEA produces an indicator called Personal Consumption Expenditure (PCE) slightly different in scope than household actual consumption expenditure. But, for the purposes of this research, these differences are not significant and PCE is a reasonable approximation of household actual consumption expenditure as measured for the economies of other countries. Prior to the initiation of this research, the BEA published PCE at the State level for all 50 states in the United States of America, on a trial basis, for 2011.

This consumption basis for GPI distinguishes the framework as compared to other alternative indicator frameworks because the other current frameworks recognized as broader indicators complementing GDP have focused either on adjustments to production (e.g. adjusted measures of net domestic production) or adjustments to capital or investment (e.g. net adjusted savings, formerly called "genuine savings"). GPI is unique in providing an aggregate economic welfare measure based on the perspective of final consumption of goods and services and other indicators of flow benefits to individuals in the economy. In principle, the GPI presents the possibility for a more direct measurement of welfare as compared to other broad economic indicators used by analysts and policy-makers.

Of course, a relationship between consumption of goods and services and production should be expected since production is the source of income that can be used for consumption expenditure. However, there are important differences across the states (and between countries and regions of the world) with respect to the ratios between values of per capita consumption and per capita GDP. For example, California ranks 8th in PCE per capita but only 19th among the 50 states for per capita GDP. Several of the top ranking states for gross output, such as Alaska, Wyoming and North Dakota, which rank 2nd, 3rd, and 6th among all US states in per capita GDP, consume at rates much closer to the lowest income states in the country. One explanation for these variances between levels of production and consumption among the highest ranking states in terms of output is that the actual income from the production in some of these states is accrued to residents elsewhere. This is likely an important factor for the states, such as Alaska, Wyoming and North Dakota which have large shares of their outputs coming from exporting natural resources to other states or regions. Other factors could include effects of income inequality on aggregate consumption expenditure and variance in rates of saving. These examples underscore the rationale for considering an adjusted measurement of consumption expenditure for assessing economic welfare of the states in addition to GDP. These issues associated with potential impacts of natural resources and income inequality on welfare are not evident from looking only at GDP values.

Figure 1: Top ranking states in per capita production and consumption



Income Inequality

Inequality measurement is one of the most complex elements for integration into the GPI. Unlike with all other variables, no attempt is made in the previous GPI studies to calculate a monetary value for income inequality. Instead, an inequality measure is multiplied by PCE, creating an adjusted index for consumption expenditure, weighted according to the income inequality in each state.

The measure for income inequality used in the previous GPI studies is the ratio of the actual Gini coefficient value with a presumed ideal or desirable Gini value, such as a historical minimum level of income inequality as calculated by the Gini coefficient for other years or locations. The use of the Gini

coefficient has been criticized as a sometimes crude and potentially subjective approach to inequality measurement. However, the Gini value is a practical solution for the purpose in the GPI framework because the Gini is a relative value for inequality, which is suitable since the index is used in this framework as a weighting factor. Gini coefficient values are calculated for the 50 U.S. states by the U.S. Census Bureau's American Communities Survey (ACS). Nationally and for the period from 1960-2012, the minimum value for the Gini coefficient (least inequality) was 0.38 , recorded in 1969. The maximum Gini coefficient value was 0.44 (recorded in 2006 and 2010). In 2011, the most unequal state as measured by the Gini coefficient was Wyoming (0.475) and the least income inequality for 2011 was in New York State (0.533).

Other possibilities for measuring income inequality in the GPI include measurement of redundancy or randomness in the income distribution data (Thiel index) or application of the Atkinson index of income distribution. A particularly interesting alternative approach, based on the Atkinson index, was inspired by research by Layard et al. (2008)[1], which measures elasticity of marginal utility of income. The idea is to utilize an empirically-grounded approximation of the diminishing returns relationship between income and self-reported well-being statistics to discount values of marginal consumption expenditure for higher income individuals with respect to the lower 50 percentile group of resident income owners. Although this is a novel approach to inequality measurement, the concept is well grounded in economic theory, for example work from Arthur Pigou and many of the classical economists, who pointed out that the logical conclusion from diminishing returns was that income growth affects different income groups differently. Pigou questioned whether economic growth without a proportionate benefit to the lower classes can be, *a priori*, classified as a welfare improvement for that population at all. The disregard for this question is a major limitation of GDP as a general indicator for economic progress and including an inequality adjustment in the GPI, whether through the relatively simple application of the Gini coefficient or through the measurement of marginal utility of income, is a way of incorporating this issue into the measurement of economic progress.

Underemployment

Unemployment or underemployment potentially affects welfare of societies in ways not reflected in consumption expenditure and thus a variety of employment-related measures were included in the data compilations for this research. The concept of "underemployment", as applied in previous GPI studies in the United States, is the sum of categories presented in the "alternative measures of labor underutilisation" table, available with annual statistics for each State by the Bureau of Labor Statistics (BLS). These categories include the unemployed and also people who are “marginally" employed or discouraged (e.g. part-time employed people who would prefer full-time work). The rates for the unemployed plus the marginally employed are used with data for each state on the size of the labor force in each state to calculate estimates of the numbers of persons unemployed or marginally employed in each state. These numbers are weighted by the wage rates in each state.

The reason for weighting the underemployment values by average wages is not, as might be naturally assumed, an opportunity cost valuation approach to underemployment. Weighting the rates according to

[1] "The Marginal Utility of Income", Journal of Public Economics 92 (2008) 1846–1857

average wages can be used as a method to approximate expected relationship between average wage rates and the state or regional economic demand context for time or employment (the same reasoning is applied for weighting the time use variables, see below). A strict opportunity cost rationale for integrating time use in GPI is problematic for many reasons; one being that it creates multiple possibilities of double-counting with consumption expenditure or other GPI variables. Also, no one is able or willing to work or do any other activity for 24 hours a day, and so trade-offs of time are inevitable and not subject to continuous opportunity costs evaluation in the real world. These same concepts apply for the time use indicators described below, in which average wages are also used for valuation factors.

Average wage rates vary significantly from state to state. Average wage rates are calculated for all industries by the BLS annually for each State. Calculations are also available for the 10th, 25th, 75th, and 90th percentile wages , so variations on the weighting factors of time use elements of GPI can be done without sacrificing comparability. As part of this research, sensitivity tests were conducted on the use of average wages for an underemployment variable as well as for other variables in the time use cluster. The tests assessed how utilizing average wages (as compared to other rates, such as the top 25 percentile and bottom 25 percentile rates) affect the results for the indicators and for the overall computation of GPI. Average wages hug closely in value and trend with the wages of all groups of employed persons, with the exception of the top 25 percentile. The top 25 percentile displays a different trend in the United States. During the period tested (2004-2012) the wage for the top 25 percentile wage earners grew at a significantly faster rate than the rest of the employed population. Given this difference, it is not sensible to use the top 25 percentile group as marker for weighting costs associated with the unemployed. The average wage rate, however, appears to be appropriate, assuming that underemployment affects the whole population.

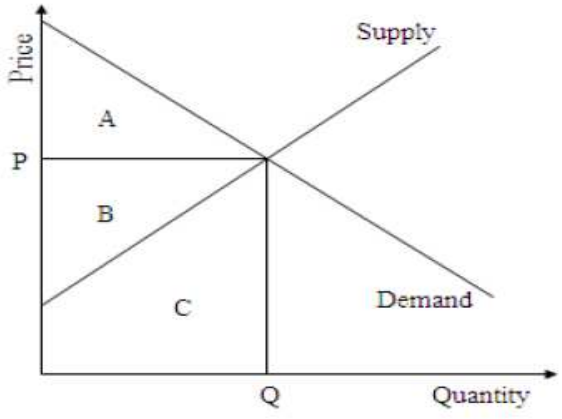
Incidentally, the highest rate of underemployment during the past 10 years in the United States was 2011 (at 15.9%), the time period used for compilation of all the data in this is study. As already mentioned, one reason for incorporating underemployment data in the index is because the social costs of underemployment not reflected by PCE are varied and difficult to pin down to specific measureable effects. They may include indirect effects, such as impacts on crime rates. For the purpose of testing this theory, the values used in the framework were converted into indices, comparable across the states to test for correlations. Remarkably, there was no significant correlation between our calculations of per capita costs of crime with underemployment, but there is a moderate correlation between crime and inequality, suggesting that it is general income inequality, more than underemployment, that may be a good indicator for predicting social costs of crime.

Valuation of Ecosystem Services

Ecosystem services are the positive externalities provided by nature. They are unvalued in consumption expenditure (or GDP) but crucial inputs into the sustainable wellbeing of households. The central challenge for incorporating the flows of ecosystem services into the GPI framework is valuation. Standard unit values for land use or land cover classes that have been used in previous GPI studies cannot be used in a database compilation across states or countries or regions because the evaluation in each case needs to incorporate both information on land use, information of the condition of that land or resource and the demand for its benefits from the proximate communities.

The supply side of the equation is the capacity of ecosystems for providing benefits. Some statistics were compiled for this research that can be used for assessing ecosystem capacities, including the extent (area) of selected land cover or land use categories (wetlands, farmland and forests) and information on water and air quality. The demand side of the equation represents the actual demand for benefits from the ecosystems. A remote ecosystem that is almost never visited by humans provides different, and probably fewer, benefits to a town or city on the opposite side of a state or country as compared to the ecosystems that are adjacent to that community that are the source of freshwater, wood, and other services such as air filtration and natural protections against natural disasters and extreme weather. The GPI studies of the past have collected little information of value for assessing the actual flows of benefits from wetlands or forests or other natural areas to the beneficiary households. Instead, GPI studies have depended on synthesis studies of previous research into valuation of ecosystem services under certain conditions for specific areas. Additional, the conceptual foundation for defining the values for ecosystem services flows has not been very well specified for GPI or in any of the other alternative indicators frameworks.

The figure below is a simplified description of the supply and demand relationship and the determination of a prices (P) through the two market forces. In this simplified presentation, the supply curve is essentially reflective of the costs of production and the area above the supply curve and below the price (area 'B') represent the amount of the profit motive for suppliers to produce the good or service, also known as the producer's surplus. Conversely, area 'A' is the consumer's surplus because consumers would have been theoretically willing to pay the prices for each unit of quantity up to the demand curve. A strict willingness-to-pay (WTP) valuation of goods or services would include the area 'A', making the valuation apparently incomparable with market price valuation by ignoring the possibility for consumer surplus. Similarly, and conversely, valuation based strictly on costs of production would seem to ignore the profit incentive (area 'B') of suppliers. However, cost of production valuation is exactly the principle that is used in the national account for the case of non-market goods and services supplied by governments and non-profit institutions.



While a WTP approach to valuation has been criticized based on the need to exclude consumer surpluses, presumably a similar argument could be used against a costs of production valuation, which is already instituted for national accounts according to the SNA. There are certain exceptional cases in the SNA where costs of production values are marginally inflated to account for a producers surplus value, known

as a valuation "mark-up". But the SNA is very explicit that the accounts should not include estimations of mark-ups (i.e. approximations for producers surplus) for non-market goods and services provided by the public sector or by non-profit institutions. This is the case, for example, for freshwater and electricity provided by public utilities as well as other government services including public education, health care, and so on. The SNA does not provide any specific rationale for adhering to a costs-of-production principle for valuation of non-market goods and services from government and non-profit institutions. One potential explanation is that it is generally the nature of non-market goods and services that they could only be supplied by the public sector or by non-profit institutions, therefore making t a producers surplus practically impossible. Inevitably, the "price" for non-market goods and services provide from government must be equivalent for all consumers and the producers surplus is necessarily negligible. This means that, unlike for the case of WTP and the consumers surplus, applying a costs of production valuation, thereby making negligible the producers surplus, may be appropriate for non-market goods and serice provided by government. It is easy to see how the same logic must apply for ecosystem services since ecosystems also cannot realistically demand a producer's surplus in exchange for supply benefits.

There are significant costs associated with supply of ecosystem services incurred by both public and private sectors, related to the protection of the quality of ecosystems and management against negative impacts from the tragedy of the commons. They include expenditures on protected areas and management of waste and emissions of all kinds and may include expenditures by non-profit institutions that aim to protect natural capital as part of public goods. These types of costs are reflected disparately in production accounting and will not be reflected in the indicator for household consumption expenditure. Indeed, currently there are not even clear international recommendations for how to calculated environmental protection expenditures comparably across countries.

For this research, a selected set of variables have been included in this research that can be used to estimate a portion of the costs associated with delivery of ecosystems services to the populations in each of the 50 U.S. states. Those values include: costs associated with enforcing emissions standards for automobiles, costs associated with managing solid waste, costs associated with managing wastewater, and estimated losses associated with rivers and lakes officially designated by the environmental protection agency as degraded water bodies.

The compilation of these valuations in this project are just a starting point for a more expansive assessment of costs of production for non-market benefits from ecosystems, which could be gradually expanded and seamlessly incorporated into this GPI framework.

Consumption and Capital

An interesting issue raised implicitly in the GPI framework and unaddressed in other indicator frameworks is the relationship between household consumption and capital? Although, in economics, capital is generally defined as the crucial input for production, along with labor, sometimes capital is consumed through consumption activities as well. For example, transportation infrastructure (e.g. roads and highways) are marginally depreciated when households use the infrastructure to transport themselves to their various activities. However, in the SNA, using up of capital (i.e. depreciation) is accounted for

only in relations to production. The difference between production in gross and net terms is depreciation of capital during the period. There is no concept of net consumption in the SNA but when developing a consumption-based indicator for sustainable wellbeing of societies, it is reasonable and appropriate to consider accounting for consumption of capital associated with consumption of goods and services by households, e.g. depreciation of roads and highways, in order to insert the dimension of sustainability into the measurement framework.

The BEA estimates depreciation rates for public roads and highways at .0202, with an average service life of 45 years. This information can be used in combination with statistics on commuting by households and miles of highways and roads in each state to estimate the portion associated with consumption activities based on and calculate annual values for depreciation for highways and roads from household consumption. This and other such calculations of depreciation associated with consumption would be unprecedented in national accounting but could ultimately serve towards making calculations of depreciation in general and net production more accurate and available, which is a crucial step necessary to improve the calculation of sustainable income.

There are wide differences in amounts of time spent by households commuting, carpooling and use of public transportation and in the amount of miles of highways in total or in per capita across states and regions and these are factors affecting the rate of depreciation of public transportation infrastructure through private consumption by households . Whereas the southern region of the United States has the most miles of total highways in the country, the Midwestern states easily ranks first in per capita terms, with a startling number of 400 miles of highways per Midwestern resident.

Depreciation of public transportation infrastructure is just one example (among potentially many) of capital that is used up not only from production activities but also consumption. However, testing this example could provide an original precedent for investigating possible methodologies for incorporating other types of depletion of capital into adjustment measures of consumption of goods and services by households.

Another issue relevant to exploring the relationship between capital and consumption is measurement of economic progress in the situation of a disaster or extreme event. One of the common examples of criticism against relying on GDP is the possibility that a disaster such as a extreme storm or an oil spill could actually result in an increase to GDP since the associated clean-up costs are considered productive activities and the losses to capital will only be reflected indirectly, if at all, in future accounting periods. Catastrophic losses to capital are not incorporated into the adjusted of production from gross to net terms in the national accounts, so the impacts from an oil spill are not even accounted in net domestic product. Moreover, if the expenses to replace lost capital are recovered from other states or countries, the impacts of a disaster on an economy from the consumption or welfare perspective may never be clearly evident from the national accounts figures. This complicates the possibility for responding to the demand for statistics on how disasters and other adverse circumstances impact economies.

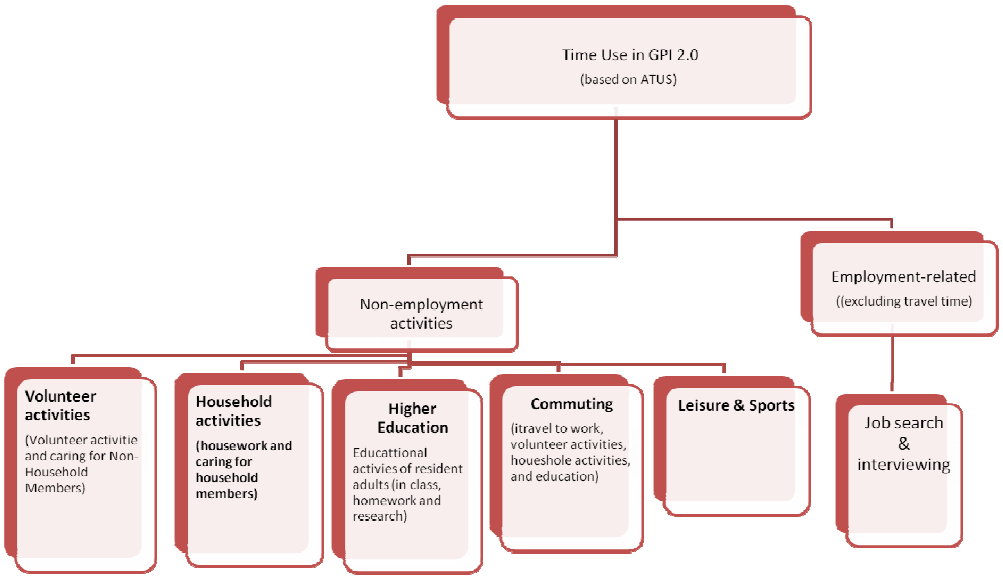
Although no attempt has yet been made in the GPI studies to incorporate the effects of disasters on consumption, this research included an indicator for assessing the costs associated with motor vehicle crashes. The expenses from motor vehicle crashes (e.g. health care costs and repairing damages) will be accounted for already in consumption expenditure and so the idea for this study was to subtract those expense back out from the adjusted consumption indicator as capital loss replacement and therefore

welfare neutral expenses. Other examples of consumption expenditure associated with losses to capital from external events, such as natural disasters, could be similarly treated in the GPI. This applies only to consumption expenditure aimed at recovering capital lost from catastrophic events. All other types of consumption expenditure should not be judged subjectively for their relevance to welfare improvement because personal consumption is a private and voluntary activity and it should not be the role of statisticians or economists to prejudice certain types of consumption above others.

Time Use

Figure 1 below describes a proposed framework, developed though this research for compilation of time use data for producing time use-adjusted indicators of progress. This framework utilized the terminologies of the American Time Use Survey (ATUS). The ATUS framework differs slightly, but is broadly coherent and comparable, with the International Classificiation for Time Use Surveys (ICATUS)[2]

Figure 1: Proposed GPI 2.0 Framework for Time Use



Employment and Leisure

[2] Simultaneously with this research project, the United Nations Statistics Division (UNSD) was leading a revision to the Guideline the classification. Our research team had regular interactions with the experts at UNSD on this topic to promote alignment of concepts. UNSD's revision work is ongoing.

In structuring the different categories of time use, the highest level distinction made in ATUS and in the past GPI studies is between time spent on work or work-related activities and all other (non-employment) activities. In principle, the accounting for benefits of time spent working are already included in GPI via consumption expenditure. However, there was an attempt in previous GPI studies to estimate unemployment or underemployment indirectly as time use elements via concepts of estimating time spent on "provided" and "unprovided" hours by the labor force. This method produced unreliable values and also ignored the possibility for double-counting with values for consumption expenditure. A more appropriate method for incorporating unemployment and underemployment in GPI is via adjustments for external social costs associated with underemployment as described earlier in this report. For the same reasons, an appropriate method for incorporating leisure into the framework is not as a residual of hours spent not working, but as observed time actually spent on activities classified as leisure according to ATUS and that objectively provide non-market benefits to households.

ATUS has a category called leisure and sports, which include time spent socializing, relaxing, participating in sports and exercising as well as attending sports events and watching TV, and so on. It is assumed that this entire category can reasonably and objectively be applied directly to a welfare-enhancing leisure time variable for GPI. The general rationale for including leisure time as additional value in GPI is based on the assumption that this is welfare-enhancing time use that may be unvalued in consumption expenditure. ATUS estimates that the average adult in the United States spends more than 5 hours per day on leisure and sports, easily the largest portion of time use among the time use categories in GPI, except employment.

There is another perspective from which unemployment or underemployment is relevant to the time use cluster of GPI indicators. Time spent searching for a job could be viewed as a positive influence to welfare because it is a generally productive activity from a welfare perspective, although not reflected in production or consumption expenditure. There are data available from ATUS for time spent on searching for work, including interviewing and a valuation of this time can be included as an additive value in GPI that reflects time use of the unemployed or underemployed. Although time use on searching for work is quite small on average (since it usually only applies to a portion of the population) and thus, in normal circumstance may have a fairly negligible impact on overall valuations for time use or for GPI, it is still sensible to include this category for completeness. For the small portion of the population that do spend time searching for work, who are, by definition, considered part of the labor force, time spent on job searching can be quite significant, averaging up to about 2 1/2 hours per day.

Household activities

Services provided by household members on “own account", meaning for own consumption within the household, are not included within the national accounts production boundary and therefore are excluded from consumption expenditure. Including own account household services activities as an additive value in GPI may be supported with 2 separate rationales , which are complementary but may imply different approaches to valuation :

(i) to expand the scope of consumption expenditure to include these services produced for own-consumption and thus adjust the value of consumption expenditure for this broader (and, arguably, more complete and consistent) scope of economic activity;

(ii) to incorporate the external (non-market) social values to society derived time spent on activities like housework and caring for family members.

Within the ATUS classification for time use, applicable categories for measuring the own account services of household are: "household activities" and "caring for and helping household members". When, summed together, and excluding the time spent on travel related to these activities, ATUS estimates that the average adult spends between 2 and 2 1/2 hours per day on household activities.

Volunteering

ATUS has a separate classification for caring for non-household family members and although this refers to essentially the same types of activities as in the caring for and helping household members class, it is presumed that this time is mo more relevant to the volunteering category for this framework. A more complete conceptual foundation for defining (and for valuing) the relevance of volunteering in GPI is needed, but meanwhile the recommendation is simply to stick closely with the ATUS classification. There is also a category in ATUS called volunteer activities, which is part of the broader class of activities labeled: "organizational, civic, and religious activities". For the period between 2003 and 2012, volunteer activities makes up about 50% of time spent for this broader class, averaging about 10 minutes per day. When combined with time use on caring for non-household family members , adults volunteer about 15 minutes per day, on average.

As with the housework variable, there are two distinct rationale for including volunteer time in GPI, both of which are additive with consumption expenditure. First is the theory that a culture of volunteerism is a desirable trait for a society that creates positive externalities (value beyond the benefit of output of goods and services that volunteers contribute to producing. In principle, and unlike with household services, the economic output produced by volunteers is already accounted for in national accounts. However, there is reason to believe that this output is under-valued , particularly for the case of volunteer work for non profits serving households (NPISHs). This is because (as discussed in the section above on ecosystem services) the output of NPISHs is valued for consumption expenditure based on operating expenses, which normally would not fully account for the contributions of volunteers, because they are provided for free. Therefore, hours spent by volunteers at NPISHs could be added to calculate an adjusted (and more complete) calculation of consumption expenditure in the same way as household activities.

Higher Education

Higher education is not treated as a time use variable in the GPI framework. However, past GPI studies have generally included an indicator for valuing the count of residents in each State already holding higher education degrees. The same rationale should apply for time spent by adults on education. The ATUS provides statistics on time used by adults on education (including time spent in class, homework and research, and related travel). According to ATUS, resident adults in the United State spend, on average and excluded travel, slightly less than 30 minutes per day on education. Among just the adults engaged in higher education, the average daily time spent is slightly over 5 hours.

Commuting

In ATUS, there is no separate class for commuting or travel. Instead, each major category includes a sub-class for travel related to that activity. Time use values selected from the most relevant categories, i.e. travel related to work, travel related to education, etc., can be summed to produce a measure of commuting or travel-related time use (and then subtracted from the totals for those elements to avoid double-counting). The general concept for this variable is that commuting is a welfare degrading, use of time because it is regrettable and usually unproductive (excluding, e.g., professional drivers,which would be time use under the employment category). Some travel may actually be a form of leisure in some cases, but these forms of commuting can be excluded by being selective on travel related to which ATUS categories are included.

Commuting also directly results in several negative externalities that affect the welfare of residents. The data compiled for this study show strong correlations between time spent on non-carpool and non-public

transportation commuting with indicators of air pollution and consumption of petroleum fuels (there is obviously also a correlation with costs from motor vehicle crashes). Further analysis is needed to understand how these relationships should be used for determine the correct and most efficient approach for valuing the negative externalities from commuting into the framework.

Valuation of time use

From the above discussion, we arrive at the basic list of activities presented in the figure at top of this section, which are productive from the perspective of a broader measure of welfare (or from the perspective of GPI) but unvalued (or undervalued) in consumption expenditure, plus one activity (commuting) that represents unvalued (or undervalued) costs to welfare. Time use statistics are available for each State annually from ATUS. The general approach to valuing these time use elements is to use average wages.

The advantage of utilizing average wage rates for valuation in the time use cluster is the different categories of time use activities are each valued in the same way, thus minimizing subjectivity with respect to time use. An exception to this must be made for the commuting time use variable. This exception is justified not only because it is the unique example of a cost element in the time use cluster but also because, as explained above, the purpose for including this as an element in the time use cluster is to integrate into GPI valued for several of the associated external costs traditionally included in separate GPI indicators, e.g. costs of motor vehicle crashes and consumption of petroleum. Although some further research and experimentation is needed, this valuation seems to be very feasible for a comprehensive compilation for time use cluster in this alternative indicators framework.