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AN ASSESSMENT OF THE VALUATION METHODS USED TO CALCULATE THE INDEX OF SUSTAINABLE ECONOMIC WELFARE (ISEW), GENUINE PROGRESS INDICATOR (GPI), AND SUSTAINABLE NET BENEFIT INDEX (SNBI)

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Abstract. For some time now, ecological economists have been putting forward a 'threshold hypothesis' – the notion that when macroeconomic systems expand beyond a certain size, the additional cost of growth exceeds the flow of additional benefits. In order to support their belief, ecological economists have developed a number of similar indexes to measure and compare the benefits and costs of growth (e.g., the Index of Sustainable Economic Welfare and the Genuine Progress Indicator). In virtually every instance where an index of this type has been calculated for a particular country, the movement of the index appears to reinforce the existence of the threshold hypothesis. Of late, a number of observers have expressed concerns about whether these alternative indexes reflect concrete reality or the prejudices of ecological economists. In view of these concerns, this paper closely examines the valuation methods used in the calculation the Index of Sustainable Economic Welfare, the Genuine Progress Indicator, and the Sustainable Net Benefit Index. It is argued that a consistent and more robust set of valuation techniques is required in order for these alternative indexes to gain broad acceptability.

Key words: genuine progress indicator, index of sustainable economic welfare, national income, valuation methods.

1. Introduction

Believing that the continued growth of macroeconomic systems is both ecologically unsustainable and existentially undesirable, ecological economists have put forward a 'threshold hypothesis' – the notion that when macroeconomic systems expand beyond a certain size, the additional benefits of growth are exceeded by the attendant costs (Max-Neef, 1995). In order to support their belief, ecological economists have developed a number of indexes to measure and compare the benefits and costs of growth. The first to be developed was the Index of Sustainable Economic Welfare (ISEW).

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Initially calculated for the USA (Daly and Cobb, 1989), the ISEW has also been calculated for a range of industrialised nations and a small number of less-developed countries. Primarily to increase its public appeal, the ISEW was given a new name – a Genuine Progress Indicator or GPI (Redefining Progress, 1995). More recently, the ISEW has been labelled a Sustainable Net Benefit Index or SNBI to reflect its theoretical underpinnings (Lawn and Sanders, 1999; Lawn, 2000a). In the process, many of the methods used in the calculation of these alternative indexes have been revised.

Irrespective of whether the ISEW, GPI, or SNBI has been calculated for a particular country, the trend movement in the chosen index consistently reveals that, up to a point, the growth of macroeconomic systems is beneficial to human well-being. Beyond this point, growth appears to be detrimental (Max-Neef, 1995; Jackson and Stymne, 1996; Lawn, 2000a) (see Figure 1). Although ecological economists openly admit that the ISEW, GPI, and SNBI are not without their imperfections, they nonetheless believe that these indexes offer solid support for the threshold hypothesis and the need for countries to abandon the growth objective in favour of sufficiency, equity, and natural capital maintenance.

Some recent articles (e.g., Atkinson, 1995; Neumayer, 1999, 2000) have called into question: (a) the supposed lack of a theoretical foundation to support the ISEW, GPI, and SNBI; and (b) the methods used to calculate the individual items that make up these alternative indexes. They also cast doubt over whether such indexes substantiate the threshold hypothesis (e.g., Neumayer, 2000). A recent response to (a) demonstrates that the ISEW, GPI, and SNBI are entirely consistent with Fisher's (1906) widely accepted concept of income and capital (Lawn, 2003). As such, these alternative indexes have a perfectly sound theoretical foundation – indeed, more so than conventional measures of national income. There has, however, been a lack of an adequate reply to criticisms regarding valuation methods. This paper aims to deal with such criticisms. Overall, it is demonstrated that many of the methods used are legitimate; that a small number of valuation methods are questionable and require considerable refinement or replacement; and that there is an urgent need to establish a consistent set of valuation techniques along similar lines to the way in which the United Nations System of National Accounts (SNA) is used to calculate Gross Domestic Product (GDP).

2. The Index of Sustainable Economic Welfare (ISEW), the Genuine Progress Indicator (GPI), and the Sustainable Net Benefit Index (SNBI)

Before delving into the methods used to calculate the ISEW, GPI, and SNBI, I will briefly mention what these indexes attempt to measure and how they are compiled.

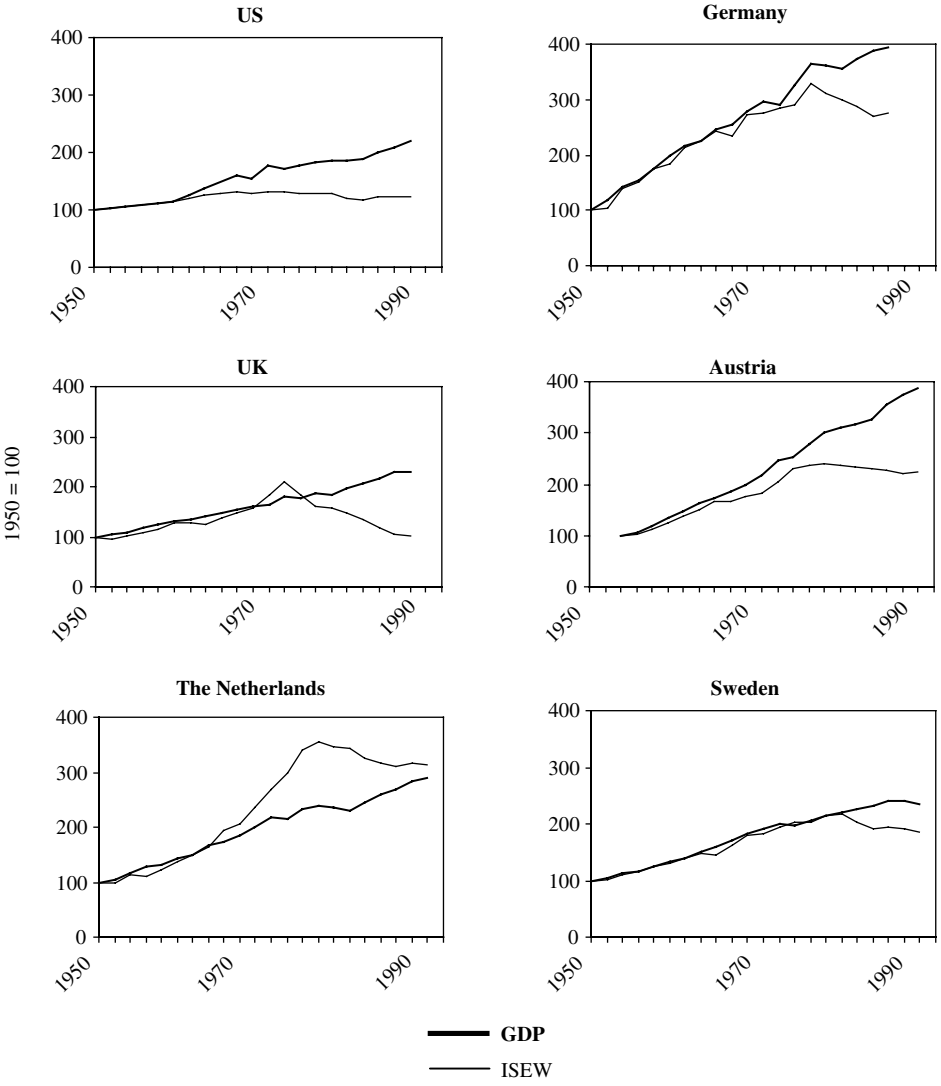

Figure 1. Comparison of GDP and ISEW for the US, Germany, UK, Austria, The Netherlands, and Sweden (Jackson, T. and Stymne, S. (1996) *Sustainable Economic Welfare in Sweden: A Pilot Index 1950–1992*, Stockholm Environment Institute, The New Economics Foundation).

2.1. Index of Sustainable Economic Welfare (ISEW) and the Genuine Progress Indicator (GPI)

The ISEW and GPI are designed to more closely approximate the sustainable economic welfare or progress of a nation's citizens. The sustainable economic welfare implied here is the welfare a nation enjoys at a *particular*

point in time given the impact of past and present activities. The notion of sustainable economic welfare being approximated is critical. For example, imagine two comparable industrialised nations – one that had long ago made the structural adjustment to operate both sustainably and equitably; the other which had not. In view of the notion of sustainable economic welfare outlined above, the ISEW or GPI of the former would presumably be lower in the past to reflect the cost of structural adjustment, but considerably higher in the present to reflect the ensuing benefits and the deceleration of increasing social and environmental costs.

What about the actual calculation of the ISEW and GPI? Unlike most 'green' measures of national income, the ISEW and GPI do not begin with GDP as their base. For reasons soon to be outlined, both indexes start with private consumption expenditure. Additional transactions deemed directly relevant to human well-being are then extracted from the national accounts and added or subtracted depending on whether they constitute welfare benefits or costs (Redefining Progress, 1995). Further adjustments are made to account for a number of social and environmental benefits and costs that escape market valuation. The following is a list of the typical items used in the calculation of the ISEW and GPI (Table I).

Table I includes a range of positive and negative items that are summed to obtain a final index number. All items are valued in monetary terms, as are the ISEW and GPI. The final index number is usually calculated in real rather than nominal values. The ISEW and GPI basically differ in name only. It is becoming increasingly common for updated calculations to be referred to as the GPI. If one compares the original ISEW with recent calculations of the GPI, the list of items used to arrive at the final index number has varied over time, as have some of the valuation methods. One also finds a difference in the valuation methods used to calculate the ISEW and GPI for different countries (see, for instance, Diefenbacher, 1994; Moffatt and Wilson, 1994; Rosenberg and Oegema, 1995; Jackson and Stymne, 1996; Jackson et al., 1997; Guenno and Tiezzi, 1998; Castaneda, 1999; Hamilton, 1999). The reasons for these differences are usually related to the availability of data and the preference researchers have for specific valuation methods.

2.2. Sustainable Net Benefit Index (SNBI)

The SNBI is much the same as the ISEW and GPI. Where the SNBI differs is in the explanation of the rationale for an alternative index and the presentation of the items used in its calculation (Lawn and Sanders, 1999; Lawn, 2000a). The items, which are similar to those listed in Table I, are sorted into so-called 'uncancelled benefit' and 'uncancelled cost' accounts (see Table II). The uncancelled benefit account measures the net psychic

TABLE I. Items used to calculate the GPI for USA from 1950 to 1995.

Private consumption expenditure (+)
Index of distributional inequality (+/−)
Weighted personal consumption expenditure
Cost of consumer durables (−)
Services yielded by consumer durables (+)
Services yielded by roads and highways (+)
Services provided by volunteer work (+)
Services provided by non-paid household work (+)
Public expenditure on health and education counted as personal consumption (+)
Cost of noise pollution (−)
Cost of commuting (−)
Cost of crime (−)
Cost of underemployment (−)
Cost of lost leisure time (−)
The cost of household pollution abatement (−)
The cost of vehicle accidents (−)
The cost of family breakdown (−)
Net capital investment (+/−)
Net foreign lending/borrowing (+/−)
Loss of farmland (−)
Cost of resource depletion (−)
Cost of ozone depletion (−)
Cost of air pollution (−)
Cost of water pollution (−)
Cost of long-term environmental damage (−)
Loss of wetlands (−)
Loss of old-growth forests (−)
Total = sum of all positive and negative items = GPI (valued in dollars)
(+) = positive item (−) = negative item (+/−) = item that may be either positive or negative

Source: Redefining Progress (1995).

income generated by economic activity – in effect, the sum total of all the psychic income-yielding aspects of the economic process (e.g., private consumption expenditure, services yielded by consumer durables, and services provided by volunteer and non-paid household work) less the sum total of its irksome or psychic outgo-related aspects (e.g., the cost of noise pollution, the cost of commuting, and the cost of crime). Net psychic income can be considered the uncancelled benefit of economic activity because if one traces the economic process from its original source (natural capital) to its final conclusion, every transaction involves the cancelling out of a receipt and expenditure of the same magnitude (i.e., a seller receives what a buyer pays). Only once a physical good is in the possession of the final consumer is there no further exchange and, thus, no further cancelling out of transactions. Apart from the good itself, what remains at the end of the process is the uncancelled exchange value of the psychic income the ultimate consumer expects to gain from the good plus any psychic disbenefits

TABLE II. Items included in the uncancelled benefit (net psychic income) and uncancelled cost (lost natural capital services) accounts – used to calculate the SNBI for Australia from 1966–1967 to 1994–1995.

	$	$	$	$
Uncancelled benefit account				
Psychic income items				
Private consumption expenditure (+)	X			
Index of distributional inequality (+/−)	X			
Weighted private consumption expenditure	X			
Services yielded by consumer durables (+)	X			
Services yielded by public dwellings (+)	X			
Services yielded by roads and highways (+)	X			
Services provided by volunteer work (+)	X			
Services provided by non-paid household work (+)	X			
Public expenditure on health and education counted as private consumption (+)	X			
Imputed value of leisure time (+)	X			
Net producer goods growth (+/−)	X			
Change in net international position (net foreign lending/borrowing) (+/−)	X			
Total psychic income = $\sum$ psychic income items = XXXX		XXXX		
Psychic outgo items				
Cost of consumer durables (−)	X			
Defensive private health and education expenditure (−)	X			
Cost of private vehicle accidents (−)	X			
Cost of noise pollution (−)	X			
Disamenity cost of air pollution (−)	X			
Cost of commuting (−)	X			
Cost of crime (−)	X			
Cost of family breakdown (−)	X			
Cost of underemployment (−)	X			
Cost of unemployment (−)	X			
Total psychic outgo = $\sum$ psychic outgo items = XXX		XXX		
Net psychic income = total psychic income − total psychic outgo = XXXX − XXX = AAA			AAA	

Uncancelled cost account				
Lost source function items				
User cost of non-renewable resources (metallic minerals, coal, oil and gas, and Non-metallic minerals) (−)	Y			
Loss of agricultural land (−)	Y			
Net change in timber stocks (−/+)	Y			
Net change in fishery stocks (−/+)	Y			
Cost of degraded wetlands, mangroves, and saltmarshes (−)	Y			
Total lost source function = ∑ lost source function items = YY		YY		
Lost sink function items				
Cost of water pollution (−)	Y			
Cost of air pollution (−)	Y			
Cost of solid waste pollution (−)	Y			
Cost of ozone depletion (−)	Y			
Total lost sink function = ∑ lost sink function items = YY		YY		
Lost life-support services function items				
Cost of long-term environmental damage (−)	Y			
Ecosystem health index (+/−)	Y			
Total lost life-support function = ∑ lost life-support function items = YY		YY		
Lost natural capital services = lost source function + lost sink function + lost life-support function = YY + YY + YY = BBB			BBB	
Sustainable Net Benefit Index (SNBI) = net psychic income – lost natural capital services = AAA – BBB				ZZZ
(+) = positive item				
(−) = negative item				
(+/−) = item may be either positive or negative				

and other costs associated with the good's production (Lawn, 2000b). Note, therefore, that if the costs are subtracted from the good's final selling price, the difference constitutes the 'use value' adding during the production process as the resources provided by natural capital are transformed into benefit-yielding goods.

The uncancelled cost account measures the source, sink, and life-support services provided by natural capital that are sacrificed as a consequence of obtaining the throughput of matter-energy required to fuel the economic process. Lost natural capital services constitute the uncancelled cost of economic activity because, on this occasion, if one traces the economic process from its ultimate conclusion back to its original source (natural capital), the amount remaining after all transactions have been cancelled out is the uncancelled exchange value of any sacrificed natural capital services (Lawn, 2000b).

The SNBI is obtained by subtracting the total of the uncancelled cost account from the uncancelled benefit account. The advantage of this approach over the ISEW and GPI is that it directly compares the benefits and costs of a growing macroeconomy. In so doing, it strengthens its own case as well as the case for the ISEW and GPI.

3. An assessment of the valuation methods used

The ISEW, GPI, and SNBI have been criticised for a wide variety of reasons. One of the more damning criticisms is the supposed lack of a theoretical foundation to support the ISEW and related indexes. As I mentioned earlier, this has been refuted with a recent demonstration that the ISEW and related indexes are soundly based on Fisher's (1906) concept of income and capital (Lawn, 2003). However, the criticism made in relation to the valuation methods used has yet to receive an adequate response. To assess the methods and the assumptions used in the valuation procedure, I will go through each of the items listed in Table II.

3.1. Private Consumption Expenditure

As previously pointed out, the ISEW, GPI, and SNBI begin with private consumption expenditure as their initial reference item, not GDP. This ensures one starts not with a monetary measure of the goods a nation annually produces, which does not equate to welfare, but with an approximate estimate of what Fisher (1906) described as the services or psychic income enjoyed by the ultimate consumers of human-made goods (Lawn, 2003).

Method of valuation: The monetary value of personal consumption expenditure is extracted directly from the national income accounts (SNA).
Criticism: It is assumed that all personal consumption expenditure contributes to human well-being. Since this item includes the consumption of such things as junk food, tobacco products, alcohol, and guns, it is most unlikely that all consumption expenditure would boost the psychic income of a nation's citizens.
Response: It may be necessary to determine the elements of consumption expenditure that should or should not be omitted in the calculation of the ISEW and related indexes. Of course, this requires the researcher to make subjective judgments which, in the end, may lead to an even greater degree of criticism. Not surprisingly, the issue has been largely avoided by ISEW and GPI advocates.

One way of dealing with this problem is to conduct a sensitivity analysis by excluding some of the components of personal consumption expenditure. For example, personal consumption expenditure in the SNA includes a category for 'cigarettes and tobacco' and another for 'alcoholic drinks'. The full amount of the former could be omitted and half of the latter. There might also be a justification for excluding a small percentage of expenditure on 'food' – say 20%. Given the magnitude of the consumption expenditure item, omissions of this nature could lead to a small variation in the overall index which would then allow analysts to make their own conclusions regarding its impact on sustainable economic welfare.

One could, of course, argue that the inclusion of junk food, tobacco products, and alcohol does not undermine the legitimacy of the ISEW and other like indicators since subjective judgments about what contributes to human well-being are common to all indicators. As it is, these alternative indicators already include items to capture some of the costs of undesirable forms of consumption (e.g., the impact of additional health costs and reduced productivity). There is, therefore, the potential to double-count some of the costs by omitting a certain percentage of all consumption expenditures on the assumption they provide few if any benefits. Clearly, there is a need for further debate on this issue.

There is another important consideration regarding personal consumption expenditure that warrants closer examination (Lawn, 2000a). Personal consumption expenditure is measured in *real* rather than nominal money values in order to capture the change in the physical quantity of goods consumed over time. For two reasons, an increase in real private consumption expenditure cannot be directly equated with a proportionate increase in psychic income. The first is due to the law of diminishing marginal utility which suggests that as one increases their consumption of physical goods, the service they enjoy increases at a diminishing rate. The second is due to the fact that an increase in the rate at which some individual goods

are consumed may not increase the service one enjoys at all. Consider, for example, the lighting of a room by a single light bulb. Is more service experienced if three light bulbs are worn out or 'consumed' over 1 year compared to just one light bulb because the latter is more durable? No, because the total service provided by the three fragile light bulbs is the same as that provided by the more durable light bulb.

Despite this, real personal consumption expenditure may still prove the best available reference point in the estimation of economic welfare. Why? It is generally recognised that people will pay a higher price for a good embodying superior service-yielding qualities. Consequently, a measure of psychic income can be approximated with the use of market prices. For instance, the rental value of a car, a house, a TV, or a refrigerator – i.e., the amount paid to rent durable goods for a 1 year period – can be used as a proxy measure of the annual services they yield. The service yielded by goods entirely consumed during the accounting period in which they are purchased can be valued at their actual market prices (Daly, 1991).

Unfortunately, market prices and rental values vary for reasons other than a change in the service-yielding qualities of physical goods. The price of a good is also affected by: (a) the relative prices of the different forms of resources available to produce it; (b) the actual quantity or supply of the good itself; and (c) changes in taxes, the nominal money supply, and the opportunity cost of holding money. Clearly, for prices to remain a proxy indicator of psychic income, it is necessary to eliminate all price-influencing factors other than those related to a good's service-yielding qualities. Given that this is a near impossible task, there are two choices available. The first option is to leave prices as they are, that is, to rely on current prices. The second is to deflate the nominal annual value of private consumption expenditure by an aggregate price index, such as the Consumer Price Index (CPI). If the former option is chosen, the nominal value of private consumption expenditure will embody unwanted price influences over and above any use value-related influences. If the latter is chosen, one obtains a real value of private consumption expenditure. But, in so doing, one also eliminates the price-influencing effect of a variation in use values – the very influence that one wants to maintain in order for prices to be used as an approximate measure of psychic income.

The most desirable option, and the option chosen by ISEW, GPI, and SNBI advocates, is to follow the lead of Daly and Cobb (1989) and use, as a reference point, the real value of private consumption expenditure. This second option is desirable for the following reason. While the law of diminishing marginal utility suggests that an increase in psychic income will be proportionately less than any increase in the quantity of physical goods consumed, the law is based on the assumption that there is no change in their service-yielding qualities. However, it is reasonable to assume that,

through technological progress, the service-yielding qualities of most goods will continue to increase for some time to come. If so, this will largely offset the effect of the law of diminishing marginal utility. To what extent it does so, one cannot ascertain, however, it should be sufficient to ensure that any positive impact on psychic income over time is probably well reflected by an increase in real private consumption expenditure.

3.2. Index of Distributional Inequality/Weighting of Personal Consumption Expenditure

It has been widely shown that the distribution of income can have a significant impact on a nation's economic welfare (Easterlin, 1974; Abramowitz, 1979). For example, if personal consumption expenditure does not change from 1 year to the next but the distribution of income deteriorates, the economic welfare enjoyed by society as a whole is likely to fall because the marginal benefit uses of the rich is less than the marginal benefit uses of the poor. Unless personal consumption expenditure is weighted according to changes in the distribution of income, it will inaccurately reflect its true contribution to a nation's economic welfare. This adjustment is made in the calculation of the ISEW, GPI, and SNBI but not so in conventional measures of national income.

Method of valuation: In general, the method of adjusting consumption expenditure involves the use of an index of distributional inequality that is constructed from the Gini coefficient on income distribution. The index of distributional inequality is assigned a value of 100.0 for the first year of the study period and is adjusted in accordance with changes over time in the Gini coefficient. Personal consumption expenditure is then divided by the index value and multiplied by 100. An improvement/deterioration in the distribution of a nation's income results in the upward/downward weighting of personal consumption expenditure. Stockhammer et al. (1997) use the index of distributional inequality to weight the final or 'raw' ISEW value, not simply personal consumption expenditure.

Criticism #1: Following evidence on the link between income distribution and environmental quality, it has been suggested that a more equal distribution of income can lead to a greater rate of environmental damage. If so, a more equal distribution of income would presumably lower the ISEW and GPI as much as it might increase it. This suggests that no weighting should be applied to personal consumption expenditure.

Response: I disagree for two reasons. In the first instance, let's assume that a more equal distribution of income increases the present welfare contribution made by personal consumption expenditure but also results in deteriorating environmental quality. This does not alter the welfare-related justification for the adjustment to personal consumption expenditure since

any increase in resource depletion and environmental degradation should be captured by other items used to calculate the ISEW and GPI (e.g., environmental cost items). Next, the argument put forward linking income distribution and environmental damage is unconvincing. The argument is based on the view that sustainability is positively correlated with current savings, whereby the latter can fall as a consequence of redistributing income from the rich (who have a high marginal propensity to save) to the poor (with a low marginal propensity to save). The overall fall in savings presumably contributes to growing environmental damage. As true as the savings impact of income redistribution might be, it is equally true that a less equal distribution of income leads to environmental deterioration because the poor, usually subsistence farmers in many Third World countries, are forced to live beyond the carrying capacity of their local environments in order to survive. In addition, much of the savings undertaken in industrialised countries takes the form of human-made capital accumulation. This invariably occurs at the expense of natural capital depletion, as evidenced by national measures of genuine savings that include the depreciation of natural as well as human-made capital (Pearce, 1993). Last but not least, the alternative policy option to redistribution – namely, more growth – appears to be a major contributing factor towards deteriorating environmental quality.

Criticism #2: The second criticism lies in the use of the Gini coefficient to establish an index of distributional inequality. Neumayer (2000) claims this technique is very subjective and *ad hoc*. Neumayer believes the Atkinson index of distributional inequality (Atkinson, 1970) is less subjective because it makes explicit the researcher's assumption regarding a society's aversion to income inequality.

Response: I disagree, indeed, I believe it is the converse. By starting with an index value of 100.0, the Gini coefficient method makes no subjective assumption about the desirability of the distribution of income at the beginning of the study period. It is only assumed that an improvement/deterioration in the distribution of income has a positive/negative impact on the overall welfare of a nation's citizens. This is hardly subjective since, as already mentioned, the welfare impact of a changing distribution of income has empirical support. On the other hand, the Atkinson index approach requires the researcher to make an explicit choice as to what is society's aversion to income inequality at the beginning of the study period. This seems to be far more open to subjectivity.

One final point. As mentioned above, Stockhammer et al. (1997) go much further than most and use the index of distributional inequality to weight the final or raw ISEW value. Whether this is justified is debatable. There is certainly good reason for weighting the services provided by consumer durables along with private consumption expenditure. However,

while it could be successfully argued that the cost of environmental damage, crime, and family breakdown is disproportionately borne by the poor, it could also be argued that the poor benefit most from public consumption expenditures. Given what appears to be a clear case of inconsistency and the potential for different methodologies to significantly alter the ISEW, GPI, and SNBI, further debate on this issue is required.

3.3. Services Yielded by the Stock of Consumer Durables

Not included in personal consumption expenditure is the value of the services annually yielded by previously purchased consumer durables. As Fisher argued, these services constitute current income and should be included in any comprehensive welfare estimate. Thus, in the calculation of the ISEW, GPI, and SNBI, the annual value of these services is added to the running total.

Method of valuation: The service value is usually calculated as a percentage of the total value of the entire stock of consumer durables. Ideally, the percentage rate chosen reflects the estimated depreciation rate or 'rate of consumption' of consumer durables.

Criticism: None that I am aware of. There is the potential for criticism in the sense that the estimated depreciation rate of consumer durables is chosen by, and therefore at the discretion of, the researcher.

3.4. Services Yielded by Publicly Provided Human-made Capital

Consumer durables are not the only form of human-made capital that yields services. Publicly provided human-made capital such as libraries, museums, roads and highways do likewise. To be consistent with the Fisherian concept of income and capital, these services are treated as income and added in the calculation of the ISEW, GPI, and SNBI.

Method of valuation: The service value is usually calculated in the same way as it is for consumer durables, that is, as a percentage of the total value of the existing stock of publicly provided human-made capital. Consistent with the Fisherian concept of income and capital, current expenditure by governments on human-made capital is not included because it merely constitutes a current addition to the stock.

Criticism: None, however, the potential for criticism exists for the same reason as the previous item.

3.5. Services provided by Volunteer Labour and Non-paid Household Work

Not all benefit-yielding services are provided by market-based economic activity. The initial reference item of personal consumption expenditure

overlooks the services provided by volunteer labour and non-paid household work. To obtain a better indicator of the psychic income enjoyed by a nation's citizens, the ISEW, GPI, and SNBI include these important services.

Method of valuation: In general, the gross opportunity cost method approach is adopted where, to begin with, the total hours of volunteer labour and non-paid household work are estimated. The totals of each are multiplied by the gross opportunity cost of an hour of unpaid household and volunteer labour – assumed to equal the average hourly wage rate.

Criticism: None, although there are a wide variety of methods available to calculate these two items. These include two 'market replacement cost' methods – namely, the individual function replacement cost method and the housekeeper replacement cost method; and two 'opportunity cost' methods – they being the gross opportunity cost and net opportunity cost methods (see the Australian Bureau of Statistics, 1992). To ensure consistency and to facilitate comparability, it would be efficacious to settle on one particular valuation method.

3.6. Public Expenditure Counted as Personal Consumption

For the same reason that private consumption expenditure is included in the measure of sustainable economic welfare, so must be the public expenditure on consumption goods that clearly contribute to human well-being. The dilemma one confronts in relation to this item is that it is considerably difficult to measure the public's demand for government services. This makes the correlation between government expenditure and economic welfare a rather tenuous one (Daly and Cobb, 1989). In addition, a significant amount of government spending involves the augmentation of publicly provided human-made capital. This constitutes an addition to the stock of human-made capital that renders services in future years. It does not, therefore, constitute current income in the Fisherian sense. For this reason, current government expenditure on publicly provided human-made capital should not be included as part of the running total.

Method of valuation: Given the aforementioned, only a portion of government spending is counted as making a positive contribution to a nation's psychic income. Exactly what is omitted differs considerably across the various studies undertaken. Daly and Cobb (1989) take the view that only a portion of public expenditure on health and education should be included (i.e., one half of higher education expenditures and one half of the difference between current and initial expenditures on health). Lawn and Sanders (1999) adopt the same approach. Stockhammer et al. (1997) include all public consumption expenditures.

Criticism: Again, while there are no direct criticisms, there is clearly a problem of inconsistency in the method adopted to calculate this item.

3.7. The Cost of Consumer Durables

Included in personal consumption expenditure is the amount paid in the current year on consumer durables such as cars, refrigerators, and household furniture. This amount constitutes an addition to the stock of human-made capital that, again, renders services in future years. As previously mentioned, this does not constitute current income in the Fisherian sense. In the calculation of the ISEW, GPI, and SNBI, the cost of consumer durables is subtracted from weighted personal consumption expenditure.
Method of valuation: The monetary value of the expenditure on 'household durables' and 'purchase of motor vehicles' is extracted from the national income accounts (SNA) and deducted from the running total.
Criticism: None, although there have been various estimates of the ISEW and GPI where this item has been omitted or overlooked (e.g., Hamilton, 1999). This oversight, it seems, is due to researchers being unaware of the need to subtract current expenditure on consumer durables. A broader recognition of the theoretical foundation underlying these alternative indexes is likely to reduce the frequency of oversight.

3.8. Disservices Generated by Economic Activity

The items so far discussed make a positive contribution to the psychic income of a nation. As I mentioned earlier, the economic process involves a range of irksome activities while it also generates many undesirable side-effects. To extend the concept of psychic income to that of 'net psychic income', the cost of irksome and psychic outgo-related aspects must be deducted. The ISEW, GPI, and SNBI do this by deducting the following:

- the cost of noise pollution,
- the cost of commuting,
- the cost of crime,
- the cost of underemployment,
- in some cases, the cost of unemployment,
- the cost of lost leisure time.

Criticism: There are three main criticisms. First, the lack of appropriate data and need to make heroic assumptions ensure the values of these items are likely to be, at best, distant approximations of their correct value. Second, since there have been a wide variety of different methods used to calculate these items, the inconsistency problem again emerges. Third, there is

the belief that some of these items should not be deducted at all. According to the logic of Rymes (1992), the cost of noise pollution, the cost of commuting, and the cost of lost leisure time would be factored into the labour supply decisions made by workers. Thus, the amount of personal consumption expenditure, for example, would reflect the additional benefits from work (money income) that are desired by workers to compensate for having to endure the undesirable side-effects of economic activity. Subtracting the costs listed above is a case of double-counting.

Response: There is no doubt that workers do factor these costs into their labour supply decisions. However, if the undesirable side-effects of economic activity are not deducted, personal consumption expenditure will overstate the psychic benefits generated by the economic process. That is, the additional consumption required for compensation purposes will count as an additional benefit when, in fact, its role is to offset the psychic disbenefit of undesirable and irksome activities.

3.9. Defensive and Rehabilitative Expenditures

A large portion of the human-made capital produced each year does not contribute to the psychic income of a nation. It is produced to prevent the undesirable side-effects of the economic process reducing the psychic income enjoyed in the future. In calculating the ISEW, GPI, and SNBI, the following defensive and rehabilitative expenditures are subtracted from the running total:

- the cost of household pollution abatement,
- the cost of vehicle accidents,
- the cost of family breakdown,
- in some cases, a certain percentage of private health expenditure assumed to constitute a form of defensive expenditure.

Criticism: The subtraction of defensive expenditures has been widely criticised (Maler, 1991; United Nations Statistical Division 1993; Hamilton, 1994, 1996; and Neumayer, 1999). It has been suggested that the concept of defensive expenditure is very dubious because it is impossible to draw the line between what does and does not constitute a defensive form of expenditure. For example, as Neumayer (1999, p. 83) argues: ''If health expenditures are defensive expenditures against illness, why should food and drinking expenditures not count as defensive expenditures against hunger and thirst? Are holiday and entertainment expenditures defensive expenditures against boredom? Should they all be subtracted from personal consumption expenditures?'' Furthermore, a United Nations review of national accounting has argued that when the concept of defensive expen-

ditures is pushed to its logical conclusion, scarcely any consumption expenditure contributes to an improvement in human welfare.

Response: There is some degree of truth in the above criticism. Certainly some percentage of food and drinking expenditure is defensive, as is spending on clothes and housing. However, there is a fundamental difference between necessary expenditure on such things as food and drink and expenditures people feel increasingly required to make to protect themselves against the unwanted side-effects of the economic process. It is safe to say that the latter are defensive in nature and the majority of the former are not. In addition, if personal consumption expenditure was confined to defensive measures only, a lot less spending would take place since, for example, expenditure on cosmetic surgery would not occur. Nor would spending on gourmet food at a restaurant. Perhaps there is some justification for counting only half of all money spent on food and drink as welfare enhancing? As it is, where calculations of the ISEW, GPI, and SNBI involve deductions for defensive expenditures (e.g., private health and education expenditure), only a percentage of the total expenditure is deducted.

While not directly criticising the subtraction of defensive expenditures, some observers have stressed the need to attribute the cost of such expenditures to the year in which the injurious activities took place (e.g., Leipert, 1986). As is quite rightly argued, a failure to address this issue will result in the overstatement of the economic welfare of earlier years. Except for the ISEW calculated for Austria by Stockhammer et al. (1997), little has been done in this regard. The lack of any action is due largely to the difficulty in assigning the present cost of defensive expenditures to the years in which the damaging activities took place. To date, the overall impact on the ISEW, GPI, and SNBI of subtracting defensive expenditures has been less significant than with other costs. This may not, however, continue to be the case. Hence, in order for future calculations of the ISEW, GPI, and SNBI to better approximate the economic welfare generated in a given year, it will be necessary for the present cost of damaging activities to be imputed and attributed to past years.

3.10. Net Producer Goods Investment

The inclusion of this particular item is contentious. One of the key implications of the Fisherian concept of income and capital is that additions to the stock of human-made capital should not be counted as income. The ISEW and related indexes go a long way towards ensuring this by subtracting current expenditure on consumer durables and by not adding current government expenditure on human-made capital. However, the calculation of the ISEW, GPI, and SNBI includes the net investment in the stock of producer goods (plant, machinery, and equipment). If the calculation of

this item was based on an estimate of the net increase in the total stock of producer goods, as it is in the calculation of conventional measures of national income, the inclusion of this item would be inconsistent with Fisher's concept of income and capital. It is not, however, calculated in this manner. Rather, net capital investment is calculated as the increase in the stock of producer goods above the amount required to keep the quantity of producer goods per worker intact. As contentious as this item is, there is some justification for its inclusion. Because of the complementarity between human-made and natural capital (Daly, 1996; Lawn, 1999, 2000a, b), *sustainable* economic welfare requires both forms of capital to be non-declining. In terms of human-made capital, this implies that the quantity of producer goods per worker must not fall. Therefore, should the stock of producer goods be greater than the necessary minimum requirement, the difference constitutes an increase in a nation's productive capacity. This, of course, is a clear benefit.

3.11. Net Foreign Lending/Borrowing

This item is included because a nation's long-term capacity to sustain the psychic income generated by the economic process depends very much on whether natural and human-made capital is domestically or foreign owned. Evidence clearly indicates that many countries with large foreign debts have difficulty maintaining the investment levels needed to keep their stock of human-made capital intact. Furthermore, they are often forced to liquidate natural capital stocks to repay debt (George, 1988).

3.12. Cost of Sacrificed Natural Capital Services

As I explained earlier, one of the major implications of Fisher's concept of income and capital is its recognition of the continual maintenance of human-made capital as a cost. The cost is eventually borne out by way of the natural capital services lost in obtaining the throughput required to keep the stock of human-made capital intact. To be consistent with the Fisherian concept of income and capital, it is necessary to deduct the cost of the lost source, sink, and life-support services provided by natural capital. The ISEW and GPI do this by deducting the following:

- the loss of farmland and the cost of resource depletion (lost *source* services of natural capital),
- the cost of ozone depletion and air and water pollution (lost *sink* services of natural capital),
- the cost of long-term environmental damage and the loss of wetlands and old-growth forests (lost *life-support* services of natural capital).

Criticism #1: In terms of the cost of non-renewable resource depletion, there is, again, little if any consistency in the methods used by the ISEW and GPI proponents. This has attracted criticism in itself. As for the methods used, Neumayer (2000) is particularly critical of the rationale behind the use of a replacement cost approach. Neumayer believes a resource rent approach should be used. This has been done in a number of ISEW and GPI calculations, however, the typical resource rent approach involves a deduction of the *total* cost of non-renewable resource depletion. In most instances, it also involves the assumption of escalating non-renewable resource prices. Neumayer argues against the deduction of the total cost of non-renewable resource depletion by claiming that El Serafy's (1989) 'user cost' formula is the correct means of calculating resource rents. The significance of El Serafy's user cost formula is that only a portion of the total cost of resource depletion is deducted.

Response: I agree entirely with Neumayer regarding the El Serafy user cost formula, although the interest rate used in the formula (see Equation (1) below) should be replaced by the regeneration rate of the renewable resource that must be cultivated to keep the total stock of natural capital intact (Lawn, 1998). However, I disagree with Neumayer's argument against the use of a replacement cost approach. Neumayer dislikes the replacement cost approach because he believes there is no reason why non-renewable resources have to be fully replaced in the present when there are reserves available for many years to come. If there is no current requirement to fully replace non-renewable resources then, according to Neumayer, it is wrong to use a replacement cost approach to calculate the cost of depletion. I disagree with Neumayer because the ISEW and related measures are interested in the *sustainability* of, as well as the economic welfare generated by, economic activity. While the present quantity of resources being extracted from non-renewable resource stocks can be sustained for some time without having to find or establish a renewable resource replacement, this does not mean that it can be sustained indefinitely. And while it may not be necessary to think about a replacement resource for some time, for proper accounting purposes, the actual cost of establishing a renewable resource substitute must be attributed to the point in time when the depletion took place. Indeed, this is the basis behind the El Serafy user cost method.

It might be argued that I am being inconsistent here – after all, I am arguing in favour of the replacement cost approach while also promoting the use of El Serafy's user cost formula. The El Serafy user cost formula is regarded as just one of many ways to execute the resource rent approach. However, the beauty of the El Serafy user cost formula is that it can be used to calculate resource rents and replacement costs, and so it is not

entirely correct to say it is exclusively a resource rent method. For example, consider the El Serafy user cost formula below:

$$X/R = 1 - \frac{1}{(1+r)^{n+1}} \tag{1}$$

where X is the true income (resource rent); R, the total net receipts (gross receipts less extraction costs); r, the discount rate (or regeneration rate of renewable resource in the case of a strong sustainability approach); n, the number of periods over which the resource is to be liquidated; $R - X$, the user cost or the amount of total net receipts that must be set aside to establish a replacement asset to ensure a perpetual income stream.

This user cost approach is a resource rent method in that the portion of the proceeds from resource extraction that does not constitute a user cost is a genuine resource rent (X). It is also a replacement cost method in that the portion of the proceeds from resource extraction that does constitute a user cost is, in fact, the genuine cost of resource asset replacement ($R - X$). Since it is the user cost that ought to be deducted when calculating the ISEW, GPI, and SNBI, the El Serafy formula serves its purpose as a replacement cost means of estimating the cost of resource depletion.

Criticism #2: Neumayer (2000) is critical of the assumed escalation of future non-renewable resource prices when most commodity prices have tended to fall in real terms.

Response: Neumayer's observation that most commodity prices have not increased in real terms is entirely correct. Nevertheless, in view of the expected life of many non-renewable resources and the projected rates of depletion, the price of non-renewable resources should have already begun to rise to reflect their impending absolute scarcity. That they have not simply reflects the fact that markets, while very good at signalling relative scarcities (e.g., the scarcity of oil relative to coal), are woefully inadequate at signalling the absolute scarcity of the total quantity of all low entropy resources available for current and future production (Howarth and Norgaard, 1990; Norgaard, 1990; Bishop, 1993; Daly, 1996; Lawn, 2002). Should one use the actual market prices of non-renewable resources to assist in the calculation of the ISEW, GPI, and SNBI if they fail to reflect their increasing absolute scarcity? I think not. To get an accurate picture of sustainable economic welfare, one should use the best estimate of rising non-renewable resource prices. Many studies have used a 3% escalation factor. In the calculation of the SNBI (Lawn and Sanders, 1999; Lawn, 2000a), a 2% escalation factor was assumed. In all, an assumed escalation of non-renewable resource prices seems justified.

Criticism #3: Another highly contentious issue is whether the deduction term for the cost of ozone depletion, long-term environmental damage,

and lost old-growth forests should, in each case, be a cumulative total. By cumulative I mean that the amount deducted for each year is equal to contribution made to the cost for the year in question plus the accumulated cost from previous years. Neumayer (2000) believes this is wrong since it involves double counting. He believes that only the present cost should be deducted.

Response: Neumayer has a very good point here and unless accumulation of the cost can be adequately justified, it should be abandoned. However, I believe accumulation of the cost can be justified because, as explained at the beginning of the paper, the ISEW, GPI, and SNBI measure the sustainable economic welfare of a nation at the time it is being experienced. In other words, the ISEW for a particular year is an estimation of the sustainable economic welfare being experienced by a nation's citizens in that year. In the case of ozone depletion, long-term environmental damage, and lost old-growth forests, the impact on the sustainable economic welfare in a given year depends very much on what has happened in the past. Hence, the total cost in any given year must reflect the amount required to compensate a nation's citizens in that year – in a sense, a compensatory fund – for the cumulative impact on the ozone layer and old-growth forests of past as well as present economic activities.

4. The need for a more robust and consistent set of valuation methods

In no way should the criticism of the valuation methods used to calculate the ISEW, GPI, and SNBI be rejected out of hand by the advocates of these alternative indexes. Instead, heeding the criticism and finding better and more robust means of valuation should strengthen the ISEW, GPI, and SNBI as well as the case for them. However, the most urgently needed refinement of the ISEW, GPI, and SNBI concerns the establishment of a consistent set of valuation methods. To date, there have been as many as five different approaches to the calculation of some of the items that make up these alternative indexes. In addition, the inconsistency problem extends to the choice of items. For example, in some studies, the imputed value of leisure time is added (Lawn and Sanders, 1999; Lawn, 2000a); in others, the value of lost leisure time is deducted (Redefining Progress, 1995); and in others, there is no inclusion of leisure at all (Daly and Cobb, 1989; Stockhammer et al., 1997). Furthermore, the inconsistency problem is compounded by the existence of three different names for essentially the same index.

Most people are aware of the United Nations System of National Accounts (SNA). The SNA sets out the standardised methods by which GDP and other conventional macroeconomic indicators are calculated. A

consistent set of valuation methods and procedures, as well as an agreed upon name, is also required for the ISEW, GPI, and SNBI. While it is unlikely that governments would initially acknowledge and certify the new index and its methodology, professional and academic organisations and societies are much more likely to do so. This is critically important. The eventual acceptance of a new welfare index – including its eventual use as a policy-guiding barometer – is likely to depend heavily upon its recognition by large, reputable organisations.

4.1. A Suitable Name for an Alternative Welfare Index

It is not for me to say which of the three current names categorically stands as the best name for an alternative welfare index. Apart from anything else, there may be a superior name that has not yet been suggested. Nevertheless, a number of factors should be taken into account when determining an agreed-upon name. First, the name must be short and simple. Second, the name must describe, in a non-technical fashion, what is being measured. Third, the name must avoid alienation. People from whatever background or position in society must feel, from the name alone, that they are an integral, living element of the index – not just another statistic. For these reasons, I lean towards the Genuine Progress Indicator as the best name so far devised.

4.2. A Standardised Set of Items and Valuation Methods to Calculate the Index

Any move towards the standardisation of items and valuation methods must take into account the availability of the data required to calculate the individual items. After all, if the aim of standardisation is to eliminate inconsistency and facilitate inter-country comparisons, there is little point agreeing on the items if the data needed to calculate certain items is not readily available in many countries. From my own experience in calculating the SNBI for Australia – a country possessing a wealth of statistical information – I am acutely aware of the difficulty obtaining appropriate data. Data availability will undoubtedly be a more pressing problem in many Third World countries. If, in trying to establish a standardised welfare index, the lack of available data leads to an index with so few items as to render it superfluous, it may be expedient to have two indexes – a more comprehensive index for countries with the necessary data; an abridged version to be calculated for all countries to permit inter-country comparisons.

Second, the choice of valuation technique for each particular item should be aimed at minimising the subjectivity required on the part of the researcher. By subjectivity, I mean the extent to which the researcher is left to make one's own assumptions in order to calculate the individual item in

question. Maximising objectivity lends itself to a greater degree of consensus that is clearly necessary for an alternative welfare index to be broadly accepted by reputable organisations as well as the wider community.

5. Conclusion

As imperfect as the ISEW, GPI, and SNBI are, the illumination of a sound theoretical foundation has gone a long way to strengthening the case for these alternative indexes. However, the absence of a more robust and consistent set of valuation methods remains. It is the task of the ISEW, GPI, and SNBI proponents to ameliorate this problem. Only then will these indexes and the threshold hypothesis they seek to confirm gain broad acceptance. This is of major importance and a continuing challenge to ecological economists at a time when nations urgently need to reject growthmania in order to achieve sustainable development.

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