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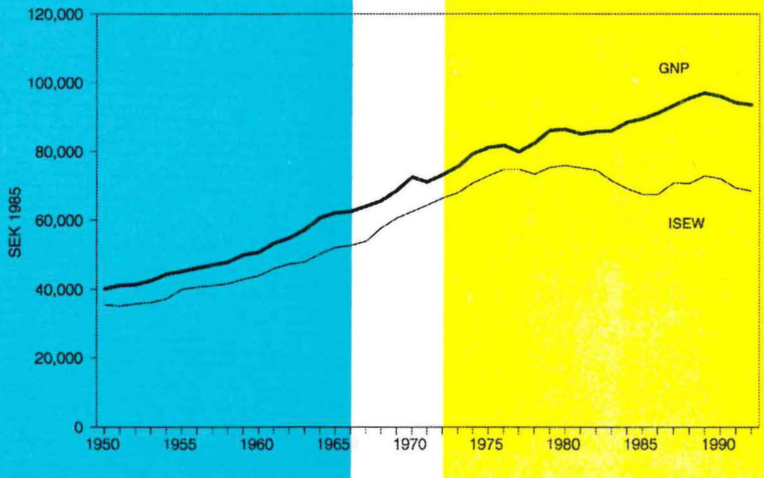
Sustainable Economic Welfare in Sweden
A Pilot Index 1950 - 1992

Tim Jackson and Susanna Stymne



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ABSTRACT
National economic performance is not necessarily the same thing as sustainable welfare. A number of social and environmental factors contribute to welfare, but remain excluded by conventional measures of economic performance such as the Gross National Product (GNP). To remedy this, an Index of Sustainable Economic Welfare (ISEW) was developed for the United States. The same methodology has since been applied to a number of other developed countries including the UK, Germany, Austria and the Netherlands. The purpose of the present paper is to explore the application of the ISEW methodology to Sweden over the period between 1950 and 1992. Preliminary results presented here indicate that some of the conclusions from earlier studies also hold for Sweden: in particular that, in the later years of the study, ISEW tends to stabilise in spite of continued growth in GNP. But there are also significant differences between Sweden and other countries. The paper discusses the implications of these differences both for the ISEW methodology and for environmental and economic policy-making in Sweden.

1 INTRODUCTION

In spite of its evident political power, the traditional concept of national economic performance, measured as the Gross National Product (GNP), is not necessarily a measure (or even an indicator) of welfare - and in particular *sustainable* welfare - in the nation.

There are various, complex reasons for this. One of them is that the GNP fails to account for capital depreciation. In the national accounts this omission is usually corrected for in the Net National Product (NNP), sometimes called the National Income. But even within this revision, there are important aspects of welfare which remain unaccounted for. Non-monetarised aspects of the economy escape measurement in terms of either economic consumption flows or capital evaluation. Their contribution to levels of welfare therefore goes unrecognised. These non-monetarised aspects may be either positive or negative contributions to welfare and include the (positive) value of household labour in the economy, changes in available leisure time, and the (negative) impacts of environmental degradation. Furthermore, some consumption flows are required only to offset the negative impacts of consumption flows elsewhere in the economy. These so-called "defensive" expenditures increase the GNP (or NNP), but cannot really be regarded as *additional* contributions to welfare.

Such difficulties have prompted consideration and development of alternative ways of accounting for success or failure in delivering welfare to the nation. Two broad avenues of development have opened up. The first has been to propose sets of non-monetarised indicators to complement traditional economic accounts. For example, Anderson (1991) discusses a set of sixteen indicators covering aspects of basic welfare such as literacy and education, employment, health and mortality, population growth and environmental quality. The second approach has been to incorporate monetarised measures of these factors within adjusted economic accounts.

Each of these two approaches to the evaluation of welfare has its own merits. The development of sets of indicators allows for a disaggregated look at trends in different aspects of welfare over time. The disadvantage of this approach is that, apart from exceptional circumstances (such as those in which all indicators are increasing or all are decreasing), it is difficult to assess performance in overall terms - to say whether or not welfare as a whole is improving or declining.

The advantage of a quantitative monetary index is that - if it is both accurate and robust - it can be used directly to assess aggregate changes in the level of welfare in the nation. But the monetarised index itself has two disadvantages. In the first place, by conflating different aspects of welfare, it loses some of the depth and clarity of a disaggregated approach. Perhaps more importantly, it can only be an accurate measure of welfare if it is successful in placing monetary values on flows which lie outside the normal market mechanism for monetary evaluation, a task which is by no means easy or perhaps even possible.

Despite these difficulties, there have been a number of attempts to adjust measures of economic performance to reflect welfare. Eisner (1988 & 1989) summarises the early attempts to produce “measures of economic welfare” by adjusting GNP to reflect a variety of factors. He identifies three main kinds of adjustments made in the work of the seven different authors he examines. We summarise these adjustments as follows:

- inclusion of capital aspects and expansion of the definition of capital to include for example *natural capital* - natural resources and environmental quality;

- inclusion of non-market flows such as the impacts of environmental degradation or the value of household labour; and

- re-classification of products as final or intermediate to account for so-called defensive expenditures.

One of the earliest of these attempts was the Measure of Economic Welfare (MEW) devised by Nordhaus and Tobin (1972). The results of that exercise suggested that between 1950 and 1965, welfare in the US grew consistently, although at a slower rate than the growth in GNP.

Within the last few years, there has been a renewed interest in this kind of methodology, sparked in particular by international debates over the concept of sustainable development (WCED, 1987). Daly and Cobb (1989) have proposed substituting the concept of Hicksian income for GNP as a measure of sustainability. They reiterate Hicks (1939) suggestion that “the purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves” in the future.[1]

The Index of Sustainable Economic Welfare (ISEW) was first published as an appendix to Daly and Cobb’s (1989) book *For the Common Good*, and further developed in a revised form in *Greening the National Product* (Cobb and Cobb, 1994).

[1] Hicks (1939), p. 172.

Like Nordhaus and Tobin's MEW, Daly and Cobb's ISEW also shows a rising trend in the US between 1950 and 1965 (Figure 1). But from the late 1960s onwards, the Index begins to stabilise, and towards the end of the period declined slightly, in spite of continuing growth in GNP. Interestingly, Nordhaus (1992) has recently constructed a new measure of national income which also reflects an increasing divergence from GNP during the later years of the period.[2]

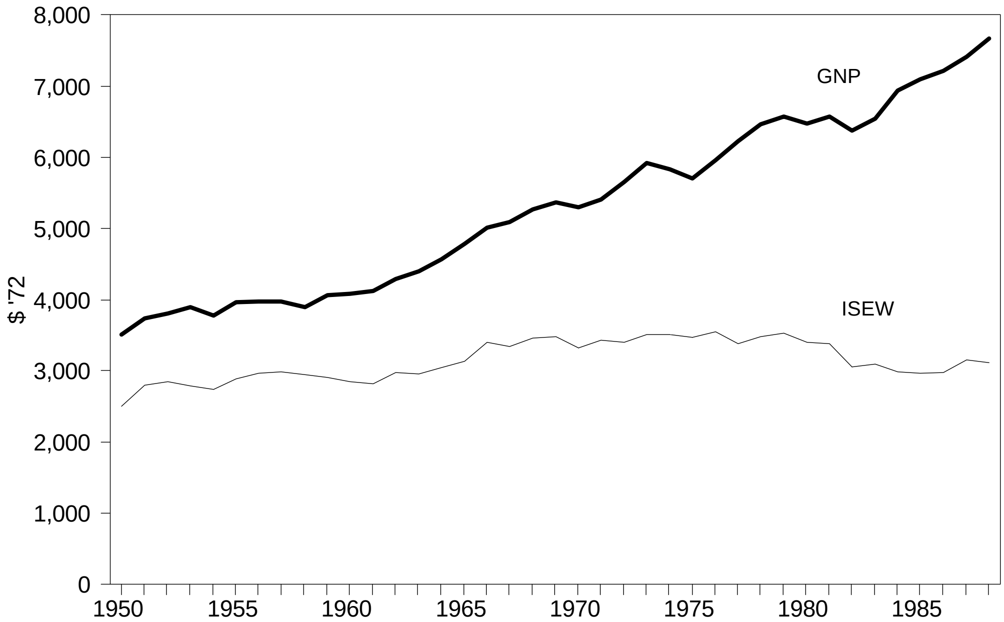

Figure 1. Per capita ISEW and GNP in the US (1950-1988).

Following this pioneering work, similar indices have been constructed for a number of other countries, including Germany (Diefenbacher, 1994), the UK (Jackson and Marks, 1994), Austria (Obermayr *et al.*, 1995), and the Netherlands (Rosenberg and Oemega, 1995). For comparative purposes, all of the existing studies, together with the Swedish ISEW presented in this paper, are shown in indexed form, in Figure 11 below.

Some clear similarities emerge from the general picture presented by these initial studies. For example, in all of the studies so far carried out, the calculated ISEW departs from a straightforward measure of economic output, in particular during the later years of the study period. This departure is most marked in the UK (Figure 2), but also visible in the other studies (Figure 11).

In the light of these similarities, it would be tempting to suggest that a methodological consensus is emerging through the ISEW. But this is not the case. Critics have attacked both general and specific methodological elements of the proposed indices.[3] There has not even been exact consensus amongst the existing ISEW studies.

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2 However, Nordhaus attributes most of this stabilisaton to changes in conventional economic factors, and argues that "environmental corrections account for very little of the growth slowdown" (1992, p 37).

3 See for example, a number of papers in Cobb and Cobb (1994), Nordhaus (1992), and Atkinson (1995).

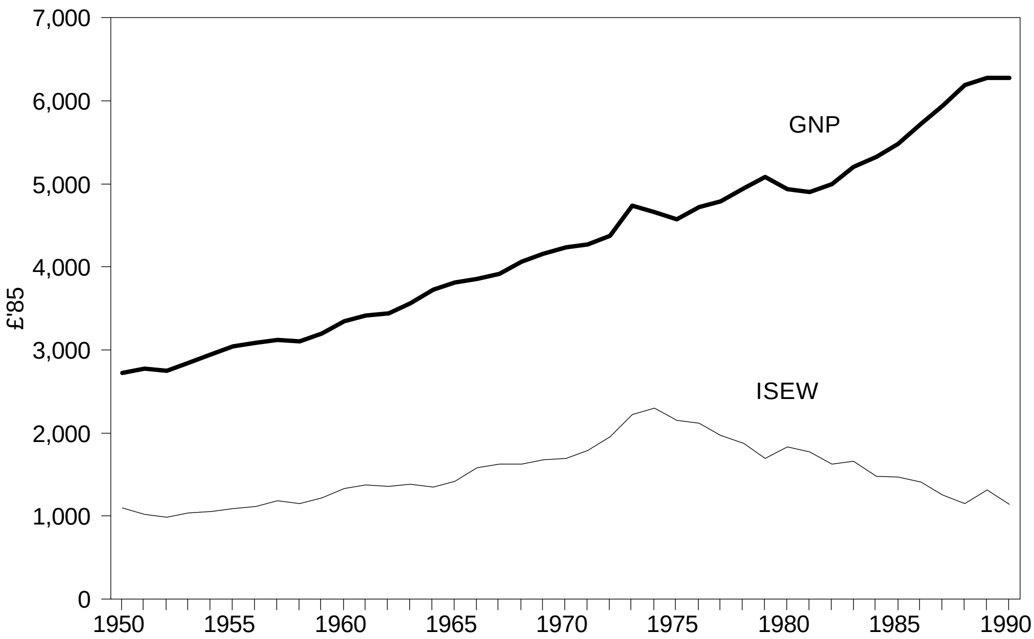

Figure 2. Per capita ISEW and GNP in the UK (1950-1990).

Differences in methodology - sometimes dictated by the availability of data, sometimes by structural idiosyncracies - have meant that international comparisons on the basis of individual studies are in fact far from straightforward, so that conclusions drawn from looking at Figures 1 and 2 may still be regarded at best as tentative.

Furthermore the study of alternative economic methodologies is still evolving. In particular, the Index of Sustainable Economic Welfare has been criticised for omitting accounts of human capital - a vital contribution to welfare in the nation. This deliberate omission in the methodology was an attempt to avoid the complexities involved in accounting in monetary terms for an essentially non-monetarised asset, at least in the early stages of deliberation. But in the US, for instance, there are now attempts to remedy this short-coming using a Genuine Progress Indicator (Cobb *et al.*, 1995).

In the light of such differences and difficulties, it is clear that any attempt to produce an ISEW for an individual country cannot be regarded as a definitive comment on the trend in welfare in that country. It can at best accomplish three nonetheless important tasks. Firstly, it can provide a critique of the GNP as a welfare measure.[4] Secondly, the process of developing a particular index can contribute valuable methodological insights into the development of such indices generally. Finally, it may be possible through such a study to provide a first base, from which to evolve a more satisfactory indicator of welfare in the future, through ongoing processes of critical feedback and refinement. Any ISEW presently conceived raises many crucial questions. But questions are themselves an important stimulus to future policy development.

[4] As described in more detail in Jackson and Marks (1994) this function depends heavily on questions of robustness of the index, and some attention will be paid to this question later in the present paper.

It is in this spirit that the present paper offers an ISEW for Sweden. The bulk of the paper is devoted to describing the methodological decisions which contribute to the building up of this ISEW. Towards the end of the paper, some time is devoted to comparisons of these results with results obtained in other countries - in particular the UK.[5] Before engaging in the main agenda of the study however, the next section will briefly place the present exercise in the context of economic welfare and developments in measuring sustainable economic welfare in Sweden.

2 ECONOMICS AND WELFARE IN SWEDEN

During the past century Sweden has evolved from a largely agricultural economy to one in which less than 3% of the population is employed in agriculture. The initial phase in this transition saw the rapid growth of the manufacturing sector, based to a large degree on rich natural supplies of coniferous forest, water power, iron ore and certain other mineral deposits. Cheap hydro power was a major factor in Sweden's industrial development and today accounts for over 15% of total energy supply,[6] and more than 50% of electricity production. A cold climate, the development of energy intensive industry, and high living standards have all contributed to high per capita levels of energy consumption, and a dependency on imported oil and coal. Improved energy efficiency followed the first oil crisis in 1973, and led to falling energy consumption, through the 1980s. But the intention to phase out the use of nuclear power (which presently contributes just under 15% of energy supply and between 40 and 50% of electricity supply) imposes demanding constraints on future energy policy.

In the years immediately following the second world war, Sweden experienced a rapid export-led economic expansion. Although this was slowed to some extent by Korean war inflation and cyclical downturns, the growth rate during the 1950s averaged 3.4% per annum. The 1960s have sometimes been characterised as a "golden decade" for the Swedish economy, with average annual growth rates of 5.3% between 1960 and 1965, and over 4.5% for the decade as a whole. But the oil crises of the 1970s slowed the pace of economic growth during the 1970s to just above 2% per annum. Until the 1970s industrial output had been growing faster than the economy as a whole. But it peaked in 1974 at 27.3% of GDP, and has fallen more or less consistently since then. The economy as a whole recovered from the slowdown of the 1970s, and growth rates between 1982 and 1989 averaged 2.5% per annum. This was largely due to the expansion of the service sector, and the devaluation of the Swedish krona in the early 1980s.

The most severe and the longest recession since the 1930s hit Sweden (along with many other western countries) in 1990, and for the years between 1990 and 1992, annual growth rates averaged -0.7%. Output began to increase again during 1993 and 1994 following a *de facto* devaluation of the krona late in 1992, and at the time of writing, Sweden has maintained a fragile economic recovery.[7]

In spite of this recent recession, and the slowdowns of the 1970s, the overall trend over more than forty years has been one of steady economic growth, as Figure 3 illustrates. This trend is of course similar to that of many other western economies over the same time period. For example, GNP in the UK grew by over 200% during

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5 The reason for choosing that particular comparison is that, having one author common to both the studies, there is probably a higher degree of methodological overlap than exists between other studies.

6 Calculated on an electricity-supplied basis. In terms of primary fuel equivalents, hydro provides around 25% of Sweden's energy.

7 This recovery is not yet visible on Figure 3, which only shows the trend to 1992.

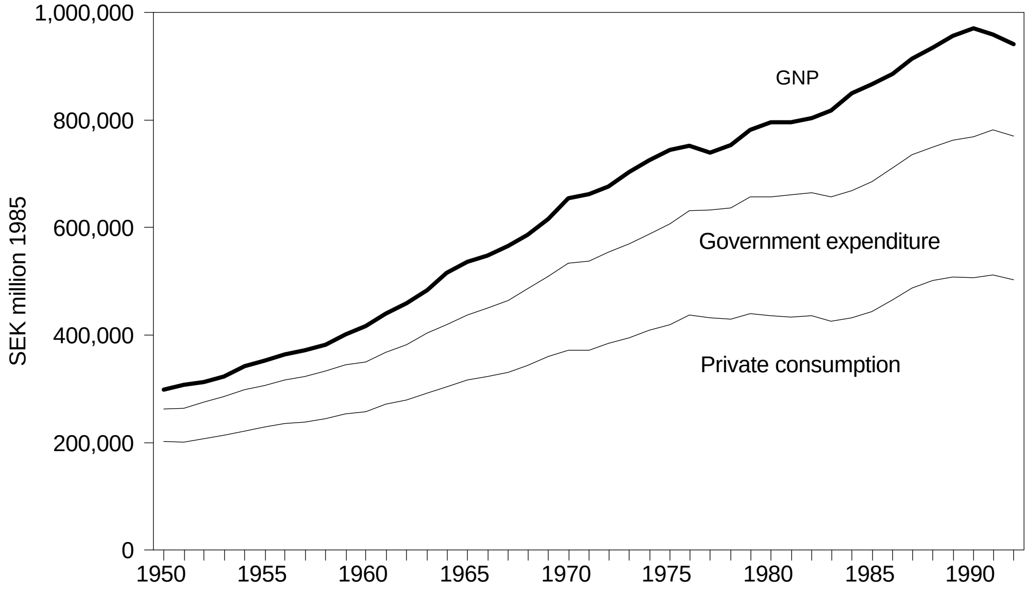

Figure 3. Gross National Product (at market prices) in Sweden 1950-1992.

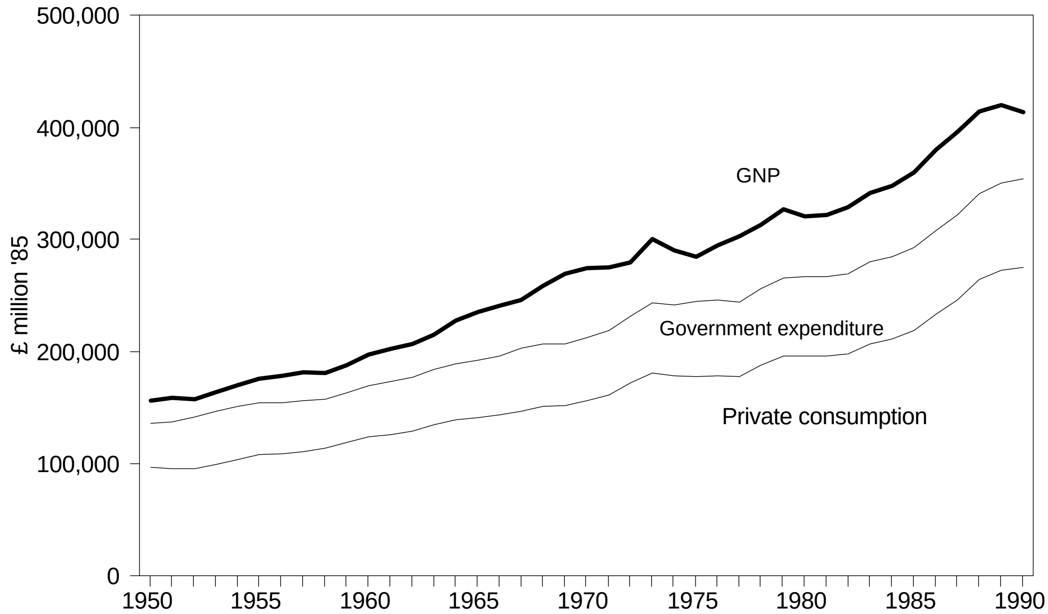

Figure 4. Gross National Product (at market prices) in the UK 1950-1990.

the period from 1950 to 1990 (Figure 4). But in the case of Sweden, there are some aspects relating to the *structure* of economic growth which merit some comment, since they bear directly on differences in the measured index of welfare in Sweden by comparison with other countries.

In the UK (as Figure 4 reveals), and in certain other Western economies, personal consumer expenditure has grown faster than GNP over the time period in question.

In 1950, personal consumption in the UK represented 61.7% of GNP. It fell slightly during the 1970s, but by the end of the period had risen to 66.4% of GNP. At the same time, the proportion of UK government expenditure had fallen from a peak of 29.4% of GNP in 1952 to 19.3% in 1990.

In Sweden, by contrast, government expenditure has represented an increasing proportion of GNP, growing from only 20.2% in 1950 to 28.5% in 1992. At the same time, the share of GNP from personal consumption in Sweden has fallen from 67.7% in 1950 to 53.4% in 1992. These changes reflect a quite deliberate orientation of Swedish domestic policy towards the creation and maintenance of welfare: progressive taxation rates; high rates of national insurance payment; state responsibility for health and social services; extensive social security, pension rights, disability, maternity and paternity benefits; and an ambitious labour market policy to reduce unemployment.

During the last decade, this social policy has to some extent been revised, partly to cope with the increasing demands imposed on the central government budget. During the 1980s, these revisions have tended to stabilise government expenditure as a percentage of GNP, while the proportion of personal consumption has gradually risen. Nevertheless, there are some quite specific ways, as we shall see later, in which this social policy has contributed to significant differences between measured sustainable economic welfare in Sweden and measurements in other Western countries.

Sweden has also been progressive in realising the importance to future welfare of present fiscal and monetary policies. For example, the 1990 official long-term report argued that the ultimate economic and political goal to increase welfare should be given a time dimension; and the 1992 report attempted to analyse what was the most appropriate concept of national welfare to use in this context (FD, 1992). In particular, the 1992 report suggested that national wealth can be defined either as the existing stocks of assets or as the present value of all future consumption. It also looked at the possibility of widening the concept of national wealth to include variables such as the depletion of natural resources, and the costs of environmental degradation.

One estimate of Sweden's "environmental debt" (Jernelöv, 1992) puts the cumulative debt at 260,000 million Swedish kronor (SEK)[8] with a growth rate of around SEK 7,000 million per year. In 1990 a commission was set up to analyse the possibilities for and methodological implications of setting up an environmental and resource account (FD, 1991). In spite of the acknowledged difficulties, the commission recommended the development of such accounts, and three institutions received this difficult mandate in June 1992.

The National Statistics Office (*Statistiska centralbyrån* - referred to in what follows as SCB) is to develop physical environmental accounts, and improve environmental statistics. The National Institute for Economic Research (*Konjunkturinstitutet* - referred to as KI) is to analyse the most important connections between the economy and the environment, and is responsible for research and development in the area of monetary accounting. The Swedish Environmental Protection Agency (*Statens naturvårdsverk* - referred to as SNV) is to develop an environmental index system to give an overall picture of the state of the Swedish ecosystem and its change over time. The project is to produce a final report in 1997. An interim report on environmental accounting from KI and SCB has developed a model for environmental valu-

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8 In what follows we shall use the abbreviation SEK to refer to monetary figures measured in Swedish kronor.

ation, and presents two pilot-study projects to illustrate environmental accounting from different perspectives. The reports recognise that there are both theoretical and practical difficulties involved in the project, but declare that "these difficulties do not make a sustainable reason to give up or postpone the work on environmental accounting" (KI/SCB, 1994).

This present paper has a limited but nevertheless important role in relation to the more ambitious and extensive programme described above: namely, to provide for Sweden a pilot Index of Sustainable Economic Welfare, following as closely as possible the methodology already set out by previous studies. We accept that this methodology is open to question in various important respects. Nor do we believe the present study in any sense supplants the importance of a full, and extensive examination of the question of environmental accounting in Sweden. Nevertheless, we contend that there are important lessons to be learned and comparisons to be made, by applying the existing ISEW methodology within a Swedish context. It is our hope that this exercise will inform a more detailed and extensive examination of these very crucial issues in the future.

3 A METHODOLOGICAL OVERVIEW

Gross National Product may be viewed in three different, but ultimately equivalent, ways.[9] It may be seen, firstly, as the total of all **incomes** (wages and profits) from the production of nationally-owned goods and services. Next, it may be regarded as the total of all **expenditures** made either in consuming the finished goods and services or in adding to wealth (less the net costs of international trade). Finally, it can be looked at as the sum of the **value added** by all activities which produce goods and services, that is, their net output.

The Index of Sustainable Economic Welfare takes as its basis the expenditure method for calculating GNP. The conventional methodology adds up all public and private "final" expenditures on goods and services, taking account of gross fixed capital formation.[10] It adds exports, subtracts imports, and adds in the net property transactions from abroad.[11]

Daly and Cobb's (1989) methodology starts out with the standard economic measure of private consumer expenditure or "personal consumption". For various reasons, many of which are discussed elsewhere,[12] this measure may not in itself provide an unassailable basis from which to account for welfare in the nation. Nevertheless, it is clear that personal consumption provides some indicator of the amount of money which consumers are willing and able to pay for the goods and services through which welfare may be provided. Figures for consumer expenditure are reported (and used in the ISEW) at market prices - that is including certain indirect taxes and subsidies imposed on them. For a variety of reasons it is difficult to make *ad hoc* adjustments to these reported figures to arrive at a factor cost account of consumer

9 For a discussion of the calculation of GDP and GNP see (e.g.) the United Kingdom National Accounts (UKNA, 1989).

10 These final expenditures consist of all private and government expenditures on goods and services which are not used-up in production during the period of the account. They include 'consumption expenditures' - all expenditures on current goods and services by the personal and government sectors as consumers - and 'investment expenditures'. Investment expenditures embrace both those expenditures which lead to a physical increase in stocks and works in progress, and all expenditures on fixed assets.

11 The conventional methodology also adjusts these expenditure figures from market prices to "factor costs", in order to account for the impact of indirect taxes and subsidies.

12 See for example discussions in Daly and Cobb (1989), various contributions to Cobb and Cobb (1994), Jackson and Marks (1994), Jackson (1996) and Jackson and Marks (1996).

expenditures. In a sense, we may argue that a market price basis is correct if we are measuring welfare in the economy, since it reflects prices which consumers are prepared to pay for their welfare. Clearly, however, there is a potential danger from double-counting if the calculation of government expenditures includes monies raised through indirect taxation and included in the personal consumption tally. For this reason, there will be instances in what follows where we shall deliberately exclude certain government expenditures from the index, in an attempt to avoid double counting.

Using this basis in personal consumption, the ISEW then makes several specific adjustments to reflect the various elements discussed in Section 2 above. These adjustments fall into five broad categories.

Firstly, account is made of defensive expenditures - 'expenditures necessary to defend ourselves from the unwanted side-effects of production' (Daly and Cobb, 1989, p. 70). Certain defensive expenditures from the personal sector are subtracted from the account, and government expenditures are generally included in the index only to the extent that they are *not* defensive. Defensive expenditures subtracted from the personal sector include expenditures on health and education, and on lifestyle maintenance (such as the costs of commuting). Government expenditures added into the index include certain health-related and educational expenditures. In the case of Sweden, where there is a high rate of taxation supporting a wide public expenditure base, there is an argument that certain other categories of government expenditure should also be included in the index. For instance, expenditures on sports and leisure facilities might legitimately be considered as contributions to consumption. There are two reasons not to engage in this exercise here, however. In the first place, there is certainly an argument that even some of these expenditures are defensive, for instance against the loss of a natural recreational environment. In addition, the proportion of these expenditures to total government expenditure is quite low (less than 5% in the case of recreational expenditures), so that the extra effort would be unlikely significantly to alter the shape of the index.

Secondly, the index includes some measures relating to capital formation. One of these is a "net capital growth" adjustment to account for changes in the stock of man-made capital.[13] The other provides an indication of the robustness (and sustainability) of the economy in international terms.[14]

Thirdly, account is taken of environmental degradation. Some environmental degradation may incur defensive expenditures in the economy, and these costs have already been mentioned. Other kinds of environmental externality relate to the (nonmonetarised) loss of environmental quality, and to the accumulation of future long-term liabilities from environmental damage.

Next, an attempt is made to account for non-monetarised contributions to welfare by accounting for the contribution of domestic labour.

Finally, the index provides a number of ways of measuring the loss of natural capital, including the depletion of natural resources, and the loss of natural habitats.

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13 The term man-made capital refers to the stock of conventional economic capital assets, and should not be con fused with the term "human capital" which refers to the stock of human resources. It might be noted that the GNP already includes a measure of gross fixed capital formation. The capital adjustment in the ISEW differs from the GNP adjustment in two specific ways: firstly it takes account of capital depreciation as well as formation; secondly it includes only that capital growth which is net of a basic capital requirement to maintain changes in the workforce (see column V below)

14 In the conventional expenditure-related calculation of GNP, there is also an assessment of net international trade (export minus imports). The difference entailed by the ISEW methodology is the inclusion of the capital aspects of overseas trade.

Table 1. Summary of the ISEW methodology.

Column	Item	Adjustment	Rationale
B	Consumer expenditure		Basis for the index
C	Income distribution		Accounting for social effects of distributional inequality
D	Weighted personal consumption	B/C	New basis-weighted by income distribution
E	Services from domestic labour	+ve	Incorporation non-monetarised contributions to welfare
F	Services from consumer durables	-ve	Accounting for defensive expenditures on stock replacement
H	Public expenditure on health & education	+ve	Adding in non-defensive public expenditures
I	Expenditure on consumer durables	+ve	Accounting for service value of consumer stock
J	Private expenditure on health & education	-ve	Subtracting defensive private expenditures
K	Costs of commuting	-ve	Subtracting defensive private expenditures
L	Costs of personal pollution control	-ve	Subtracting defensive private expenditures
M	Costs of car accidents	-ve	Subtracting defensive private expenditures
N	Costs of water pollution	-ve	Subtracting costs of environmental damage
O	Costs of air pollution	-ve	Subtracting costs of environmental damage
P	Costs of noise pollution	-ve	Subtracting costs of environmental damage
Q	Costs of wetlands	-ve	Accounting for loss of natural capital
R	Costs of farmlands	-ve	Accounting for loss of natural capital
S	Depletion of non-renewable sources	-ve	Accounting for loss of natural capital
T	Long-term environmental damage	-ve	Subtracting costs of environmental damage
U	Costs of ozone depletion	-ve	Subtracting costs of environmental damage
V	Net capital growth	+ve	Accounting for increased man-made capital
W	Change in net international position	+ve	Accounting for international stability (sustainability)

The overall index can therefore be roughly expressed in the following terms:

ISEW = *personal consumption*
+ *non-defensive public expenditures*
- *defensive private expenditures*
+ *capital formation*
+ *services from domestic labour*
- *costs of environmental degradation*
- *depreciation of natural capital.*

Two further adjustments are made to this broad algorithm. Firstly, a weighting factor is applied to the consumer expenditure to reflect changes in the distribution of income in the economy. Secondly, the methodology of the index attempts to account for the difference between annual *expenditure* on consumer durables and the *services* flowing in each year from the stock of those goods. Table 1 presents a summary of the composition of the index with the main rationale for each of the adjustments made.

It may also be worthwhile to point out some of the factors which have *not* been included in the ISEW, even though they are relevant to the issue of sustainable economic welfare, and even though they have been included in some other attempts at a welfare measure. The main deliberate omission is the absence of any accounting for *human capital*, that is improvements in human physical (health), intellectual (educational) and emotional resources. Daly and Cobb (1989, p. 404) agreed "in principle" that human capital should be included in an account of human welfare, but could not bring themselves to take actual expenditures in (for example) health and education as an appropriate proxy for real "changes in the stock of human capacities that enhance productivities".

Leisure has also been excluded from the ISEW, even though it was included for instance by Nordhaus and Tobin (1972) in their earlier Measure of Economic Welfare. In later revisions, Cobb *et al.* (1995), have made attempts to include a variety of factors relating to non-monetarised aspects of human welfare in their Genuine Progress Indicator. These factors include the loss of leisure time, the costs of crime, the breakdown of the family, and the human costs of underemployment. While we believe these attempts to quantify different aspects of welfare are important to an overall assessment of sustainable economic welfare, we have for the moment retained only those factors which form the basis for the majority of ISEW studies which have so far been carried out.

This overview of the methodological basis of the ISEW should serve to provide something of a rationale for the adjustments made to conventional measures of GNP, as well as providing a framework within which the subsequent detailed discussion of individual elements can be placed. However, it is not possible to reflect here the depth of discussion on specific points which has been undertaken elsewhere, and the interested reader is advised to read the very detailed appendix to Daly and Cobb (1989). Further detail on the development of the ISEW, critique of its methodology, and responses in the light of criticisms, can be found in Atkinson (1995),[15] Diefenbacher and Habicht-Erenler (1991), in Cobb and Cobb (1994), and in Cobb *et al.*, 1995.

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[15] The critique offered by Atkinson (1995) focuses on the ISEW developed for the UK by Jackson and Marks (1994). However, a careful reading of Atkinson's paper reveals that - to the extent that they are valid - his criticisms are directed at methodological decisions pertinent to the ISEW methodology generally, rather than to the specific way in which it has been used in the case of the UK. It should be noted, furthermore, that many of the difficulties Atkinson raises were highlighted by the authors themselves in their original paper.

4 THE SWEDISH ISEW COLUMN BY COLUMN

In the following subsections, we describe the individual columns which contribute to the Swedish Index of Sustainable Economic Welfare. It is worth re-emphasising that we have made no attempt to construct or to reconstruct a methodology for the purposes of this exercise. Rather we have largely followed the procedures already laid down for the US ISEW (Daly and Cobb, 1989), and later revisions of the same index (Cobb and Cobb, 1994). Where appropriate we have taken on board methodological amendments suggested by Jackson and Marks (1994). Occasionally, we have changed aspects of the methodology ourselves where this has been necessary to suit the particular context in Sweden. In what follows, we have also attempted to highlight those aspects of the methodology which we believe to be contentious or ripe for further investigation. For the main part, however, this is not intended as a detailed methodological discussion. Rather it is an explicit attempt to mirror for Sweden, what others have already carried out for other countries.

All costs in what follows are real costs (net of inflation) converted to 1985 Swedish kronor. In making this conversion we have used an implicit GDP inflator calculated from the ratio between published figures on GDP at current prices and GDP in 1985 prices.

Column A: Year

The Swedish index is presented for the period 1950-1992. During this period there have been certain changes in the national account statistics which have resulted in discontinuities in some statistical series in the years 1962/63, 1969/70, and 1979/80. We have attempted to bridge these discontinuities as and where they arise in as robust and consistent a fashion as we can, given the individual circumstances. Before 1950 there was no official book-keeping, and it would therefore be difficult to obtain reliable material in order to extend our time series before this year. Choosing 1992 as an end date was a practical decision, based on availability and accessibility of the relevant data; but it should be pointed out that it would be very interesting to see the development of the ISEW after 1992, in particular noting the impacts of the deep recession, subsequent partial recovery and emerging currency weaknesses in the last three years.

Column B: Personal Consumption

The basis for the ISEW, as for GNP, is a measure of private consumer expenditure or "personal consumption". Data on personal consumption have been published in Sweden since 1950 by SCB in the annual Statistical Reports (*Statistiska meddelanden).* A summary of data from 1950 to 1992 is also to be found in the 1993 National Accounts (SCB, 1993a, pp. 10-13).

As we have already noted (Figure 3), GNP in Sweden has steadily increased since 1950. The proportion of private consumption has decreased, and the percentage of public consumption has risen. This trend of shifting towards public consumption and away from private consumption is now changing, but it is worth noting again, that it is the opposite trend to development in, for example, USA and UK where proportions of public expenditure have fallen and private increased. The impacts which these differences exert on the ISEW will become clearer in what follows.

Column C: Distributional Inequality

This column attempts to account for the impacts of distributional inequality in the economy. The diminishing marginal utility of income is one of the reasons to suggest that distributional effects are likely to play a significant role in the relationship between personal consumption and welfare. Generally speaking, we may expect that "an additional thousand dollars in income adds more to the welfare of a poor family than it does to a rich family" (Daly and Cobb 1989, p. 402).

Clearly, some caution needs to be exercised in interpreting greater distributional equity as necessarily leading to higher levels of welfare, since other important variables, such as the work environment, number of working hours, or productivity may have been sacrificed in the struggle for a fairer income distribution.[16] Nevertheless, the significance of distributional equity is such that, following Daly and Cobb (1989) and other ISEWs (e.g. Jackson and Marks, 1994), we have felt bound to include the impacts of changes in income inequality in this study. Ironically, however the particular context has exerted an influence on income distribution which differs markedly from the effects of policies in certain other ISEW studies. Whereas in other countries (particularly in the US and the UK), the effects of income distribution have tended to exert a depressive effect on the index, in this study income distribution improves significantly over the period. In fact, as a result of its social and fiscal policies, Sweden had one of the most equally distributed incomes in the world during 1980 (Björklund, 1995).

When it comes to actually calculating the effects of income distribution, there are a number of possible routes.[17] One of the most well-known distribution measures is the Gini coefficient.[18] Rising values in the Gini coefficient indicate greater inequality and lower values mean less inequality. Our index is based on several different attempts to provide Gini coefficients for income distribution in Sweden. This was necessary since there is as yet no single study[19] which covers the whole time period in a consistent fashion. The two main sources were a preliminary study by Björklund (1995) on individual income distribution for the years 1951-1958 and 1960-1973 and a study by Jansson (1994) on household income distribution for years between 1975 and 1990.

It should be noted that the two studies are not directly comparable. Björklund (1995) calculates the Gini coefficient for individuals, both sexes, using collective net income data for the years above. Jansson calculates the Gini coefficient for household incomes, with different compositions made comparable by the use of "equivalence scales"[20] (Jansson, 1994, p. 7).

Revisions in the fiscal regime in 1990/91 led to adjustments in the calculation of income distribution. Fortunately for our purposes, Jansson (1994a) has revised his calculations for 1989 and 1990, and extended them to 1992. For the period between 1989 and 1992, we have therefore extended his initial series by indexing the value of the original coefficient for 1989 on the revised series for the last four years.

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16 In general, however, we would expect changes in these other variables to be reflected elsewhere in the index.

17 Cobb and Cobb (1994) discuss several of these, and Atkinson (1995) introduces another one.

18 The Gini coefficient is calculated by taking the area between a curve of actual income distribution and the line of perfect (ie equal) distribution. The coefficient takes values between 0 and 1, with 0 representing perfect distribution.

19 The study by Björklund (1995) will however, when finished, cover the whole time period.

20 Equivalence scales are used to weigh the number of adults and children in a family to make the families comparable.

Figure 5. Index of income inequality 1950 - 1992.

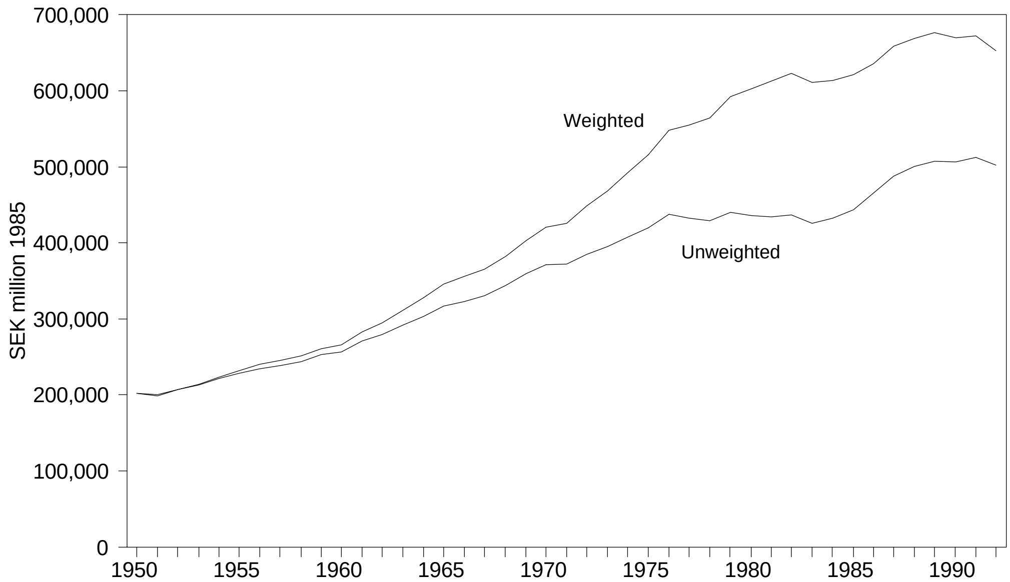

Figure 6. Personal consumption and weighted personal consumption.

The discontinuity between the Björklund data and the Jansson data series was more difficult to deal with as there were no overlapping years between the two studies. However, we managed to find a single existing observation of income distribution on a household basis for the year 1967.[21] Thus, we used the individual income distribution data to create an index of inequality of income from 1950 to 1967, and used the

21 Referenced in Björklund (1995).

household income distribution data to extend this index, based in the year 1967. To reduce the impact of year on year fluctuations in the data we have taken a five year rolling average of the series. Gaps within the two data series have been estimated by linear interpolation. The result is shown in Figure 5.

For purposes of comparison, Figure 5 also shows the index of income inequality for the UK. As the Figure illustrates, income distribution improved significantly in Sweden (although it remained largely static in the UK) through to about 1980. During the 1980's, income inequalities increased dramatically in the UK, whereas in Sweden the index more or less levelled out. There was a slight improvement in income distribution in Sweden during 1992. But according to Jansson (1994) it is too early to say if this can be interpreted as a break in the trend or not.

Column D(+): Weighted Personal Consumption

Weighted personal consumption has been calculated by dividing the personal consumption data of Column B by the index of inequality in Column C, and multiplying by 100. The division by column C (rather than multiplication) reflects the fact that the higher numbers in the index of inequality imply greater inequality and therefore (by assumption) lower levels of welfare. Figure 6 illustrates the impact of this weighting on personal consumption. As may be seen from the graph, the weighting of personal consumption has virtually no impact over the first decade of the study. Thereafter however, weighted personal consumption rises significantly above the unweighted value as income distribution improves. Given the importance of income distribution in determining the overall shape of the index (cf Jackson and Marks, 1994, Appendix B), we could already predict that (other things being equal) the Swedish index will demonstrate considerably less "downturn" than was demonstrated (for instance) by the UK (cf Figure 2).

This column now becomes the revised basis for the rest of the index. Subsequent columns are either added to or subtracted from this column, according to whether they represent benefits or losses in terms of sustainable welfare.[22]

Column E(+): Services from Domestic Labour

Not all activities which contribute to welfare belong under the remit or regulation of the market sector of the national economy. Personal household labour, childcare, parenting, mending and maintenance, voluntary care-work and leisure activities all contribute in some form to well-being in the population, and in many cases are, as Cobb *et al.*. (1995) point out, "a precondition for a healthy market sector". Yet the level of contribution of such activities is entirely excluded from measures of GNP in the economy. The idea of including some at least of these activities in satellite accounts or within the umbrella of economic statistics now has a strong pedigree. It was proposed, for instance, at the United Nations' Decade (1990s) for Women Conference in Nairobi. It was the subject of an unsuccessful private member's bill in the UK in 1989; and it is recommended explicitly in Agenda 21, the Rio Earth Summit's (1992) "blueprint for sustainability".

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[22] Of the other studies, only the preliminary study from the Netherlands shows a similar trend in improvement of income distribution over the period. In that study, the authors based the index (=100) at the end of the period rather than the beginning. This would have the effect of lowering the absolute magnitude of the ISEW relative to GNP, particularly at the beginning of the period, but the shape of the index would still remain similar. However, it would tend to obscure the impact of income distribution in the Swedish case by comparison with other countries whose income distribution worsened. For this reason, we have chosen to keep 1950 as the base year.

Amongst the first person to attempt such an exercise was Eisner (1985) who derived an annual value for household labour in the United States by multiplying "time-use" data by the average hourly compensation for domestic workers. This methodology was followed by Daly and Cobb (1989) in their ISEW for the States. Cobb *et al.* (1995) have taken the idea even further and included not only household labour but also voluntary work and leisure time within their Genuine Progress Indicator.

In the present study, we follow the general trend pursued within previous ISEW studies. We acknowledge here the need for more extensive and more detailed analyses of other unpaid aspects of the economy. But resource and data limitations (and our desire for compatibility with other studies) limits the present exercise to an assessment of the value of selected aspects of household labour in Sweden.

We found only one officially recognised national time-use study in Sweden, namely the one undertaken by the SCB (1992a) for 1990/1991. In 1984/85 however, SCB carried out a pilot study for the 1990/91 national study (SCB, 1988), which used much the same format as the later study, but drew from a smaller sample. To get an idea of the trend over time, we also used data from a study carried out by the *Socialdepartementet* (SOU, 1965) which collected time-use data for the year 1963.[23] This earlier study had aimed to estimate the value of time spent in household work in order to form a basis for calculating the costs of child-care in the home, as more and more women joined the labour market.

Domestic activities from the three studies are divided into a number of different categories, not entirely commensurate between the studies. For the purposes of this paper we have therefore attempted to select a set of activities which is common between the studies. Our included activities fall within the broad scope of activities generally classified as domestic labour,[24] namely: child care, housework, odd jobs, and shopping for necessities. Some activities - such as "recreational" shopping and gardening have been excluded since they are essentially leisure activities. Assessment of changes in leisure time is an important aspect of the measurement of welfare, in particular in relation to human capital. However, we have deliberately omitted these aspects from the ISEW (see section 3 above). Travelling has been excluded because it does not seem obvious that increased shopping travel time represents an increase in welfare. Finally, we were forced to omit time taken in caring for elderly and sick relatives (even though this clearly contributes to welfare) because there was insufficient data in the early study to warrant inclusion.

Differences in categorisation aside, the studies revealed that the average time spent in domestic labour fell by over 15% from about 23 hours a week in 1963 to about 19 hours in 1984/85, with relatively little change between 1984/85 and 1990/91. It is perhaps interesting to note a marked tendency for men to spend more time in household work (13 hours in 1990/91) later in the period than they had spent earlier (less than 3 hours in 1963). Conversely, women spent considerably less time (25 hours in 1990/91) later than they had done earlier (43 hours in 1963).[25]

Using these three sample years (1963, 1984 and 1990) we have created two time series - one for women and the other for men - by linear interpolation and extrapola-

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23 We also checked the trends derived from these Swedish studies against trends in other similar countries, in particular the Scandanavian countries, as reported by Gershuny (1992).

24 See for example: *The People's Activities and Use of Time - a reference book based on two surveys in Great Britain 1974-5*, BBC, Audience Research Department, British Broadcasting Corporation, London, 1978.

25 This latter change seemed significant enough to warrant independent verification, so we checked the 1963 data against a consumer survey carried out by the Swedish Consumer Institute in 1961 (and reported in SCB 1980). On the basis of 1,000 interviews the Institute concluded that Swedish housewives spent around 40 hours in household tasks (washing, cleaning etc) during 1961.

tion. The total annual time spent in household labour has been computed from these series using population statistics by sex in the 16-64 age group.

Monetary evaluation of time spent in household labour is a complex question. It is generally agreed that the correct approach is to identify an appropriate "shadow" wage rate - the basis for which is the wage rate applicable to that section of labour market which most closely resembles domestic labour. This is the approach adopted by other ISEW authors, and we have followed it here. There is still a question over which is the appropriate wage rate. Firstly, one must identify an appropriate wage rate for that sector of the market. In principle this might demand a thorough calculation of the different wage rates, and it is unlikely that wage rates would be available for every type of work. In practice, however, it is not unreasonable to choose a representative wage rate for domestic labour. In Sweden, the closest to such a representative wage rate was the wage rate of a home help or *hemsamarit*.

Finally, one must decide whether to use a real time-varying wage rate for each year of the series, or whether to use a constant real wage rate. To use a time-varying wage rate is in a sense most in tune with the concept of valuing time spent in domestic labour at the "real" shadow cost of employing someone else to do it. But it could certainly be argued that changes in relative wage rates for specific sectors of the workforce is more to do with social policy than real changes in productivity in those sectors. To use a constant wage rate is therefore to suggest that - irrespective of the wages actually paid - the unit *value* of household labour is independent of actual wage regimes. In spite of the intuitive validity of this reasoning, there is little evidence to support one particular value for household labour over another, apart, for course, from the value imputed by actual wage rates! In other studies, there has been no consistency in making this choice. The original US study used a constant real wage rate. Both the German study and the UK study used a time-varying wage rate, although the UK study provided a sensitivity using a constant (1990) wage rate. Here we follow the example of the UK study by adopting as our main case, the use of a time-varying shadow wage rate, and applying a sensitivity analysis. This sensitivity analysis showed that the impact of this choice on the overall shape of the index was substantial enough to warrant a more detailed examination of the issue. Unfortunately, such an examination must also remain beyond the scope of the present paper.

The wage rate for a household worker (*hemsamarit*) in Sweden in 1991 was around SEK 70 in 1991 prices - or just under SEK 50 in 1985 prices (SCB personal communication). Since we were unable to find a consistent time series for this kind of worker, we have indexed this 1991 figure on the basis of the average hourly rate for a general labourer in the manufacturing, mining, and quarrying sector (SCB, 1994a).[26]

Column F(+): Services from Consumer Durables

Each year a proportion of personal spending is dedicated to purchasing consumer durables. Since these durables last for longer than the year in which they are purchased, it is in principle incorrect to count the whole expenditure as a consumption flow in that year. At the same time, services in that same year are delivered by durables purchased in previous years. Conventional accounting for consumer expenditure within the national accounts makes no allowance for these differences between expenditure and the services which flow from them. The ISEW attempts to rectify this failing by treating consumer durables as capital investment and computing a "service

[26] This time series was available for each year except 1951 and 1950 for which we have estimated the wage rate assuming the same annual change between subsequent years as there was between 1952 and 1953.

flow" from the net stock of durables during each year of the study. For the Swedish study (as for the UK study) we have used existing work (Berg, 1988, 1995) to estimate the value of services from consumer durables. The results of this work are expressed in terms the services flow from consumer expenditure as a whole, rather than from consumer durables *per se*. Accordingly we only need to consider the difference between the consumer expenditure as a whole and the estimated service flow from it. This is done under column I below, where we also discuss some of the details of the work we have used.

Column G(+): Services from Streets and Highways

As was indicated in section 3, government expenditure should be included in the ISEW only to the extent that it is non-defensive and contributes to improving welfare. An example of such expenditure might be the investment in capital infrastructure such as streets and highways. In principle, therefore one would wish to include some contribution to government expenditure arising from such investments. In practice however, it is necessary to avoid double counting, when the costs of such investments are levied under indirect taxation such as vehicle licensing. In the conventional system of national accounts these indirect taxes are included in personal consumption. Government spending is also included as a contribution to GNP, but any tendency towards double-counting is remedied by making the factor-cost adjustment which removes the effects of indirect taxes and subsidies from the final account. On the assumption that we have included such taxes already within personal consumption, we have therefore made no additional contribution to the index from government expenditures in this column.

Column H(+): Public Expenditure on Health and Education

There are a number of ways of characterising public expenditures on health and education. In the first place, one could consider that some of these expenditures represent pure consumption. For example, contributions to adult education might be deemed to fall into this category where these contributions seek to stimulate leisure activity rather than the acquisition of skills for the job market. On the other hand, there are clearly elements of such expenditure which do seek to improve the skills of the labour force. The difficulty here is that this expenditure really represents investment in human capital, which is (presently) excluded from consideration under the ISEW. It is moreover extremely difficult to identify a fail-safe method of accounting for the accumulation of human capital accruing from these investments. Daly and Cobb (1989) argue forcefully that some at least of these expenditures are purely defensive, and relate more to improving relative position in the labour market than to a significant overall increase in human capital or to increased productivity in the market. Finally, it is clear that some at least of the expenditure on health must be regarded as defensive against accidents and environmentally-related illnesses incurred in the population as a result of activities carried out in the economy.

Accordingly, the ISEW does not include all government expenditures on health and education, but takes only half of the expenditure on health and half of the expenditure on further education as non-defensive contributions to welfare.

For the years 1970-1992 data on these expenditures were taken from statistical reports on education published by SCB (1992b, pp 21; 1985, pp 16-17, personal communication). The government current expenditure on universities and adult education was added up, converted into 1985 prices, halved and then added to the index.

Note that only expenditure on further education has been included. Expenditure on, for example, comprehensive schools, integrated upper secondary schools, and special schools have been excluded.[27]

For the years 1950-1970 there is no disaggregated compilation of educational expenditures within the National Accounts. However, in the government budget, published in the Statistics Yearbook (*Statistisk årsbok*), state expenditure on education is specified by school type. We have therefore used these data to compile the contribution to education prior to 1950.[28,29]

Data on government and community expenditure on health have also been taken from the National Accounts and from the Statistics Yearbook for various years[30] and converted into 1985 prices.

Column I(-): Consumer Durables
- difference between services and expenditure

The methodology of the ISEW, as distinct from conventional national accounting, is to exclude expenditures on consumer durables, but to include an estimate of the services flowing from the stock of consumer durables in any one year. In the Swedish case we have used the results of a calculation by Berg (1988, 1995). These results are expressed in terms of the services flowing from consumer expenditure as a whole. But the calculation from which Berg derives his results makes it clear that he has included essentially the same methodology for calculating the flow of services from durables as was intended by Daly and Cobb (1989) and Cobb and Cobb (1994) in their ISEW for the US.

In order to derive this service flow, Berg considers consumer expenditure in two main categories: consumables - in which all service flows derive from expenditures in that year; and durables - in which service flows derive from a number of years following the year of purchase, depending on the service life of the durable in question.[31] The consumer durables are computed according to three subcategories: cars, other durables and semi-durables. The service flow is estimated by taking the net stock in each year and deriving from it a "user value" based on two components. The first component is the depreciation charge calculated using an appropriate depreciation rate on the net stock in that year. The second component is an interest rate to account for the opportunity cost involved in possessing a consumer durable in that year. The net stock is calculated from a base year (1950) by depreciating the base year stock by the appropriate depreciation rate.

Thus the overall calculation of the consumption flow CF_t in year t from consumer expenditure CE_t in year t is given by the following formula:

$$CF_t = CE_t - CD_t + (h+d)K_t,$$

[27] The capital expenditure (current + capital expenditure =total) (i.e. investments including student loans) is not avail able by school type, which makes it impossible to define how much is devoted to further education. Therefore we had to exclude the capital expenditure even though this is not a satisfactory solution.

[28] We used the expenditure figures on "higher education and research", "teacher education" and "adult education" from the Ministry of Education and the figures on "education and research" from the Ministry of Agriculture.

[29] Expenditures by municipal and provincial authorities are not specified by type of education - and are therefore excluded from our analysis.

[30] SCB (1955, 1964, 1975a, 1981a, 1993b).

[31] Actually, in the Berg study which we have used here, lifetime assumptions are expressed in terms of an exponential depreciation at constant rate.

where CD_t is the expenditure on consumer durables in year *t*, *h* is the real interest rate (after tax), *d* is the depreciation rate, and K_t is the net stock of durables in year *t*. The net stock in each year is calculated from:

$$K_t = (1 - d/2)CD_t + (1-d)K_{t-1}.$$

Different depreciation rates are applied to the three categories of durables. For cars, the depreciation rate has been taken from a report by Jacobson (1980), and varies on a yearly basis from 1965 onwards. For durables other than cars the applied depreciation rate is 15%, and for semi-durables it is 30%.

It is clear from this methodological overview that the calculation here differs slightly from that carried out in the US by Cobb and Cobb (1994) and Cobb *et al.* (1995) in which the service flow from consumer durables was calculated by multiplying net stock in each year by 22.5% based on an assumed depreciation rate of 15% and an interest rate of 7.5%. To the extent that Berg's depreciation rates and interest rates incorporate some variance according to (respectively) category of goods and time, the present methodology is slightly more sophisticated, but essentially compatible with, the US methodology.

Since the results of Berg's calculation are expressed in terms of total consumption flow from all consumer expenditures, in this column we need only subtract the difference (positive or negative) between consumer expenditure and service flow.

In fact, this difference is for the most part negative, since (as Figure 7 reveals) the service flow exceeds consumer expenditure except for a handful of years.[32]

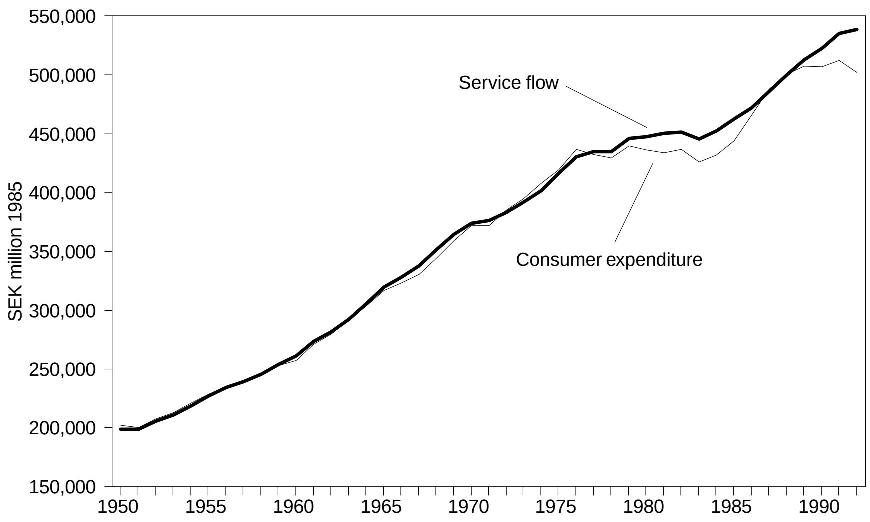

Figure 7. Consumer expenditure and service flow in Sweden 1950 -1992.

[32] This result is significantly different from the UK result (Jackson and Marks, 1994), in which the service flow was consistently less than the expenditure, and diverged from it over the period of the study. In that study, the authors also used existing literature (Patterson, 1992) estimating the service flow from consumer expenditure, but the methodology of the UK study was different. At the present time it is not possible to comment on whether the different results arise purely from methodological differences or whether they reflect real differences in the value of the service flow between the two countries. Clearly, this question is worthy of further investigation.

Column J(-): Defensive Private Expenditure on Health and Education

Consistent with the assumption that one half of public expenditures on health and education contribute to welfare, the ISEW also assumes that one half of private expenditures on health and education contribute to welfare. Since all such expenditures are included in personal consumption, this assumption requires us to subtract the requisite sum from the index in this column. In fact, this calculation is relatively insignificant in the case of Sweden because much of the expenditure on both health and education is borne by the government.

Data on private health expenditure have been taken from the National Accounts for various years.[33] Included in the expenses for health and medical care are costs for: medical and pharmaceutical products, medicines, therapeutic appliances and equipment, and fees for services by physicians, dentists and related practitioners. This classification of health and medical expenditure has been used for the years 1980-1992. Over the years classifications have changed. There are two large "jumps" in the series due to reclassification, the first in 1962/63 and the second in 1979/80. In order to prevent discontinuities the ratio of the old and new values for 1980 has been calculated and used as an index for the earlier series. The same thing has been carried out for the "jump" in 1962/63, although this has been complicated by the lack of comparability between the pre and post 1963 statistics. The 1950-63 statistics included a much broader classification of health expenditures including undertaking, dyes, paint, toilet articles, medicines, domestic services, hairdressing, doctors fees, dentists fees, and laundry expenses. To remain compatible with the index post-1963, we indexed the pre-1963 data using only expenditures on medicine, doctors fees and dentists fees.

Data on private expenditures on education are available for the years 1963 to 1992 from the column "private education" under "private final consumption expenditure" in the National Accounts (see footnote 30). Prior to 1963 no data are available, therefore an extrapolation has been made.

Column K(-): Cost of Commuting

Travelling to and from work is necessary in order to maintain the productivity of the economy. But the time and money spent on commuting do not contribute to personal welfare, even though the financial expenditures appear as additional contributions to GNP in the national accounts. In the ISEW therefore, commuting expenditures are treated as defensive and subtracted from the index in this column.

Travel surveys and expenditure on cars and public transport have been used for the calculation. The aim is to calculate the cost of commuting for each mode of transport. But for our purpose we have only used two groups: cars and public transport. We have excluded travel by sea and by air.

There are to the authors' knowledge only two travel surveys available in Sweden, one for the year 1978 and one for the year 1984 (SCB, 1980b, 1986).[34] For the year 1950 an estimation by the Transport Commission (*Transportrådet*) has been used (Nelldal, 1982). These studies have been used to estimate the proportion of commuting journeys by type of transport. Linear interpolation has been used for the intervening years, and a linear regression analysis has been used to estimate the proportions during the final years of the series. Total transport distances, allocated by mode of transport, have also been taken from Transport Commission data (Transportrådet,

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33 SCB (1975a, 1981a, and 1993b).

34 Another travel study is due to be published shortly.

1982) for the years 1950-1980. Data for 1990 were taken from an SCB report (SCB, 1993c, p. 44). These studies have been used to estimate the proportion of total transport allocated to commuting journeys. For the intervening years interpolation has been used and for the years 1991 and 1992 regression. These two calculations then allow us to estimate the total number of commuting kilometres travelled by the two categories: cars and public transport.

In order to calculate an economic cost, we have used expenditure figures from the National Accounts (see footnote 30). These data supply a total cost, and have been used to estimate an average cost per kilometre figure (for all purposes) using the total transport distance data. This average cost per kilometre was then multiplied by the estimated kilometres for commuting purposes in each year of the series. Inconsistencies in the classification of consumer expenditure on transportation have been dealt with by indexing the earlier parts of the series on the basis of overlapping years.

Column L(-): Cost of Personal Pollution Control

In the revised index, Cobb and Cobb (1994) argued that defensive private purchases of (for example) pollution control equipment should not be included in a welfare measure. However, figures for this kind of expenditure have not been found for Sweden. It might be possible to estimate private pollution control expenditure for Sweden on the basis of the ratio between GNP in Sweden and GNP in other ISEW countries. But this did not seem appropriate since rather different legislative and policy environments operate in Sweden, and have certainly contributed in some measure both to improved environmental performance and higher public expenditure on environmental protection. We have therefore decided to omit this column from our calculation, at least until there is a more reliable basis for estimation.

Column M(-): Cost of Automobile Accidents

The costs generated by car accidents are deemed to be defensive in nature, and are therefore subtracted from personal consumption in this column. Estimates of these costs in Sweden have been compiled in a number of places. For example, the National Road Association, has recently articulated a relatively sophisticated method for evaluating the cost of road accidents (NRA, 1992), in which account is taken of hospital costs, material damage to property, administrative costs and humane costs (including the cost of suffering, sorrow and worry). These cost categories are estimated for deaths, severe injuries, slight injuries and accidents involving only property damage.

Unfortunately, consistent time series data on these categories are not available for the entire period of the study. We have therefore used a total cost estimate for all road traffic accidents in 1982 compiled by the Department of Communication (DsK, 1985). Converted to 1985 prices this total cost is estimated at just over SEK 10,500 million and comprises costs for hospital care, material damage, administrative costs, production losses and humane costs.

It would clearly not be appropriate to include all of these costs in our estimate, since to do so would invoke double-counting. We have therefore excluded health costs (on the basis that some account at least of this is taken in the treatment of health expenditures in the index). We have also excluded the estimate of production losses, since these will already have been reflected in the level of national income (and hence of consumer expenditure) in the given year. Once these costs are excluded the total cost of traffic accidents in Sweden in 1982 becomes SEK 7,818 million.

To arrive at a consistent time series we have indexed the total 1982 cost on the basis of the reported data on the number of accidents involving injuries or death in Sweden (Statistical Yearbook, various years). Ideally we should have indexed this series on the total number of accidents, including those involving only material damage. However, reporting on this total stopped in 1965, and since that time only accidents involving injuries and/or death have been compiled. The main reason for this is the unreliability introduced as a result of an increasing number of unreported accidents (involving only material damage). It should be noted that our estimate is therefore probably an underestimate of the total costs, particularly in the later years of the study.

Column N(-): Cost of Water Pollution

Water resources are a key element in maintaining sustainable economic welfare. It is therefore important to consider the degradation or depletion of those resources, and to keep some account of that degradation within the ISEW. This column attempts to carry out this task by reflecting changes in water quality over the period of the study.

Assessment of water quality is complex and multifaceted. There is no single measurement which will suffice to reflect overall water quality. In the first place, there are a number of different kinds of water resources: river water, coastal waters, ground waters and so on. For some of these resources, there are really no reliable time series data on quality. For others, such as river water quality, measurements exist in Sweden, but are generally disaggregated according to different kinds of pollutant levels: phosphorus, nitrogen and biological oxygen demand.

To construct an index of water quality for the purposes of this paper, we have started from the yearly mean values of measured levels of pollutants in river water. Data from 1965 onwards have been taken from measurements made under the PMK programme which is a monitoring programme instituted in the 1960s, first under the supervision of SNV and later the Swedish University of Agricultural Science (*Sveriges Lantbruksuniversitet* (SLU)). There are no data available for the years preceding 1965. Consequently, we have extended the series prior to 1965 based on remarks by Falkenmark (1977) to the effect that in 1925 the average release of P and N was negligible, but the total load had increased 30 fold in P and 10 fold in N by 1970. Many lakes, rivers and coastal water areas became heavily polluted during the 1940s, 1950s and 1960s reaching a peak in 1970 since anti-polluting measures were introduced in the 1960s (*op cit* p. 65).

Using the mean value of pollutant levels in different rivers does not necessarily provide a representative measure of overall river quality, as the different rivers vary in size and length. We therefore explored two separate ways of creating a quality index. In the first method, we simply took the monitored pollutant levels for each pollutant, indexed them on 1985 levels and then took the average of the three indices. In the second method, we first weighted the average pollutant levels by drainage area, before indexing the series to 1985 and averaging over the three pollutants.[35] A comparison shows (Figure 8) that the two final indices display similar trends, but the one using weighted measures is somewhat “smoother” (some extreme values have been eliminated) and the peak is a bit earlier than the unweighted one. For the purposes of this study we have used the weighted measure.

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35 It should be noted that drainage area is not necessarily comparable with the total pollution load, but in the absence of any other indication of size, it does provide an estimate of the extent of pollution in affected rivers.

We could find no data on the costs of damage from water pollution in Sweden. Consequently, we decided to use the same methodology which was employed in the UK study, namely to scale the estimated costs of water pollution in the USA in 1972 according to the relative difference in GNP. We recognise that, as with the case of the UK study, this does not necessarily provide sufficient representation of the differences in geography, policy regime or industrial structure between different countries. Nevertheless, in the absence of a more detailed assessment it will provide an indication of the costs associated with water pollution in Sweden. The estimate indicated that the costs of water pollution in Sweden in 1972 were in the region of SEK 25,474 million (1985 prices).

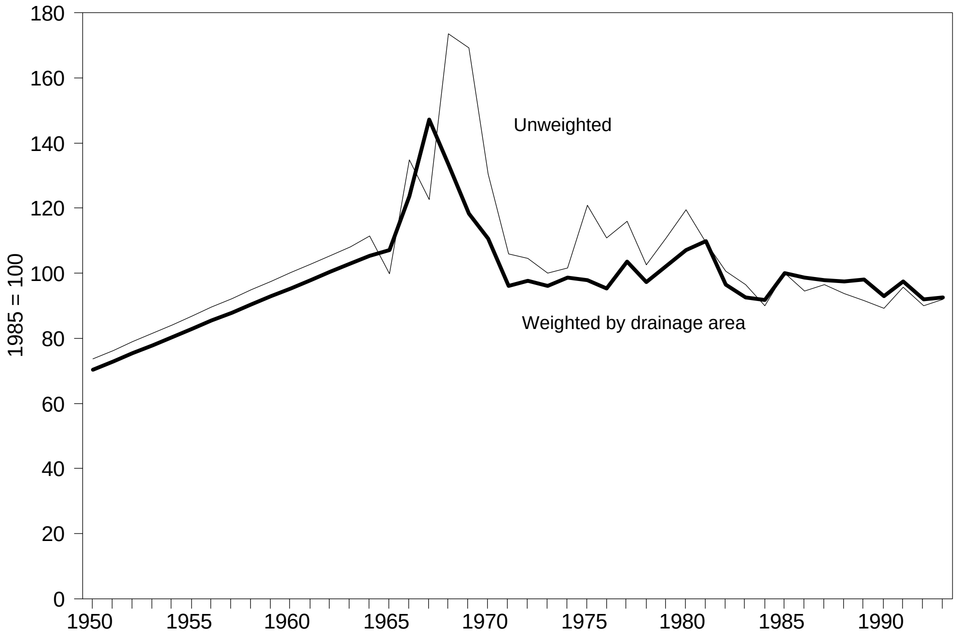

Figure 8. Weighted and unweighted water pollution indices.

Column O(-): Cost of Air Pollution

The original US ISEW (Daly and Cobb, 1989) used emissions of three priority pollutants - sulphur dioxide (SO_2) nitrogen oxides (NO_x) and particulates - to provide an index of air pollution. Critics have argued (Cobb and Cobb, 1994) that the ISEW should be measuring the "loss of services from the stock of clean air", and in the revised index, Cobb *et al.* used ambient air quality levels, rather than emission levels, as a proxy for this factor. Jackson and Marks (1994) have argued that in fact this revision is misleading for a number of reasons. In the first place there is only very limited data on ambient air quality. In spite of extensive monitoring in specific locations, there is no robust picture of national trends in air quality. Secondly, the damages caused by air pollution are not entirely reflected by losses of ambient air quality, but also include impacts on buildings, soils, plant life and water supplies. Jackson and Marks therefore retained the original use of emission levels as a proxy for the loss in services resulting from air pollution. They also argued for the inclusion of two additional priority pollutants - volatile organic compounds (VOCs) and carbon monoxide (CO) in the UK index. In the present study we have followed these methodological decisions.

Official "bookkeeping" of atmospheric emissions in Sweden was started by SCB in 1980. Prior to that date, we have used a number of different sources to estimate an index of emissions over the whole period. These sources are discussed in more detail below, where we also discuss the derivation of the economic cost assigned to emissions of each pollutant.

Sulphur dioxide (SO_2) emission data has been estimated for every fifth year between 1950 and 1980 by SNV (1984). From 1980 and onwards (not including all years), SCB (1994b) has kept an official record. Linear interpolation has been used to fill in the gaps in data.

The value that has been used for our estimation of the damage value of sulphur has been taken from the first pilot study by KI and SCB of the Swedish National Environment Account (see section 2 above). This study has valued the costs of sulphur related damages in 1991 in four different areas: forest, agriculture, fresh water and urban areas, and the valuation has been carried out on the basis of lost production, replacement costs and compensation costs. The estimation is considered by the authors of that study to be conservative, and the largest contributor (as shown in Table 2) is the corrosion damage as it is the easiest to value.

Table 2. Valuation of total sulphur related damages in 1991.

Areas	Total damage cost in million SEK in 1991
Forest	550
Agriculture	5
Fresh water	130
Corrosion	1885
Total	2570

Source: KI/SCB 1994

On the basis of this estimate, the cost of releasing 1 tonne of SO_2 is estimated at SEK 6,425 in 1991 prices (SEK 4,259 per tonne in 1985 prices).

Nitrogen oxides (NOx) emissions data have been taken from a report (Kindbom *et al.*, 1993) by the Swedish Environmental Research Institute (*Institutet för Vatten- och Luftvårdsforskning* (IVL)). Their estimates are slightly higher than those published by SCB, but are used here as they cover the whole time period up until 1990. For 1991 and 1992 we have complemented the series with adjusted data from SCB.

The Swedish National Road Association (NRA, 1992) has valued the average cost of NO_x emissions at SEK 40 per kilo in 1993 prices which includes the negative effects on health and nature. This gives a value in 1985 prices of SEK 26,142 per tonne.

Data on releases of **carbon monoxide (CO)** from traffic are published in the SCB's (1990) Environmental Statistics Yearbook (*Miljöstatistisk årsbok*) for the years 1950, 1960, 1970, 1980 and 1990, and we have constructed a series for the entire period from these data using linear interpolation and regression analysis for 1991 and 1992. We were unable to find a valuation estimate for CO emission in Sweden, and we have therefore used the Tellus (1991) estimate used by Jackson and Marks (1994) in the UK study. That study calculated the cost of emission at £380 per tonne of CO which translates to SEK 4,245 per tonne in 1985 prices.

Official recording of emission levels from **volatile organic compounds (VOCs)** started in 1988. SCB (1994c) has data for the years 1988, 1990 and 1992. We also found two individual estimates of total VOC emission levels, one for 1975 (Levander, 1978), and another for the year 1969 (SCB, 1979b). Prior to 1969, we managed to find selected estimates of VOC emissions from the transport sector (SCB, 1990). Noting that emissions from transport comprised 90% of total VOC emissions in 1969, we have estimated total emissions prior to that date by indexing the 1969 figure on pre-1969 transport emissions. For intervening years, linear interpolation has been used to complete the series. In determining economic costs we have again drawn on the Tellus (1991) estimate. The marginal cost of VOC emission is estimated at £2,312 (1985) which converts to SEK 25,824 (in 1985 prices).

Data on the emission of **particulates** (*stoft*) were identified for the years 1969 (SCB, 1979b), 1975 (Levander, 1978), 1987 and 1990 (SCB, 1990). The trend in particulate emissions was declining sharply through the 1960s and early 1970s as a result of improved pollution control in industry and power stations. For instance emission levels in 1969 were 400,000 tonnes, but by 1975 they had dropped to less than 200,000 tonnes. A graph taken from a SNV publication (1982) indicates that particulate emissions prior to 1969 were even higher than 400,000 tonnes with a 1965 figure in the region of 500,000 tonnes. For the purposes of this exercise we have assumed that emissions peaked at 500,000 tonnes in 1965. Prior to that date we have indexed emissions on the basis of total industrial output (expressed in terms of constant 1985 prices as supplied from the Statistics Yearbook - various years).

In determining the economic cost we have once again drawn from estimates used in previous studies. Two such estimates were identified by Jackson and Marks (1994), one arising from the Tellus study (1991) and the other from the Pace study (1990). In this study, we have taken an average of these two estimates. In 1985 prices this comes to SEK 15,543 per tonne of particulate emissions.

Column P(-): Cost of Noise Pollution

The long-term objective for outdoor noise levels is given by the Swedish Environmental Protection Agency (SNV) as not exceeding 55 dB. Noise above that level is classified as pollution. The Swedish National Road Association (NRA) have estimated that the cost of noise from traffic is SEK 8,000 (1993 prices) per person exposed to the noise pollution (NRA, 1992). Estimates of the number exposed to noise differ from study to study due to different assumptions about the variables which affect exposure. The variables usually considered when estimating the number of people actually exposed to road noise are: urban expansion, traffic development, population density and preventive measures against noise pollution.

One study has examined the number of people exposed to noise between 1970 and 1990 (Wittmark, 1992, p. 17). It estimates that 1,571,000 people were exposed to noise in 1990. According to this study there had been only slight changes in the number of people exposed to road traffic in the previous twenty years, even though the traffic density has increased. This is due to reasons such as better traffic planning. The estimated number of people exposed to traffic noise in 1970 was 5.3% more than in 1990. Linear interpolation has been used between the years 1970 and 1990. We assumed the same increase in the number of people exposed to traffic noise in the years 1950 to 1970 as the decrease of 5.3 % between the years 1970-1990. For the last two years in the series we used a linear extrapolation.

Column Q(-): Loss of Wetlands

About 20% (9.3 million hectares) of the total land area in Sweden is classified as wetland (Löfroth, 1991, p. 23). This wetland area has decreased over the years, mostly due to draining of farmlands and forests in order to raise productivity. According to an SNV estimate, the ditching of farmland amounted to 1 million hectares between 1800 and 1950. During the same period the ditching of forest land was 0.5 million hectares. This makes a cumulative loss of 1.5 million hectares of wetland until 1950 due to ditching and drainage. Since 1950 only a small amount of farmland has been drained. The draining of forest land has, however, continued after 1950 and is the main source of wetland loss for the study period. Peat cutting is only responsible for a small part of the loss. Data for the change in wetland during the study period is scarce. Since the draining of forest land is seen as the largest contributor to the loss of wetlands during the study period, these figures have been used to estimate the change in wetland over the years.

The data on drained areas is taken from the Forest Statistics Yearbooks (SSÅ, 1957, 1970, 1974, 1984 and 1994). Before 1982 the so-called "benefit area" (area affected by ditching) is not shown in the statistics. The yearbook only gives the length of ditches in kilometres. We have therefore used a conversion factor of 200 metres of ditching to 1 hectare of wetland to estimate the wetland loss.[36] In 1982 the method of accounting was changed and remedial ditching was calculated separately. Since 1986 no official statistics for private remedial ditching exist. The Swedish National Forestry Board estimate private ditching at 8, 000-10, 000 ha in 1986 (SSÅ, 1994, Table 6.13, p. 130), for the remaining years we have assumed a link between the amount of private ditching and that carried out by the Crown.

To calculate the cumulative loss of wetland area we used the estimated 1.5 million hectare loss up to 1950 and then added the calculated yearly loss of wetland due to forest draining. The total loss of wetland since 1800 until 1992 is according to this calculation 2.5 million, i.e. a further 1 million hectares were drained from 1950 onwards.

According to a survey of wetland studies (Gren & Söderqvist, 1994) there are two Swedish studies that have estimated the environmental value of wetlands (as a nutrient sink and fish and water supply). Using an indirect valuation method, Folke (1991) estimated the value of wetland at US $240/ha/year. While Gren (1994) using both direct and indirect methods estimated the value as US $239-585/ha/year. We have used a low figure of US $240, since the majority of the wetland loss will probably not have the same high functional value as that of the field studies. We multiplied the cumulative loss of wetland by the value above (SEK 948 in 1985 prices) to get the value of the loss of wetland.

Column R(-): Loss of Farmlands

This column attempts to account for the loss of sustainable productivity from agricultural land in two distinct ways. Firstly, it estimates the costs of losing productive farm land through urbanisation. Secondly, it assess the costs of reduced productivity in the land, resulting from falling soil quality.

[36] This is the conversion factor used in Table 6.12, SSÅ 1994 p129.

Urbanisation

When urban expansion occurs, land is permanently taken out of agricultural production. New urban land use may increase industrial output, which in its turn will be reflected in a higher level of personal consumption. Nevertheless, the cost associated with this increase in economic output is the loss to present and future generations of agricultural productivity.

Urban expansion in Sweden reached a peak in the period 1965-1977. During this time the so-called “million programme” took place, in which a million apartments were built - mostly on agricultural land. In fact, between 1970-1980 over 50% of all urban expansion took place on agricultural land. In 1977, it was decided to limit further expansion of urban areas on agricultural land, and the effect of this policy decision is clearly revealed by the data from later years.

Data on urban expansion have been collected and collated in Sweden since the beginning of the 1960s by SCB (1993d, 1987). The total urban area in 1960 amounted to just under 350,000 hectares. In order to estimate the urban expansion between 1950 and 1960 we have assumed the same ratio of land required per urban inhabitant as resulted during the period between 1960 and 1965. This assumption implies that the total urban area in 1950 was just over 300,000 hectares. Not all of this urbanisation will have occurred on agricultural land. To estimate the loss of agricultural land up to 1950 we have assumed that earlier patterns of urbanisation incurred the same ratio (about 0.3) of agricultural loss to total land loss as occurred during the earliest period for which we had data, namely the period between 1960 and 1965. This assumption implies that the total loss of agricultural land to urbanisation up to 1950 amounted to some 94,000 hectares.

The valuation of losses of agricultural land to urban settlement is complicated by a number of factors. In the first place, the actual market price of land differs substantially according to location and productivity. Perhaps more importantly, as Daly and Cobb (1989) have pointed out, land resources tend to be underpriced because productivity can be maintained by cheap energy and chemical inputs. From the point of view of a sustainable economy, they argued, we should use a price which “represents the value of land as if cheap energy sources had already been depleted” (*op cit.* Daly and Cobb, 1989, p. 435).

In tackling the first of these difficulties we have computed a representative market price for agricultural land based on rateable values for arable and pastural land in 1992 (SCB, 1993e). A weighted average value was computed using the rateable value of the highest quality class (5) for each land type (arable and pastural) and the proportion of arable to pastural land. This rateable value was then converted to a market price using a standard market price coefficient (SCB, 1993f, Table 4:10). In 1992 prices, this amounted to just under SEK 22,000 per hectare, which converted to around SEK 14,000 per hectare in 1985 prices. In order to account for Daly and Cobb’s argument for higher land values we rounded this figure upwards to SEK 15,000.[37]

Loss of soil quality

SNV (1992) identifies a number of factors on which the fertility of agricultural soils is dependent. These include atmospheric deposition, concentration of organic material and nutrients, soil erosion, and compaction. Of these factors, soil erosion and

[37] The use of the highest quality class in determining the rateable value was also an attempt to account for this.

compaction in particular result from modern agricultural practices, and the economic value of the permanent loss in productivity which arises from them should therefore be subtracted from any measure of economic output. According to the SNV report, there is some damage to soil caused by erosion, but the erosion itself is mostly due to wind and snow, and is not seen as a major threat to the future productivity of the soil. Some economic costs are incurred as a result of the impact of erosion on water courses. However, to include these costs would be to risk double counting with water pollution costs, so we have omitted this calculation from our index.

On the other hand, there is ample evidence of the loss of productivity associated with soil compaction from the use of agricultural machinery. SNV (1992) estimate that a cumulative permanent loss of productivity of 2.2% has resulted from compaction over the last 15 years. We have assumed that this loss has accumulated steadily between 1978 and 1992. By valuing the loss of productivity as a percentage of the representative land value (SEK 15,000) and multiplying this by the total area of arable land (in 1992) we have calculated a cost for losses due to compaction which rises from around SEK 60 million in 1978 to over SEK 900 million in 1992. This cost has then been added to the stream of costs for losses from urbanisation.

Column S(-): Depletion of Non-renewable Resources

Consistent both with the aim of incorporating capital changes and accounting for natural capital, this column attempts to take account of the depletion of stocks of natural resources. In theory, one might wish to account for the depletion of a wide variety of different minerals, all of which play crucial roles in the pursuit of wealth in the economy. In the original US ISEW (Daly and Cobb, 1989), this column was computed by taking the economic value of mineral production as a proxy for resource depletion.

Following certain criticisms, Cobb and Cobb (1994) abandoned the original method in their revised index. Instead, they used a suggestion by Daly that the appropriate cost of depletion should be calculated on a “replacement cost” basis as an “amount of rent from resource production that should be reinvested in a process to create a perpetual steam of output of a renewable substitute for the non-renewable resource being depleted”. The later US index looked only at the depletion of fuel resources - including nuclear resources - acknowledging that these were nonetheless amongst the most important aspects of resource depletion in the economy. The revised ISEW used a replacement value for fossil fuel resources “designed to reflect the cost of replacing each barrel of oil equivalent of energy consumed with renewable energy resources” (Jackson and Marks, 1994, p. 23).

Data on primary energy consumption in Sweden between 1950 and 1992 have been taken from a variety of sources. For the years following 1970, data supplied by NUTEK (1994, Table 2)). From 1950 to 1969 data have been obtained from United Nations statistics (UN, 1976, p. 103, Table 2). Gaps in the data have been filled using linear interpolation.[38]

The replacement costs of non-renewable energy consumption used in this study are based on the same value used in the US and UK studies, namely $75 (in 1972 dollars) per barrel of oil equivalent in 1988. This value is significantly higher than the actual price of crude oil on the market, and also higher than the costs of many renewable energy technologies today. But as Cobb and Cobb (1994) point out, the replace-

[38] It should be noted here that for the purposes of this paper, nuclear energy has been accounted in terms of its primary energy equivalent, rather than on the basis of electricity supplied.

ment cost does not reflect the marginal price of renewable energy options at the present time, but the cost of replacing all fossil fuel production during the period. This cost inevitably rises as the cheaper options are exploited. Cobb and Cobb therefore included a 3% annual increase in the replacement cost. This means that in 1950, the assumed replacement cost would have been much lower at only $24 per barrel. As discussed more fully in Jackson and Marks (1994), given that this cost is supposed to reflect the average cost of replacing the entire fossil fuel based energy supply with renewables, it may even be an underestimate. At any rate, for the purposes of this study we have used the same cost - and cost escalation - used in previous studies. The 1988 cost is equivalent to an estimated SEK 386 when converted to 1985 Swedish prices. As in the US and the UK cases, this replacement cost is assumed to have increased yearly at 3% per annum.

Column T(-): Costs of Long-Term Environmental Damage

The Daly and Cobb ISEW takes account of long-term environmental damage by imposing an annual $0.50 tax (in 1972 prices) on each barrel of oil equivalent consumed from non-renewable energy sources. This tax is supposed to operate cumulatively. That is to say, the total cost in any one year is taken to be equal to the cumulative energy consumption (from 1900 onwards) multiplied by the tax imposed. Daly and Cobb have acknowledged the arbitrary nature of the $0.50 tax, but argued that they were unwilling to “ignore major issues for lack of an accepted methodology”. This methodology has not been without criticisms. Atkinson (1995) has argued, for example, that to relate damage to *cumulative* energy consumption represents a “significant error”. However, his argument fails to appreciate the logic of Daly and Cobb’s proposal. Applying an annual tax to each barrel of oil is an attempt to account for an *ongoing loss of services* flowing from a *stock* of environmental damage. The long residence times of environmental pollutants such as carbon dioxide and radionuclides suggest that a cumulative approach is vital to any attempt to capture the costs of this kind of pollution. Accordingly, we have retained this methodology in the Swedish ISEW in line with other country studies.

Data on primary energy consumption after 1950 have been taken from the same sources as in the previous column. Data on energy consumption before 1950 have been estimated from a number of sources. For the years between 1900 and 1910 we have used data from Järnegren *et al.* (1980). Coal data for the year 1920 were supplied from OECD (1994). Data for occasional years from 1925 to 1950 has been obtained from Darmstadter (1971, p. 626, Table X). Linear interpolations have been used to supply the gaps. The damage cost used is the same as in the US-and UK-ISEW: $0.50 (1972 dollars) for each barrel of oil equivalent of oil, coal, natural gas and nuclear.[39] This converts to just over SEK 35 (in 1985 prices) for each million tonnes of coal equivalent of primary fuel consumed.

One way of thinking of the contribution in this column is as a measure of the ongoing environmental debt accrued as a result of long-term environmental damage. It is therefore instructive to compare our contribution from long-term environmental damage with previous Swedish estimates of environmental debt. Jernelöv (1992) used a replacement cost method calculated by using SEK 100 as the cost of “fixing” each tonne of CO_2 as biomass. On this basis, he estimated that the environmental debt from climate change in 1990 was around SEK 85,000 million, increasing yearly

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39 Again we have converted the nuclear contribution to primary energy equivalents.

by SEK 2,500 million. By comparison our own estimate, based on the Daly and Cobb methodology, amounts to a debt of just under SEK 70,000 million (in 1985 prices), increasing at around SEK 2,000 million each year. Taking into account the difference in price years, these two estimates are clearly of the same order of magnitude.

Column U(-): Costs of Ozone Depletion

The costs associated with ozone depletion were incorporated into the ISEW methodology during Cobb and Cobb's (1994) revision, after a criticism by Eisner that not all long-term environmental damage is related to energy use (column T). The authors were "particularly concerned that [they] had omitted a damage estimate from the cumulative release of chlorofluorocarbons into the atmosphere". Measurements over Antarctica have shown dramatic changes in the thickness of the ozone layer (i.e. the ozone hole) since the late 1970s. The first warnings that CFCs could have a negative impact on the ozone layer were sounded in the early 1970s, but until then global production had increased unchecked and it was not until 1987 that the Montreal Protocol governing the production and consumption of CFCs came into force.

The US-ISEW accounted for the costs of ozone depletion by applying a unit cost of $5 (1972 dollars) for each kilogramme of cumulative world production of each of CFCs 11 and 12. Since US production amounted to around one third of world production, this unit cost was equivalent to a cost of $15 (1972) for each kilo of US production of the two CFCs. Cobb and Cobb explain that this method "amounts to the same as assuming that each individual in the US would demand about $960 (1972 dollars) in 1985 to compensate for the risks involved in producing and having produced CFCs. Or it may be thought of as the amount that would have to be set aside to compensate future generations for having made their planet less habitable." As with the case of long-term environmental damage from non-renewable energy consumption, it is assumed that the damage cost is *cumulative*, reflecting the loss of services flowing from the *stock* of environmental damage.

In the UK-ISEW, Jackson and Marks (1994) argued that this adjustment should be applied not only on the basis of CFCs 11 and 12 but also (at least) to include trends in the other Montreal-listed CFCS (113, 114, and 115). Rather than accounting for an additional cost for the other CFCs however, they took a figure for the total costs associated with ozone depletion in 1986 based only on the cumulative production of CFCs 11 and 12 (as Cobb and Cobb had done), and then indexed this cost over the study period, on the basis of production of all Montreal-listed CFCs.

Jackson and Marks (1994) also addressed the question of whether it was more appropriate to use consumption as a proxy for costs, than production. This question is crucial to assessing the costs of CFCs in this study since Sweden produces no CFCs at all, although it consumes around 0.5% of global production. The issue here is really one about the allocation of environmental damage costs between parties. Should the producer be liable for the damage costs associated with a product? Or should these costs fall on the consumer? In the UK-ISEW, the authors took production as the appropriate proxy, even though a significant proportion of CFC production in the UK is for export purposes. This amounts to an assumption that the UK is responsible for damages caused by products which it exports to other countries, even after those products have been used and emitted into the environment. There is clearly some justification for this idea, since some at least of those environmental costs will later fall on the UK.

On the other hand, from the point of view of importing countries, one can ask whether it is appropriate for those countries to have the use of damaging products on the assumption that the producer will pay all of the environmental costs. In this case, the importing country would seem to be getting a polluting product at a cut-down price - one which does not reflect the environmental costs of using the product. Put like this, it is clear that there is also an argument for demanding that the costs of polluting products are paid by those who gain benefits from them, ie the consumers. If this is correct, it means that the costs associated with ozone damage have been overestimated for the UK, to the extent that production exceeds domestic consumption. For Sweden however, it means that there are environmental costs associated with its use of CFCs even though these are not produced in Sweden.

Based on these deliberations, we have modified the original Cobb methodology for this column on two counts. Firstly, we have used consumption rather than production as the basis of cost estimation. Secondly, we have extended the analysis - as Jackson and Marks (1994) did - to include all the Montreal-listed CFCs.

There is little data available before 1986 on consumption of CFCs in Sweden. Consumption prior to 1986 is therefore taken to be 0.5% of the global production.[40] World production data have been taken from the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS, 1991a, 1991b), the same data are used in the US and UK ISEW. These data provides a time series for global production for CFCs 11 and 12. The study also provides time series data for CFCs 113, 114, and 115 from 1979 onwards and a cumulative figure up to 1979 for each product. Time series estimates for CFCs 113, 114 and 115 prior to 1979 have been made using simple linear regression assumptions about annual production.

In assessing costs we have used essentially the same unit cost as that assumed by Cobb and Cobb (1994) in the US index, namely $15 (1972 dollars) per kilogramme of CFCs. This is equivalent to around SEK 240 in 1985 prices. This is considered by Cobb and Cobb to represent a damage cost estimate for CFCs. Another methodology that could have been used is the cost associated with cleaning up, for example the costs of emptying old refrigerators or commercial cooling systems of freon before scrapping them. At present, there are various attempts in Sweden to collect such appliances, although it remains to be seen how cost-effective this activity will prove to be. Alternatively, we might have used a “replacement cost” basis for the calculation in which the cost of CFC consumption is taken to be the cost of providing the same service using different technology. Interestingly, this cost has been estimated by Swedish industry to be in the region of SEK 170-330/kg/yr (Rydberg, 1994, p. 6), in line with our central damage cost estimate. As in the case of the UK index we have taken a cost in 1986 which is based on the cost of cumulative consumption of CFCs 11 and 12, and then indexed this cost over the period on the basis of cumulative consumption of all Montreal-listed CFCs.

Column V(+): Net Capital Growth

The Hicksian notion of income demands that net stocks of capital should be preserved over time. Economic consumption which depletes capital cannot be regarded as sustainable. The conventional calculation of GNP incorporates a measure of gross fixed capital formation. Daly and Cobb (1989) argued that this inclusion neglects two important factors. In the first place, it omits to account for capital depreciation.

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[40] This figure is an estimate based on the level of consumption in 1986 - as reported in the UNEP Environmental Data Report for 1986, and on levels of consumption reported to UNEP under the Montreal Protocol.

Secondly, they argued, some account needs to be taken of the need for a baseline *increase* in capital stocks to provide for the demands of an increasing workforce. They therefore included a column to account for capital formation net of both depreciation and the capital requirement flowing from an increase in the workforce. Following criticisms of the original index Cobb and Cobb (1994) revised this column to exclude public capital formation, and include only net capital growth in the private sector.

For Sweden, we have used calculations of the net stock of fixed capital assets in industry made available to us from the National Accounts Division of SCB (personal communication) from 1980 to 1992. Prior to 1980 there are no explicit calculations of the net capital stock in Sweden. We have therefore used data on gross capital stock compiled by SCB from 1950 to 1962 (SCB, 1975b) and from 1963 to 1979 (SCB, 1981b), and estimated the net stock prior to 1980 on the basis of the average ratio of net to gross fixed assets for the years when both figures were available (between 1980 and 1992). A five year rolling average of the change in net capital stock from year to year was then computed.

Data on the labour force during the time period has been taken from the labour force surveys (SCB, 1969, 1981c & 1991) for the years after 1969, and from statistical yearbooks (1950 and 1960) for previous years. A five year rolling average of the percentage increase in the workforce was then used to calculate a capital requirement imposed by increases in the workforce. This requirement was then subtracted from the rolling average change in net capital stock. The result of the calculation is shown in Figure 9.

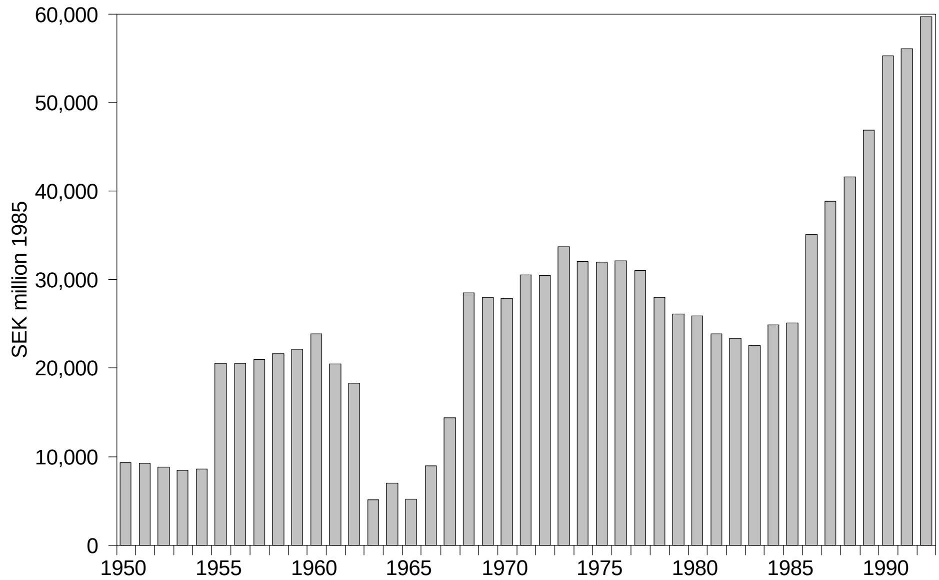

Figure 9. Net changes in capital stock.

The Figure seems to indicate a rapid increase in net capital growth during the final decade of the period. We remain sceptical that this is an accurate reflection of the situation, for a number of reasons. Firstly, the figures relating to the size of the workforce showed a substantial decrease over the final two years of the study. However, we know that this decrease was the result of the movement of workers out of the workforce either into study or into early retirement, as a result of the recession. It is not clear to us that this kind of reduction in the workforce genuinely reduces the capital requirement. As Jackson and Marks (1994) have remarked, there is an argument to suggest that a declining workforce in an increasing population imposes an increased requirement on capital investment rather than a decreased one.

Furthermore, it seems possible that at least some of the increase in capital stocks associated with the late 1980s is due to privatisation programmes which have shifted public sector capital into the private sector. Again, this seems to us merely to reflect an accounting change rather than to represent a real increase in welfare. For the purposes of the present study however, we have retained the calculation as described, noting only that there is scope for further examination of these issues.

Column W(+): Net Changes in International Position

Daly and Cobb argue that "sustainability requires long-term national self reliance" (Daly & Cobb, 1989, p. 448). To account for the degree of self-reliance within the economy they include in the ISEW a measure of the changes in net international position. Any tendency towards net borrowing could be classified as unsustainable consumption since the "borrowed welfare" eventually must be paid back with interest. Figures on Sweden's net international position (*finansiell utlandsställning*) have been taken from SCB (1994d) for the years from 1986 to 1992. Data for the earlier years have been compiled by Olsson (1993). We have computed the annual change in net international position and smoothed out short-term fluctuations in the series by taking a five year rolling average of this annual change.[41]

Column X: Index of Sustainable Economic Welfare

The total index of sustainable economic welfare is calculated in column X by adding columns D to H, subtracting columns I to U and then adding columns V and W.

Column Y: Per Capita Index of Sustainable Economic Welfare

Per capita ISEW has been calculated by dividing column X by the population in Sweden in each year in the series. Population statistics have been taken from the Statistical Yearbook (various years).

Column Z: Gross National Product

The Gross National Product, included for comparative purposes has been taken from the Statistical Yearbook (various years) and adjusted to 1985 prices using the implict GDP inflator.

Column AA: Per Capita Gross National Product

Per capita GNP is calculated using the population statistics as in column Y.

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41 The Bank of Sweden is generally regarded as providing the "official" estimate of net financial assets in Sweden (Sveriges Riksbank, 1995), but these figures are only available from 1980 onwards. For the sake of consistency over the period we have used the SCB figures, noting that the differences between the estimates during the final years of the series (due to differences in the inclusion of direct capital investment and investment in stocks and shares) are relatively minor.

5 RESULTS AND DISCUSSION

The calculated ISEW per capita for Sweden is presented in Figure 10 for the years 1950 to 1992. For the purposes of comparison, the conventional measure of GNP per capita is also included in the graph. The numerical results on which Figure 10 is based are presented in the Appendix. Two aspects of the Swedish ISEW are immediately clear. In the first place, the difference between the ISEW and GNP is nothing like so marked as the difference between ISEW and GNP in Figures 1 and 2, for the US and UK.

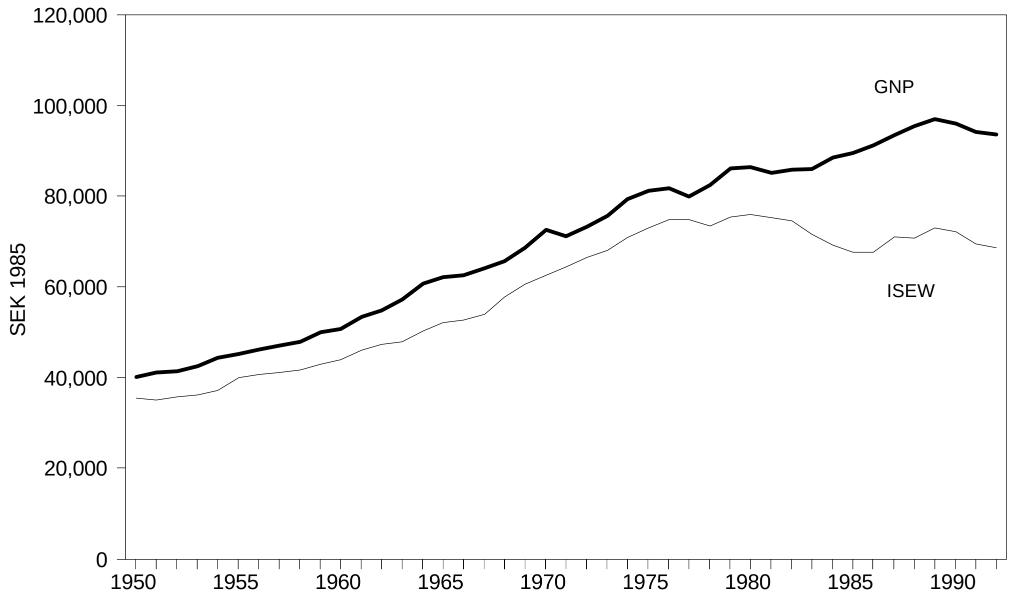


Figure 10. ISEW per capita and GNP per capita in Sweden 1950 - 1992.

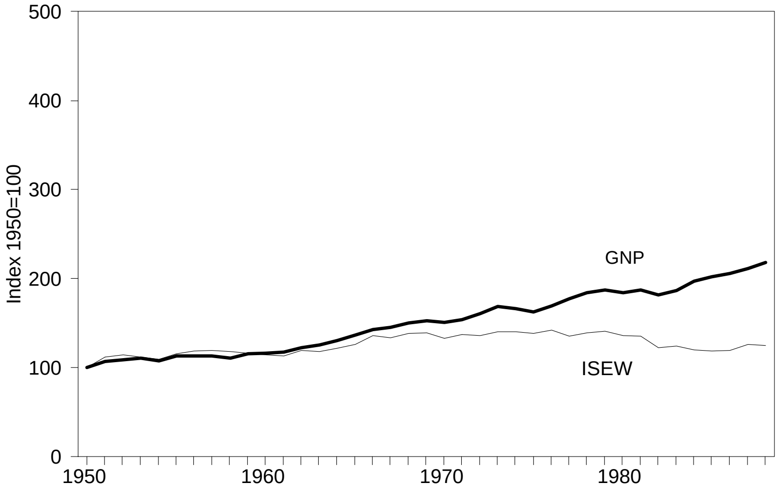
Secondly, and in spite of this conclusion, there is some similarity between the Swedish case and the case of other countries (Figure 11). In particular, all of the ISEW studies have shown a noticeable divergence between ISEW per capita and GNP per capita over the later period of the study.

In the US and UK studies (Figures 11(a) & (c)), ISEW per capita has tended to stabilise and decline from about the early 1970s onwards, in spite of a trend of continuing growth in GNP per capita. In Germany, Austria and the Netherlands (Figures 11(b), (d) and (e)), the divergence has been slightly later.

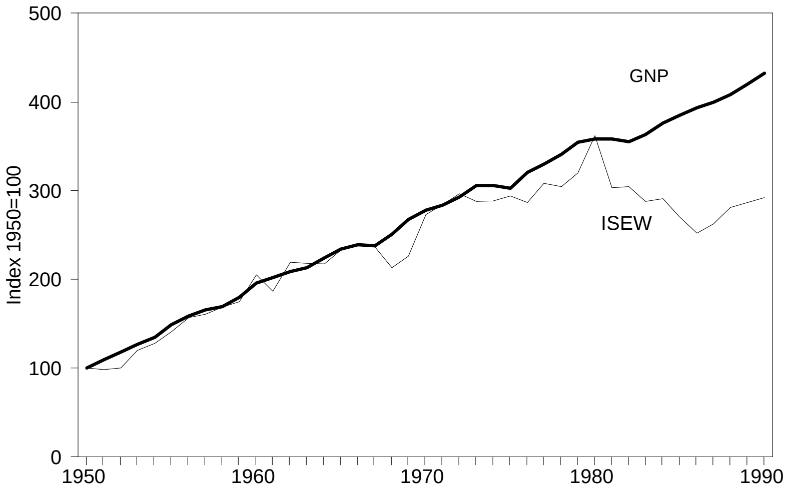
In the Swedish case (Figure 11(f)), the divergence between ISEW and GNP also happens slightly later, from about 1980 onwards. It is clearly less marked than in the UK (Figure 11(c)) or the Netherlands (Figure 11(e)), but it is nonetheless visible, underlining a common trend in ISEW analysis over a number of different countries.

It is clearly worth asking why this trend is less marked for Sweden than it has been in other cases. Is the difference merely due to spurious accounting differences, or methodological incompatibilities? Or does it reflect real, identifiable differences in sustainable economic welfare? Before attempting to answer these questions however,

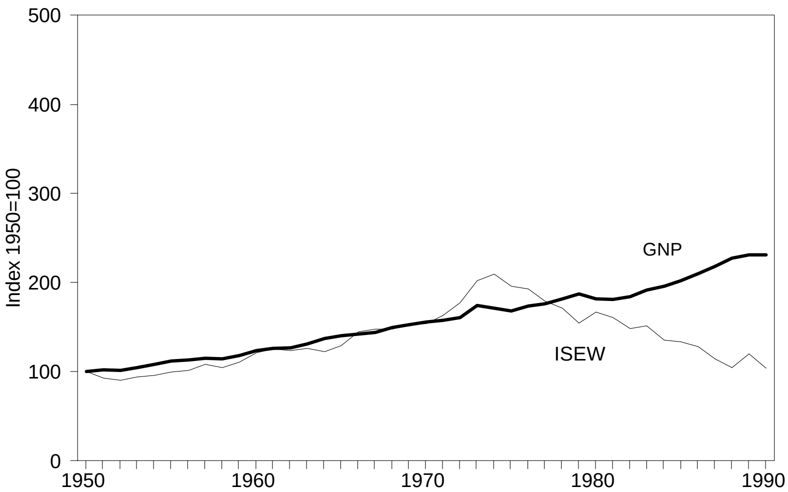
Figure 11. ISEW per capita and GNP per capita in selected countries.



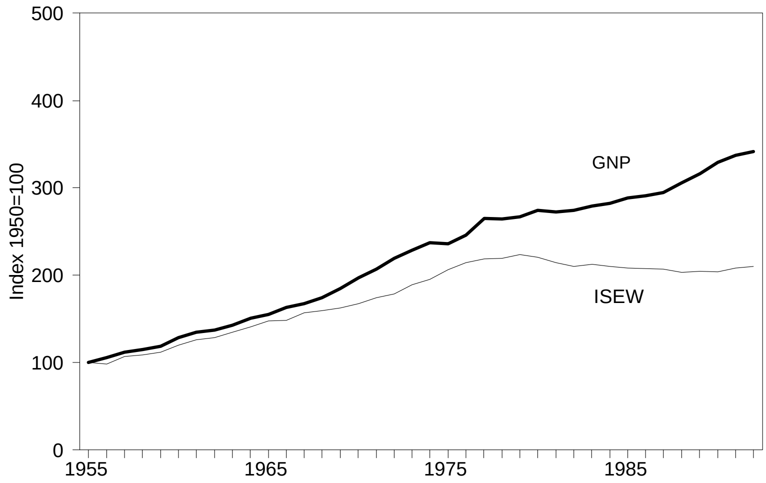
(a) USA



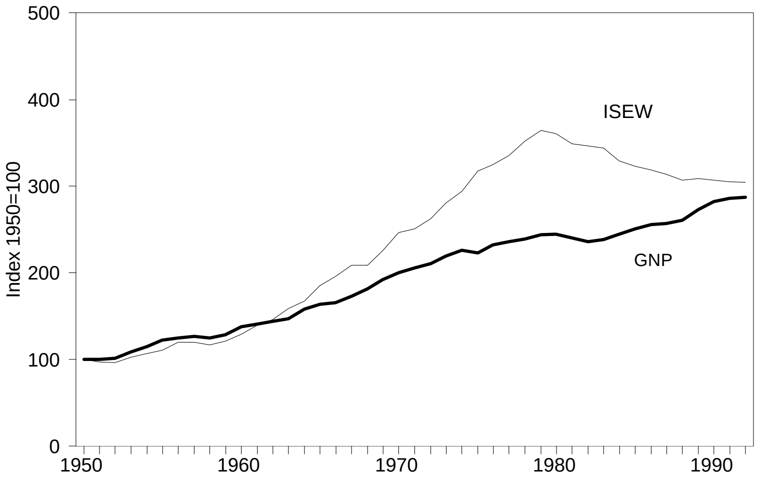
(b) Germany



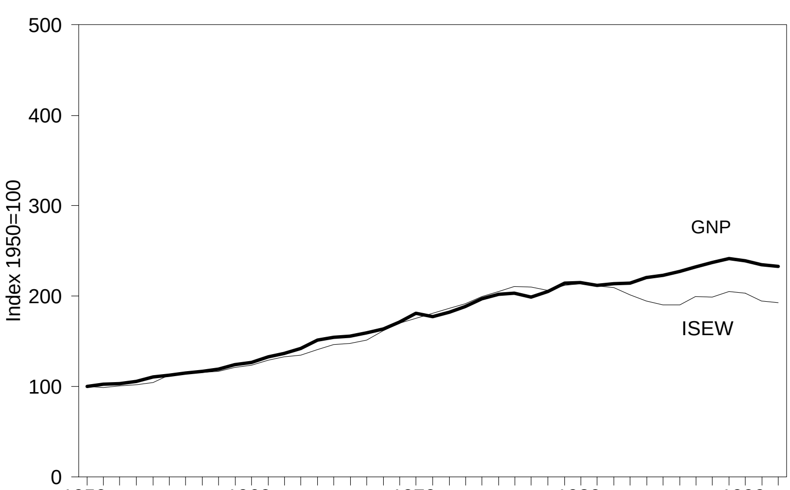
(c) UK



(d) Austria



(e) Netherlands



(f) Sweden

Table 3. Per capita growth in GNP versus ISEW.

	GNP/cap	ISEW/cap	ISEW/cap w/o income distn.	ISEW*/cap	ISEW/cap with UK income distn.
1950-60	26.4%	23.4%	20.2%	28.3%	19.3%
1960-70	42.8%	42.3%	31.9%	49.7%	38.2%
1970-80	19.0%	21.6%	-0.7%	26.6%	-1.8%
1980-90	8.4%	-9.7%	-8.4%	1.8%	-29.3%
1950-60	26.4%	23.4%	20.2%	28.3%	19.3%
1950-70	80.6%	75.6%	58.5%	92.0%	65.0%
1950-80	115.0%	113.6%	57.3%	143.1%	62.0%
1950-92	133.0%	92.9%	44.1%	147.4%	14.5%

Table 4. Annual per capita growth rates in GNP versus ISEW.

	GNP/cap	ISEW/cap	ISEW/cap w/o income distn.	ISEW*/cap	ISEW/cap with UK income distn.
1950-60	2.4%	2.1%	1.9%	2.5%	1.8%
1960-70	3.6%	3.6%	2.8%	4.1%	3.3%
1970-80	1.8%	2.0%	-0.1%	2.4%	-0.2%
1980-92	0.7%	-0.8%	-0.7%	0.1%	-2.8%
1950-60	2.4%	2.1%	1.9%	2.5%	1.8%
1950-70	3.0%	2.9%	2.3%	3.3%	2.5%
1950-80	2.6%	2.6%	1.5%	3.0%	1.6%
1950-92	2.0%	1.6%	0.9%	2.2%	0.3%

we need to make a closer comparison of the ISEW and GNP, and identify the key components contributing to the index.

5.1 GNP per capita versus ISEW per capita

The general economic trend in Sweden - described qualitatively in section 2 above - is evident in the graphical representation of GNP per capita in Figure 10. The overall trend is one of sustained economic growth. In fact (Table 3), GNP per capita has more than doubled between 1950 and 1992, and (Table 4) the average annual growth rate over the period of the study is 2.0%.[42] Table 4 confirms that the 1960s earned their reputation as a "golden decade" in Sweden with an average annual growth rate of 3.6% per annum. Growth slowed considerably however from the 1970s onwards, and during the final decade or so of the study had fallen to 0.7% per annum on average. This fall was in part due to the recession which hit Sweden in 1989 along with many other western economies. Even before the recession had hit however, the average growth rate through the 1980s was only around 1% per annum.

Per capita ISEW in Sweden has increased by just over 90% over the period of the study (Table 3), notably less than the increase in GNP. The average annual growth rate (Table 4) in ISEW was around 20% lower at 1.6% than the average growth rate in GNP. Interestingly, per capita ISEW actually grew faster than GNP during the middle two decades of the study, easily keeping pace with economic growth during the "golden decade" and staying ahead of it during the initial period of the ensuing economic decline.

The ISEW peaked in 1980 however (Appendix), and despite a partial recovery during the late 1980s, showed an overall pattern of decline (with an average annual rate of -0.8%) through to the end of the study period. By 1992, ISEW per capita was almost 10% lower than it had been in 1980, even though GNP per capita was over 8% higher.

5.2 Component effects in the Swedish ISEW

Several key factors dominate the shape of Swedish ISEW, and are also partly responsible for the distinctive differences between Sweden and other ISEW countries. Let us look first at the impact of weighting consumer expenditure according to income distribution. As we remarked earlier in the paper, income distribution in Sweden has improved markedly over the period of the study: the index of *inequality* of income fell by over thirty percentage points (Figure 6) between 1950 and the minimum level of inequality in 1983. During the later years of the study income inequality increased marginally by comparison with 1983, but nevertheless remained considerably lower by the end of the period than it had been at the beginning. The impact of factoring income distribution into the the ISEW is illustrated graphically in Figure 12.

It is to be observed that the unweighted index departs much more radically from GNP than does the weighted index. The unweighted ISEW is only around 44% higher at the end of the period than it was at the beginning (Table 3) and the average annual growth rate (Table 4) is considerably lower (at 0.9% per annum) than growth rate in per capita GNP.[43] Income distribution may therefore be seen to exert a substantial positive impact on the Swedish ISEW.

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[42] Interestingly, and despite the differences in social and economic policy between the two countries these statistics are remarkably similar to the quantitative trends in the UK over the same period: the annual growth rate in the UK between 1950 and 1990 was 2.1%.

[43] It is of interest to note however that the unweighted ISEW fell less dramatically than the weighted ISEW during the last twelve years of the study.

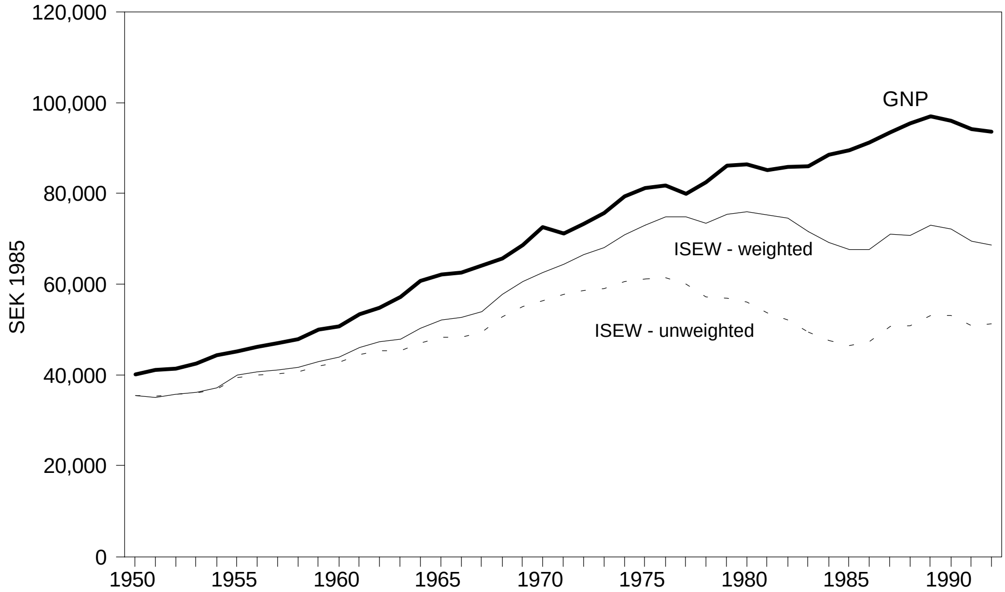

Figure 12. ISEW with and without weighting for income distribution.

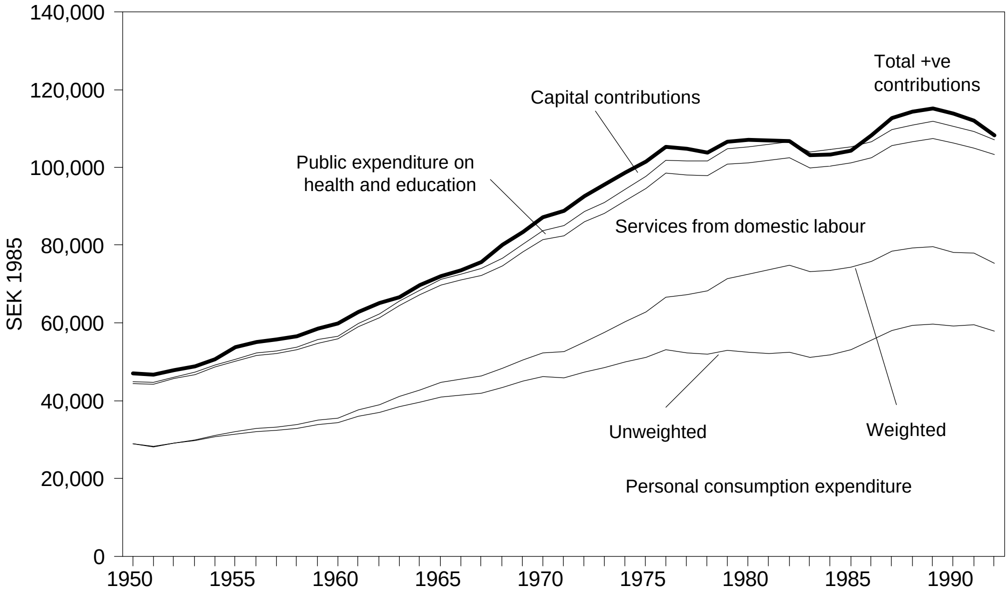

Figure 13. Swedish ISEW per capita - "positive" contributions.

The monetarisation of services from domestic labour also exerts considerable positive impact on the index. In fact, Figure 13 reveals that this factor was the single biggest positive addition to the baseline level of unweighted consumer expenditure. The valuation of domestic labour adds the equivalent of half as much (unweighted) personal consumption again to the index. It is worth noting here, and we shall explore the implications of this further below, that this contribution is higher relatively in Sweden than it is, for example, in the UK where the contribution of domestic labour was much closer to a third than a half of consumer expenditure.

The additional "positive" contributions are provided by public expenditures on health and education, and various capital contributions. Of these capital contributions, net capital growth represents an increasing positive trend particularly towards the end of the period.[44] But this positive trend is offset by contributions from the net international position which are in fact increasingly negative from the mid-1970s onwards, reflecting Sweden's growing foreign debt. The total impact of capital contributions to the index remains relatively small because of the diverse nature of these trends.

Next, let us look at the "negative" contributions to the index - those elements which have been subtracted from the total positive contributions shown in Figure 13. In Figure 14 we have grouped these contributions in four categories. The smallest of these categories comes from those columns classified as defensive expenditures, and includes components such as the costs of car accidents, the costs of commuting to work, and defensive private expenditures on health and education. This category also includes the difference between service flows from and expenditures on consumer durables. As noted above, this value remains negative - ie service flows exceed expenditures - except for a few years during the period. The impact of including this component in the index is therefore to offset the negative impacts of other defensive expenditures, and means that this category exerts a relatively minor influence on the overall shape of the index.

The other three categories of costs exert approximately comparable negative impacts on the curve. The costs of environmental degradation (air pollution, water pollution and so on) remain roughly constant over the period - in spite of reductions in some emissions, there have been increases in others. Loss of natural capital (resource depletion, loss of farmlands etc) and the costs associated with long-term environmental damage (including the costs of ozone depletion) both increase substantially over the period.

Since none of the negative cost categories exerts a dominating influence over the shape of the index, it is likely that the result will be relatively robust with respect to changes in individual negative cost components. This is perhaps surprising given the considerable sensitivity of other ISEWs to certain negative parameters.[45] In the following section, we examine some of the reasons for this difference.

5.3 Sensitivities and comparability

In their original index for the US, Daly and Cobb (1989) presented a sensitivity analysis in which two key columns - those relating to resource depletion and long-term environmental costs - were omitted from the index. The resulting curve (ISEW*) was a less radical departure from GNP than the central calculation of ISEW. In the Swedish case, as we have mentioned the impact of these two columns is less substantial than in other countries. Nor do we believe that it is appropriate to exclude calculation of these important factors from such an index. Nevertheless, for completeness, we present in Figure 15 the corresponding ISEW* for Sweden.

The Figure shows the rather surprising result that ISEW* performs better than GNP over the period of the study! As Table 4 reveals, the average annual growth rate

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44 Although we have have remarked above on some reservations about this result.

45 See, for example, Figure 11 in Jackson and Marks 1994.

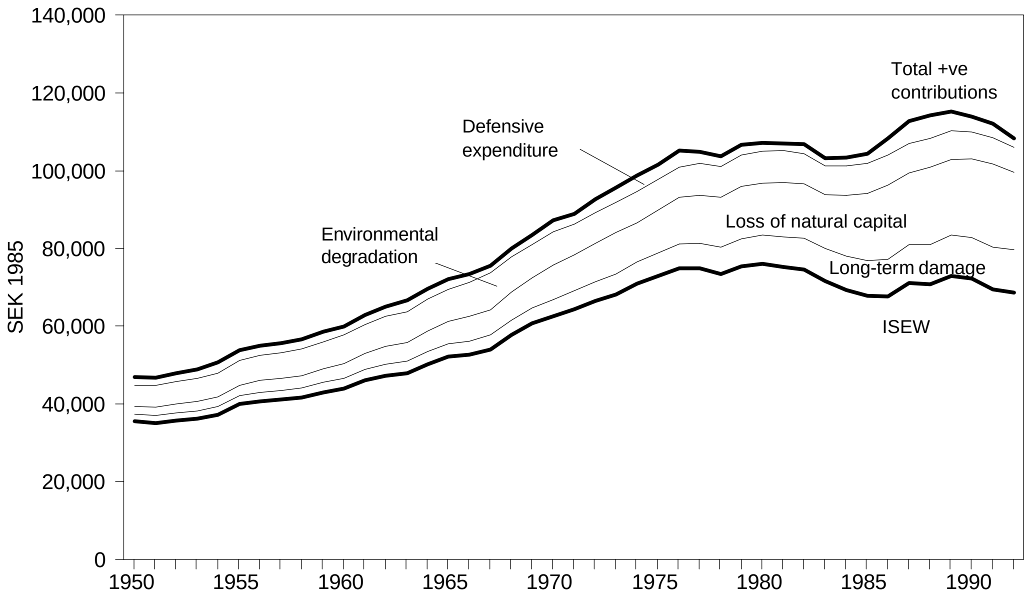

Figure 14. Swedish ISEW per capita - "negative" contributions.

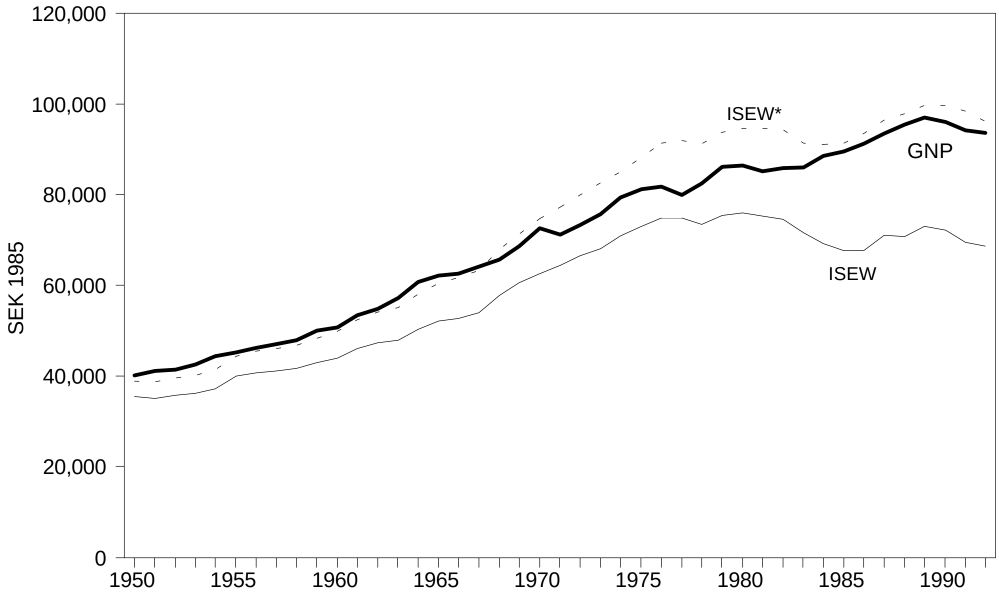

Figure 15. ISEW, ISEW* and GNP per capita in Sweden.

in ISEW* per capita over the forty two years is higher (at 2.2%) than the growth rate in GNP. Only over the final twelve years does the ISEW* growth rate fall below the corresponding rate for GNP. This latter result may in itself reinforce the lesson that sustainable economic welfare is beginning increasingly to depart from economic performance. But it also raises even more dramatically the differences that exist between the Swedish ISEW and other case study countries. It is to an examination of these issues that we now turn.

Firstly, let us look at the impacts of income distribution. In section 2, it was remarked that Sweden's social policy has been oriented quite specifically towards improving the distribution of incomes. The results of this policy are plain to see in the indexed Gini coefficient (Figure 5) on which the calculations in this study have been based. As we showed in Figure 12, the ISEW without weighting for income distribution is substantially different in shape from the ISEW with weighting. Let us proceed further with this analysis and suppose that Sweden had pursued policies more akin to those pursued in the UK, with the result that the income distribution followed the British Gini index (Figure 5). Figure 16 shows what the Swedish ISEW might have looked like if this had been the case.[46]

The effect is now quite marked. The index rises roughly in line with GNP - as did the UK index - but from the mid 1970s onwards it declines steadily as income inequality worsens. ISEW at the end of the period is now less than 15% higher than it was at the beginning of the period (Table 4); and the annual growth rate has fallen to only 0.3% - well below the comparative rate for GNP. During the final twelve years of the study, moreover, this hybrid ISEW falls at almost 3% per annum.

In fact, the impact of distributional policy goes even further towards explaining the difference between Swedish ISEW and UK ISEW than the above analysis allows. In the previous subsection we highlighted the pronounced effect which the contribution from domestic labour has on the Swedish ISEW, and noted that this effect was greater than the corresponding effect in the UK. The magnitude of this contribution is governed mainly by the shadow wage rate for domestic labour. This wage rate is in its turn determined - relative to the average level of personal consumption - by the distribution of incomes. Thus, a household help in Sweden during 1991 received SEK 70 per hour. The equivalent wage rate in the UK during the same period was around £4, i.e. less than SEK 50 per hour. Factoring this additional differentiation into a hybrid ISEW would result in an index which departed even more radically from the Swedish ISEW and from Swedish GNP.

It is worth remarking on another peculiarity of the Swedish case which exerts a significant effect on the shape of the ISEW. Some of the negative impact of environmental degradation, all of the impact of resource depletion, and much of the impact of long-term environmental damage are determined by the structure of the energy system. Sweden has been pro-active in reducing energy demand through extensive energy efficiency programmes, and as a consequence the energy intensity of the economy is lower than in some other countries. This will have had some positive effect on the ISEW.

But other contributing factors arise from the particular structure of energy supply in Sweden. In particular, a substantial proportion of Sweden's electricity demand has conventionally been supplied through hydroelectric power stations. Indeed, Sweden has one of the highest contributions from hydropower amongst any of the developed nations. This form of electricity generation is not without adverse environmental impacts, but from the point of view of the ISEW it represents a fortuitous benefit, since the costs of these impacts are not quantified in the index. In other ISEW country studies, the issue of accounting for the costs of hydro has not really arisen. In the

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46 We are neglecting here the existence of possible structural relationships between income per capita and income distribution. In principle, it might be argued that if Sweden had had a less even distribution of income (such as the UKs) this might have led to a positive impact on growth, in which case GNP would have been higher than it was, and the revised ISEW would also have been higher than suggested by Figure 16. On the other hand, Kuznets (1967) proposed a bell-shaped curve relating income inequality to income per capita. As GNP grows, income inequality grows, peaks, and then ultimately declines again. This kind of relationship does not immediately suggest that Sweden's income levels would have been positively affected by a less even distribution of wealth.

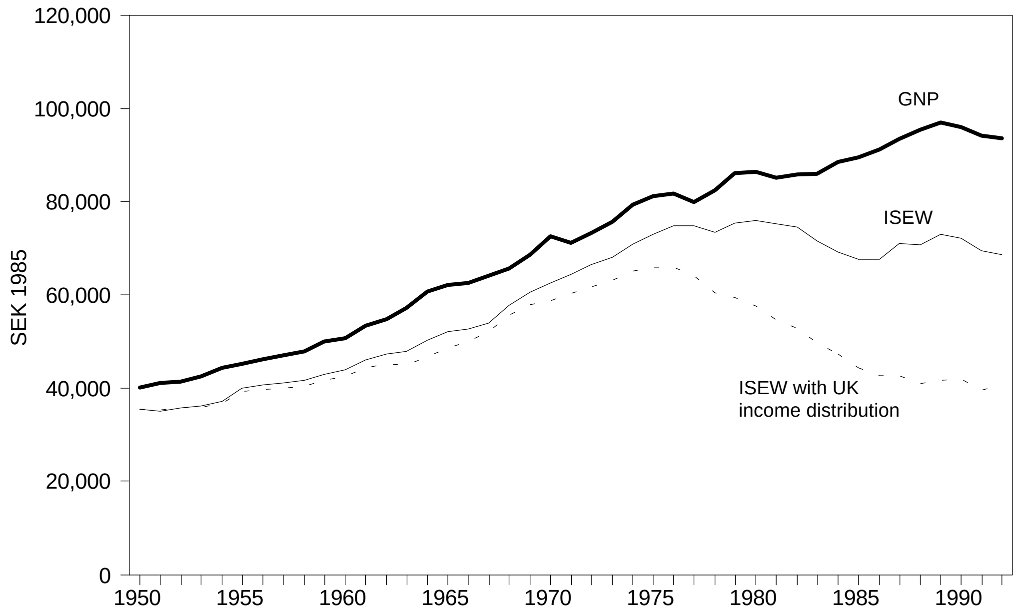

Figure 16. Swedish ISEW with UK income distribution.

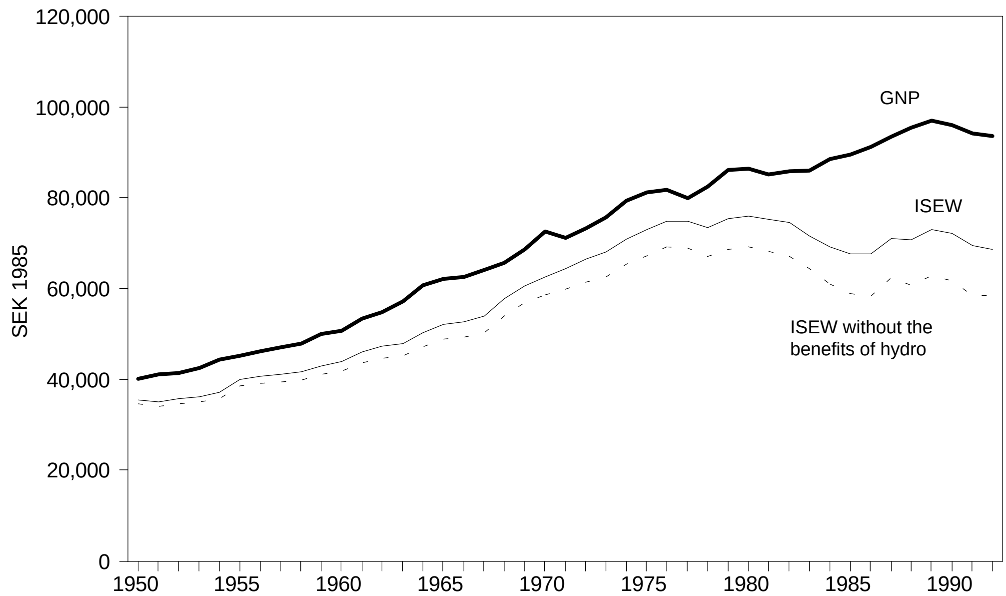

Figure 17. The impacts of hydropower on the Swedish ISEW.

Swedish index, it should ideally be tackled, even if these costs turn out to be substantially lower than the costs of conventional fossil fuel and nuclear technology. In the absence of an obvious methodology for including these costs, however, we have for the time being excluded it. This is an acknowledged limitation of our study. To compensate for it, we have investigated a hypothetical sensitivity to determine what might have been the additional environmental costs, if all of Sweden's energy had had to be provided from fossil or nuclear sources. Figure 17 illustrates the results of this analysis and shows what the ISEW might have looked like, if Sweden had not had the good fortune of extensive hydropower resources.

Finally, it is instructive to consider what the Swedish ISEW might have looked like, if a combination of sensitive parameters had taken values more akin to the UK (for example) than the ones determined by the political and geographical context of Sweden. Figure 18 shows the combined impacts of an income distribution similar to the UK, a shadow price for labour based on the UK value, and the absence of extensive hydropower resources.

It should be noted that the line ISEW# shown in Figure 18 represents an entirely hypothetical index. Nevertheless, it is instructive to observe that in this hypothetical case, ISEW# departs much more radically from GNP than does the actual calculated Swedish ISEW. In fact, by the end of the period ISEW# is considerably *lower* than it was at the beginning of the period! Although ISEW# is not in any sense a full sensitivity analysis for the Swedish index, it does illustrate an important point: namely that the methodology of the ISEW is indeed sensitive to real physical and political differences in social and environmental welfare between countries.

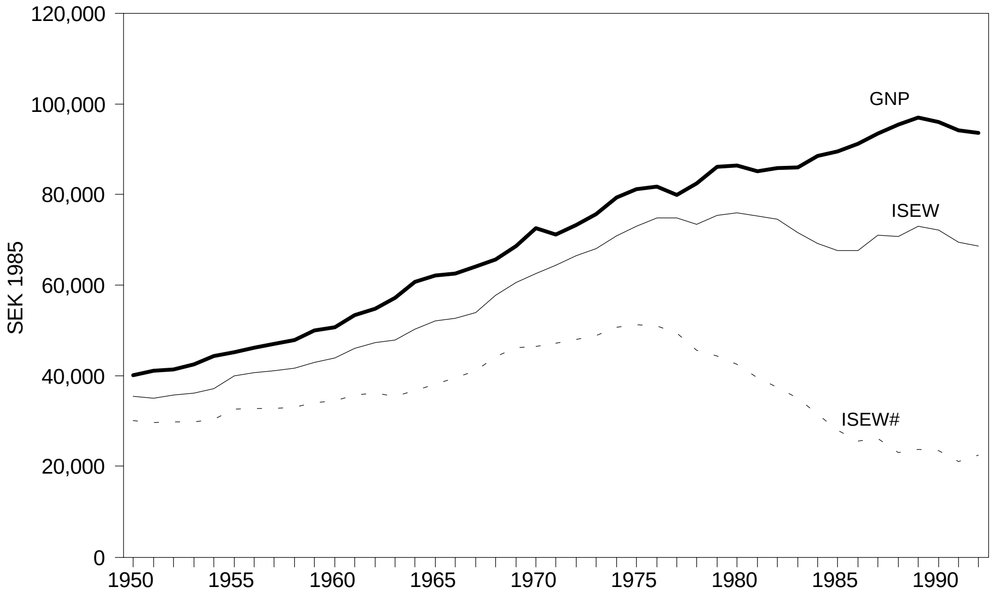

Figure 18. Hypothetical illustration of sensitivity to critical parameters.

6 SUMMARY AND CONCLUSIONS

In this paper we have striven to emulate for Sweden an exercise which has already been carried out for a number of different western nations: namely, to compute an Index of Sustainable Economic Welfare based on a methodology developed by Daly and Cobb.

The exercise has been of interest for a number of reasons. Firstly, the now familiar tendency for ISEWs to exhibit a departure from straightforward economic growth has been repeated - although less dramatically - in the Swedish case study. This departure is again more noticeable in the later years of the study than it was in the earlier years, and provides a strong indication that achieving and maintaining sustainable economic welfare is no facile task, even for a country which has been progressive in the pursuit of social welfare.

In spite of this conclusion, Sweden's ISEW shows considerably less deviation from the trend in economic growth than has been illustrated in certain other country studies. This suggests that - irrespective of comparative economic positions measured by conventional parameters - Sweden has a better historical performance than those other nations in delivering a level of economic welfare which is sustainable.

When we search for particular reasons behind this comparative difference we are drawn to highlight two (unrelated) critical factors. Firstly, we have exposed the substantial impact of distributional effects. Sweden's progressive social policies have reduced the inequality of income significantly over the period, and in the same token place a higher value on menial household tasks. These combined factors are highly visible in the ISEW. Secondly, Sweden's geophysical good fortune (and technological foresight) in possessing and developing hydroelectric resources reduces what might otherwise have been considerable negative impacts on the index from resource depletion and long-term environmental damage.

Having highlighted these features of the analysis, it should be acknowledged that their impact on the ISEW is influenced at least in part by methodological factors. It would certainly be legitimate to question whether or not the methodological emphasis placed, for example, on distributional effects is justified in terms of the overall aim of the index. Likewise it is certainly appropriate to be critical of our failure to account for the long-term environmental impacts of hydropower exploitation. In our view, these questions - and the many others raised by carrying out this study - are worthy of careful and extensive future consideration.

Nevertheless, we contend that the analysis carried out here has confirmed the usefulness of the ISEW. Care needs to be exercised in drawing hard and fast conclusions from a complex methodology. But as a tool for examining the influence of social and environmental factors on economic welfare, the ISEW continues to play a valuable critical role.

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REFERENCES

AFEAS. 1991a. *Chloroflourocarbons 11 and 12- annual production for the years 1931-1975 and annual production and sales for the years 1976-1990*. Prepared by Grant Thornton for the Alternative Fluorocarbons Environmental Acceptability Study. November 1991, Washington, DC.

AFEAS. 1991b. *Chloroflourocarbons 113, 114 and 115- cumulative production through 1970 and annual production and sales for the years 1980-1990*. Prepared by Grant Thornton for the Alternative Flourocarbons Environmental Acceptability study. November 1991, Washington, DC.

Anderson, V., 1991, *Alternative Economic Indicators*, Routledge, London.

Atkinson, G. 1995. *Measuring Sustainable Economic Welfare: A critique of the UK ISEW*. CSERGE Working Paper GEC 95-08, London.

BBC. 1978. *The People's Activities and Use of Time - a reference book based on two surveys in 1974-5*, BBC Audience Research Department, British Broadcasting Corporation, London.

Berg, L. 1988. *Hushållens sparande och konsumtion.* Allmänna Förlaget. Stockholm.

Berg, L. 1995. Personal communication to provide an update of Berg 1988.

Björklund, A. 1995. *Preliminary report on income distribution.* SOFI 95-06-11. Stockholm University.

Boström, C-E., T. Levander and B. Persson. 1982. *Luftföroreningar i Sverige 1970-1980*. Report PM 1521. Swedish Environmental Protection Agency, Solna.

Boström, C-E., V. Kucera and M.Törnqvist. 1990. *Luftföroreningar i tätorter problem och miljömål.* Underlagsrapport 1 till Naturvårdsverkets aktionsprogram mot luftföroreningar och försurning, Luft '90. Swedish Environmental Protection Agency. Solna.

Boström, C-Å., P-E. Grennfelt, M. Johansson and G. Lövblad. 1994. *Det Svenska energisystemets utsläpp till luft 1970-1990. Vad hade utsläppen till luft blivit vid en kärnkraftsavveckling*? En analys av verkligt utfall och avvecklingsalternativ. Report B1159. Swedish Environmental Research Institute (IVL), Göteborg.

Cobb, C., and J. Cobb. (eds). 1994. *The Green National Product*, University of Americas Press, Lanham Md.

Cobb, C., E. Halstead and J. Rowe. 1995. *The Genuine Progress Indicator - summary of data and methodology*, Redefining Progress, Washington, DC.

Daly, H., and J. Cobb. 1989. *For the Common Good - redirecting the economy towards community, the environment and a sustainable future*. Beacon Press. Boston.

Darmstadter, J. 1971. *Energy in the world economy- a review of trends in output trade and consumption since 1925*. John Hopkins Press Baltimore, London.

Diefenbacher, H. 1994. The Index of Sustainable Economic Welfare in Germany. In C. Cobb and J. Cobb (eds) *The Green National Product*, University of Americas Press.

Diefenbacher, H., and S. Habicht-Erenler, 1991, *Wachstum und Wohlstand: neuere Konzepte zur Erfassung der Social- und Umweltverträglichkeit*, Metropolis-Verlag, Marburg.

DsK. 1985. *Kostnader och avgifter inom transportsektorn*. DsK 1985:2 Kommunikationsdepartementet, Nordstedts Tryckeri, Stockholm.

Eisner, Robert. 1988. Extended Accounts for National Income and Product. *Journal of Economic Literature* Vol 26: 1611-1684.

Eisner, R. 1985, The Total Income System of Accounts, *Survey of Current Business*, January.

Environmental Statistics Yearbook, various years, SCB publication service, Örebro.

Falkenmark, M. 1977. *Water in Sweden - national report to the UN Water Conference 1977*. Ministry of Agriculture, Stockholm.

FD. 1991. *Räkna med miljön! Förslag till natur-och miljöräkenskaper.* Finansdepartementet, SOU 1991:37. Allmänna Förlaget, Stockholm.

FD. 1992. *Nationalförmögenheten*. Bilaga 11 till *Långtidsutredningen 1992*. Finansdepartementet. Allmänna Förlaget, Stockholm.

Folke, C. 1991, "The societal value of wetland life-support", pp. 141-171 in C. Folke and T. Kåberger (eds.), *Linking the natural environment and the economy: Essays from the Eco-Eco group*. Kluwer Academic Publishers, Dordrecht.

Gershuny, J. 1992. Economic Activity and Women's Time Use. Chapter 2 in *Time Use of Women in Europe and North America*, UN International Research and Training Institute for the Advancement of Women.

Gren, I-M. 1994, "The value of investing in wetlands for nitrogen abatement". *European Review of Agricultural Economics.* Cited in Gren & Söderqvist (1994).

Gren, I-M and T. Söderqvist. 1994. *Economic Valuation of Wetlands: A Survey*. Beijer Institute Discussion Paper No 54. The Beijer Institute, Stockholm.

Hicks, J.R. 1939. *Value and Capital*, Oxford University Press, Oxford and New York.

Hope, C., J. Parker and S. Peake. 1992. A Pilot environmental index for the UK in the 1980s. *Energy Policy.* Vol 20 pp335-343.

IVA. 1990. *Trafik, miljö och hälsa - en lägesrapport.* Ingenjörsvetenskapsakademin, Report 379. Stockholm.

Jackson, T. and N. Marks. 1994. *Measuring Sustainable Economic Welfare - a pilot index 1950-1990*. Stockholm Environment Institute/New Economics Foundation(UK), Stockholm.

Jackson, T. and N. Marks. 1996. *Expenditure Welfare and Human Needs*. In Proc. Conf. European Soc. Ecol. Econ. Paris, May 1996. (in press.)

Jackson, T. 1996. *Material Concerns - pollution, profit and quality of life*. Routledge, London.

Jacobson, L. 1980, *Personbilsmarknaden under 1980-talet*. Handelsbankens småskriftserie 18, Svenska Handelsbanken, Stockholm.

Jansson, K. 1994. *Inkomstfördelningen i Sverige 1975-1992 med särskild beskrivning av perioden 1989-1992*. Rapport 1994:1 (1994-08-17) Programmet för Inkomster och Förmögenhet, National Statistics Office, Stockholm.

Jernelöv, A. 1992. *Miljöskulden - en rapport om hur miljöskulden utvecklas om vi ingenting gör.* SOU 1992:58. Miljö- och naturresdepartementet. Allmänna Förlaget, Stockholm.

Järnegren, A., F. Ventura and O. Wärneryd. 1980. *Samhällsutbyggnad och energiförsörjning*. Byggforskningrådet rapport R52: 1980. Liber tryck. Stockholm.

Kindbom, K., K. Sjöberg and G. Lövblad. 1993. *Beräkning av ackumulerad syrabelastning från atmosfären till de svenska ekosystemen. Delrapport 1: Emissioner av svavel, kväve och alkaliskt stoft i Sverige 1900-1990*. Institutet for Vatten och Luftvårdsforskning (IVL) report B1109. Göteborg.

KI/SCB. 1994. *Swedish Economic and Environmental Accounts*. En lägesrapport från Konjunkturinstitutet och Statistiska Centralbyrån. National Statistics Office, Stockholm.

Kuznets, 1967. *Population and Economic Growth.* Proc. of the American Philosophical Society, 3: 170-193.

Levander, T. 1978. *Utsläpp av luftföroreningar i Sverige 1975*. Report SNV PM 1078. Swedish Environmental Protection Agency, Solna.

Löfroth, M. 1991. *Våtmarkerna och dess betydelse*. Report 3824. Swedish Environmental Protecion Agency, Solna.

NRA. 1992. *Reviderade värderingar 1993-2004*. Tilläggs-PM till Vägverkets Effektkatalog 1989:16. Borlänge.

Nelldal, B-L. 1982. *Arbetsresorna i Sverige - Redovisning av regional struktur och utvecklingstendenser*. Transportrådet 1982-03-01. Solna.

Nordhaus, W. 1992. *Is Growth Sustainable? reflections on the concept of sustainable economic growth*, paper prepared for the International Economic Society, Varenna, Italy, October 1992.

Nordhaus, W., and J. Tobin, 1972, Is growth obsolete? in *Economic Growth, Fiftieth Anniversary Colloquium V*, National Bureau of Economic Research, Columbia University Press, New York.

NUTEK. 1994. *Energy in Sweden Facts and Figures 1994*. Närings- och teknikutvecklingsverket. Nutek Förlag, Stockholm.

Obermayr, B., K. Steiner, E. Stockhammer and H. Hockrieber. 1995. *Die Entwicklung des ISEW in Österreich von 1955 bis 1992*. (forthcoming).

OECD. 1994. *Coal information 1993*. Organisation for Economic Cooperation and Development. Paris.

Olsson, A. 1993. *Finansiella tillgånger i Sverige 1945-90*. Nationalekonomiska institutionen. Stockholms Universitet.

Pace. 1990. *Environmental Costs of Electricity*. Pace University Centre for Environmental Legal Studies, prepared for the New York State Energy Research and Development Authoritiy and the US Department of Energy, Oceana Publications.

Rosenberg D., and T. Oegema. 1995. *A Pilot ISEW for the Netherlands 1950-1992*. Instituut voor Milieu - en Systeemanalyse, Amsterdam.

Rydberg, T. 1994. Pollution prevention through product substitution - experience from the halocarbon phase-out in Sweden. *Journal of Cleaner Production* Volume 2, No 1.

Rydenstam, K. and A. Wadeskog. 1995. *A statistical system on household production and consumption.* Preliminary report 95-02-15, National Statistics Office, Stockholm.

SCB. various years. Statistics Yearbook (*Statistisk årsbok)*. SCB publication service. Örebro.

SCB. 1964. *Nationalräkenskap 1950-1963*. Statistical reports. V 1964:5. SCB publication service, Örebro.

SCB. 1969. *The labour force surveys 1961-69* Statistical report AM 1969:57. SCB publication service, Örebro.

SCB. 1972. *Swedish National Accounts System (SNR) Concepts, definitions and classifications.* Reports on statistical co-ordination 1972:6. SCB publication service, Örebro.

SCB. 1975a. *Final consumption expenditure 1950-1974*. Statistical report N 1975:98 Appendix 1. SCB publication service, Örebro.

SCB. 1975b. *Capital formation, repair and maintenance and stocks of fixed capital 1950-1974.* Statistical report N 1975:98 Appendix 2. SCB publication service, Örebro.

SCB. 1979a. *Swedish National Accounts System (SNR) sources and methods*. Reports on statistical co-ordination 1979:11. SCB publication service, Örebro.

SCB. 1979b. *Miljöstatistisk Årsbok 1979.* SCB publication service, Örebro.

SCB. 1980a. *Hur jämställda är vi?* Levnadsförhållanden 1975/77 Rapport 20. Liber förlag, Stockholm.

SCB. 1980b. *Resvaneundersökningen 1978.* Statistical report T 1980:21.1. SCB publication service, Örebro.

SCB. 1981a. *Final Consumption Expenditure 1963-1980.* Statistical report N 1981:2.5 Appendix 1. SCB publication service, Örebro.

SCB. 1981b. *Capital formation and stocks of fixed capital 1963-1980.* Statistical report N 1981:2.5 Appendix 2. SCB publication service, Örebro.

SCB. 1981c. *The labour force surveys 1970-1980.* Statistical report AM 1981:33. SCB publication service, Örebro.

SCB. 1985. *Educational Expenditure 1970-1982/83.* Statistical report U12 SM 8501. SCB publication service, Örebro.

SCB. 1986. *Resvaneundersökningen 1984*. Statistical report T11 SM 8601. SCB publication service, Örebro.

SCB. 1987. *Urban expansion on agricultural land 1980-1985*. Statisical report NA 10 SM 8701. SCB publication service, Örebro.

SCB. 1988. *How we use our time - preliminary report from the 1984/85 Swedish time budget survey.* Living conditions report No 59. SCB publication service, Örebro.

SCB. 1989. *Utsläpp till luft av svaveldioxid, kväveoxider och koldioxid.* Statistical report NA 18 SM 8901. SCB publication service, Örebro.

SCB. 1990. *Miljöstatistisk Årsbok 1990.* SCB publication service, Örebro.

SCB. 1991. *The labour force surveys 1980-1990*. Statistical report AM 65 SM 9101. SCB publication service, Örebro.

SCB. 1992a. Levandsförhållanden. *I tid och otid. En undersökning om män och kvinnors tidsanvändning 1990/91.* Rapport 79. SCB publication service, Örebro.

SCB. 1992b. *Educational Expenditures 1975-1990.* Statistical report U12 SM 9201. SCB publication service, Örebro.

SCB. 1993a. *National Account 1980-1992*. Statistical report N 10 SM 9301. SCB publication service, Örebro.

SCB. 1993b. *Expenditure of GDP 1980-1992.* Appendix 1 to Statistical report N 10 SM 9301. SCB publication service, Örebro.

SCB. 1993c. *Landuse in Sweden 1993.* SCB publication service, Örebro.

SCB. 1993d. *Urban expansion on agricultural land*. Statisical report NA 10 SM 9301. SCB publication service, Örebro.

SCB. 1993e. *Assessment of real estate in 1992, part 2*. Statistical report BO38 SM 9301. SCB publication service, Örebro.

SCB. 1993f. *Yearbook of agricultural statistics 1994.* SCB publication service, Örebro.

SCB. 1994a. *Average hourly earnings of wage-earners in the private sector 1993.* Statistical report AM 57 SM 9401. SCB publication service, Örebro.

SCB. 1994b. *Utsläpp till luft av Svaveldioxid, kväveoxider och koldioxid 1993* Statistical report NA 18 SM 9405. SCB publication service, Örebro.

SCB. 1994c. *Utsläpp till luft av flyktiga organiska ämnen 1992.* Statistical report NA 18 SM 9402. SCB publication service, Örebro.

SCB. 1994d. *Financial Accounts 1986-1992*. Statistical report K11 SM 9401. SCB publication office, Örebro.

SNV. 1982. *1980-talets stora miljöfrågor. Naturvårdsverkets långsiktsbedömning. Ett bakgrundsdokument.* Report SNV PM 1591. Swedish National Protection Agency, Solna.

SNV. 1984. *Aktionsplan mot luftföroreningar och försurning.* PM 1862. Swedish Environmental

Protecion Agency, Centraltryckeriet, Borås.
SNV. 1992. *Framtida miljöövervakning av jordbruksmark. Effekter av brukning och förorening*. Report SNV 4109. Re. Rune Andersson. Swedish Environmental Protecion Agency. Solna.
SOU. 1965. *Hemarbete och Servicekontakter*, 1965:65, Socialdepartementet, Stockholm.
SSÅ, various years, Forestry Statistics Yearbooks, (Skogsstyrelsens årsbok) National Board of Forestry, Jönköping.
Tellus. 1991. *Environmental Benefits of DSM in New York: Long Island case study*. Tellus Institute Proceedings of the Demand Side Management and the Global Environment Conference, Arlington, Virginia, April, 1991.
Transportrådet. 1982. *Transporter i Sverige - Transportmedlens utveckling och utnyttjande*. Rapport 1982:4 Bil 1. Solna.
UKNA. 1989. Various years. *United Kingdom Nartional Accounts* - 1989 edition. Central Statistics Office, HMSO, London.
UN. 1976. *World Energy Supplies 1950-1974*. Department of Economic and Social Affairs. United Nations Statistical Office, New York.
WCED, 1987. Our Common Future, World Comission on Environment and Development, Oxford University Press, Oxford.
Wickbom, G. 1994. Studier som har värderat miljöskador/miljönytta 1994. Internal PM Swedish Environmental Protection Agency, Solna.
Wittmark, B. 1992. *Bullerexponerade i Sverige. Hur många är det egentligen*. SOU 1993:65. Bilaga 9.

APPENDIX:
THE SWEDISH INDEX FOR SUSTAINABLE ECONOMIC WELFARE

All costs are in millions of 1985 sek
except for columns Y and AA which are in 1985 sek

A	B	C	D	E	H	(I - F)
			+	+	+	-
Year	Consumer Expenditure	Income Distribution	Weighted Personal Consumption (B/C)	Services : Household Labour	Public Expenditure on Health & Education (consumption	Difference Between Expenditure on & services fr. Consumer Goods
1950	202,177	100.0	202,177	109,486	3,423	3,469
1951	199,957	100.8	198,452	114,318	3,271	1,249
1952	207,347	100.1	207,199	117,795	3,732	1,505
1953	212,782	99.5	213,930	121,239	3,833	1,963
1954	221,523	99.1	223,538	127,244	4,287	3,044
1955	228,353	98.4	232,031	132,026	4,589	1,211
1956	234,839	97.6	240,690	136,413	4,834	155
1957	238,434	97.3	244,994	138,615	5,249	(773)
1958	244,296	97.3	251,108	142,260	5,613	(1,210)
1959	253,124	97.0	261,024	147,733	5,902	(820)
1960	257,071	96.8	265,673	152,500	6,177	(3,967)
1961	270,745	95.9	282,273	161,675	6,671	(2,548)
1962	279,713	94.9	294,764	169,558	7,271	(1,719)
1963	292,073	93.7	311,843	178,617	8,874	(105)
1964	303,785	92.6	327,940	186,879	9,875	(1,773)
1965	316,692	91.5	346,088	193,513	10,745	(2,987)
1966	322,828	90.7	355,809	198,153	12,249	(5,158)
1967	330,202	90.3	365,498	203,127	13,654	(7,465)
1968	343,789	89.9	382,565	208,671	14,995	(7,410)
1969	359,037	89.2	402,718	220,900	16,778	(5,685)
1970	371,586	88.4	420,575	234,575	18,958	(2,435)
1971	371,917	87.4	425,590	241,457	21,408	(4,192)
1972	384,680	85.9	447,948	249,649	22,227	1,869
1973	394,603	84.4	467,741	250,100	22,754	2,963
1974	407,926	82.9	492,361	253,899	24,446	6,510
1975	419,341	81.3	515,550	259,066	26,063	3,175
1976	436,768	79.7	547,995	262,002	27,577	6,596
1977	432,233	77.9	554,544	254,364	30,412	(2,549)
1978	429,174	76.1	564,245	246,325	30,961	(5,531)
1979	439,543	74.2	592,272	244,624	32,317	(6,232)
1980	436,028	72.4	602,265	238,712	34,308	(11,204)
1981	433,862	70.8	612,738	233,774	34,564	(16,275)
1982	436,338	70.0	622,937	229,501	34,707	(14,818)
1983	425,890	69.8	610,364	221,025	35,394	(19,548)
1984	432,065	70.4	613,305	222,246	36,046	(20,456)
1985	443,671	71.5	620,893	223,747	34,503	(18,891)
1986	465,244	73.3	634,955	223,214	33,942	(6,654)
1987	487,683	74.1	658,332	227,614	35,443	1,793
1988	500,426	74.8	668,857	230,433	35,283	493
1989	507,284	75.0	676,201	235,560	38,054	(5,395)
1990	506,571	75.7	669,254	239,178	38,541	(16,046)
1991	512,102	76.3	671,470	232,328	37,506	(23,319)
1992	502,186	77.0	652,586	242,435	32,689	(36,224)

A	J	K	L	M	N	O
	-	-	-	-	-	-
Year	Defensive Private Expenditures on Health & Education	Costs of Commuting	Costs of Personal Pollution Control	Costs of Car Accidents	Costs of Wate Pollution	Costs of Air Pollution
1950	1,636	6,051		4,669	18,343	11,368
1951	1,543	5,902		4,985	18,995	12,716
1952	1,601	6,402		5,607	19,648	12,811
1953	1,849	7,136		6,594	20,300	13,851
1954	2,062	7,780		7,343	20,952	15,166
1955	2,100	7,745		7,722	21,605	15,982
1956	2,214	7,912		8,056	22,257	16,817
1957	2,300	8,291		8,359	22,910	17,810
1958	2,514	8,758		8,572	23,562	18,694
1959	2,638	8,774		8,780	24,214	19,939
1960	2,770	8,383		8,813	24,867	20,996
1961	2,871	8,788		9,235	25,519	22,127
1962	2,970	9,277		8,959	26,171	23,460
1963	3,131	9,819		9,323	26,824	24,620
1964	3,287	9,622		9,889	27,476	26,140
1965	3,425	10,296		9,279	27,915	27,502
1966	3,640	10,206		8,290	32,245	27,421
1967	3,914	10,817		7,883	38,357	27,594
1968	3,981	11,887		8,600	34,793	28,324
1969	4,162	12,650		8,866	30,835	28,861
1970	4,122	13,379		8,508	28,832	30,297
1971	4,226	13,439		8,398	25,016	30,210
1972	4,445	13,599		8,189	25,474	30,523
1973	4,737	14,124		8,644	25,069	30,845
1974	3,994	15,424		8,204	25,740	31,022
1975	4,206	15,054		8,206	25,527	30,936
1976	4,454	15,576		8,716	24,837	31,425
1977	4,436	14,803		8,299	27,006	31,334
1978	4,550	15,066		8,197	25,350	31,132
1979	4,722	16,402		7,888	26,638	31,508
1980	4,817	17,286		7,835	27,910	31,381
1981	5,143	19,421		7,569	28,612	30,882
1982	5,408	21,681		7,818	25,139	30,568
1983	5,708	21,915		8,105	24,103	30,225
1984	6,072	23,917		8,454	23,914	30,309
1985	6,745	24,183		8,146	26,069	30,616
1986	6,863	27,040		8,529	25,676	30,548
1987	7,185	31,017		8,004	25,523	30,072
1988	7,780	32,198		8,800	25,429	29,668
1989	8,103	30,564		9,189	25,570	28,071
1990	8,643	32,365		8,681	24,202	26,684
1991	9,745	35,830		8,184	25,419	25,210
1992	9,966	37,381		7,977	23,997	24,625

A	P	Q	R	S	T	U
	-	-	-	-	-	-
Year	Costs of Noise Pollutio	Costs of Loss of Wetlands	Costs of Loss of Farmlands	Depletion of Non-Renewat Resources	Long-Term Environmenta Damage	Ozone Depletion Costs
1950	8,214	1,436	1,409	10,546	12,578	228
1951	8,236	1,441	1,426	12,255	13,085	276
1952	8,258	1,449	1,443	13,221	13,610	330
1953	8,280	1,461	1,460	13,684	14,116	397
1954	8,302	1,472	1,477	14,825	14,643	470
1955	8,324	1,485	1,494	16,575	15,251	559
1956	8,346	1,499	1,511	19,265	15,945	665
1957	8,368	1,515	1,528	19,416	16,578	779
1958	8,390	1,531	1,545	21,149	17,248	892
1959	8,411	1,544	1,562	22,136	17,934	1,037
1960	8,433	1,557	1,579	25,906	18,740	1,210
1961	8,455	1,572	1,603	27,949	19,531	1,404
1962	8,477	1,588	1,627	31,006	20,383	1,637
1963	8,499	1,603	1,651	33,242	21,296	1,905
1964	8,521	1,619	1,675	38,024	22,299	2,217
1965	8,543	1,636	1,699	41,101	23,344	2,563
1966	8,565	1,652	1,753	46,307	24,564	2,954
1967	8,587	1,665	1,807	47,791	25,726	3,394
1968	8,609	1,677	1,861	53,212	27,013	3,885
1969	8,631	1,689	1,915	57,302	28,463	4,442
1970	8,653	1,701	1,969	67,707	30,223	5,048
1971	8,631	1,718	2,026	71,165	31,859	5,760
1972	8,609	1,735	2,083	75,712	33,544	6,572
1973	8,587	1,756	2,140	82,996	35,298	7,480
1974	8,565	1,778	2,197	78,990	36,894	8,436
1975	8,543	1,805	2,254	86,553	38,633	9,274
1976	8,521	1,832	2,286	94,338	40,575	10,176
1977	8,499	1,859	2,317	97,317	42,536	11,034
1978	8,477	1,883	2,410	102,009	44,484	11,874
1979	8,455	1,912	2,503	106,474	46,423	12,684
1980	8,433	1,941	2,597	105,672	48,288	13,493
1981	8,411	1,973	2,669	111,561	50,222	14,305
1982	8,390	2,014	2,742	112,530	52,082	15,080
1983	8,368	2,064	2,814	109,999	53,877	15,929
1984	8,346	2,117	2,887	125,243	55,811	16,869
1985	8,324	2,169	2,959	139,606	57,924	17,835
1986	8,302	2,227	3,027	155,278	60,244	18,918
1987	8,280	2,277	3,096	149,353	62,495	20,037
1988	8,258	2,317	3,164	162,582	64,738	20,999
1989	8,236	2,354	3,232	159,887	66,876	21,561
1990	8,214	2,374	3,300	166,919	69,026	21,969
1991	8,192	2,387	3,368	178,759	71,290	22,215
1992	8,170	2,394	3,436	165,511	73,352	22,474

A	V	W	X(SUM)	Y	Z	AA
	+	+	=			
Year	Net Capital Growth	Change in Ne International Position	Index of Sustainable Economic Welfare ISEW	Per Capita ISEW	Gross Nationa Product - GNI	Per Capita GNP
1950	9,291	5,258	249,687	35583	281,970	40184
1951	9,234	5,258	248,423	35123	290,446	41064
1952	8,795	3,167	254,803	35762	295,253	41439
1953	8,419	3,427	259,757	36223	304,536	42468
1954	8,584	2,393	268,509	37226	320,094	44377
1955	20,560	1,069	290,220	39964	327,473	45094
1956	20,519	156	297,970	40728	337,838	46178
1957	20,933	371	303,083	41141	346,132	46984
1958	21,614	(569)	308,381	41594	354,667	47837
1959	22,134	2	320,644	43016	372,160	49928
1960	23,899	(335)	328,626	43905	380,247	50801
1961	20,473	1,836	346,420	46067	401,446	53384
1962	18,304	1,589	357,649	47296	413,996	54747
1963	5,120	1,886	364,532	47939	434,947	57200
1964	7,037	2,104	384,836	50233	465,074	60707
1965	5,223	1,510	402,763	52077	480,210	62091
1966	8,948	(1,931)	410,786	52611	488,067	62509
1967	14,363	(1,875)	424,696	53978	504,634	64137
1968	28,500	(1,389)	456,908	57734	520,241	65737
1969	27,988	(3,097)	483,156	60622	547,002	68633
1970	27,849	(1,451)	502,503	62477	583,636	72565
1971	30,556	798	521,552	64405	576,511	71192
1972	30,437	1,664	539,571	66433	594,763	73229
1973	33,764	3,905	553,626	68038	615,414	75632
1974	32,025	3,309	578,285	70860	647,458	79336
1975	31,993	(737)	597,768	72961	665,544	81233
1976	32,132	(4,737)	615,640	74877	671,800	81708
1977	31,054	(5,790)	617,692	74854	659,239	79888
1978	28,014	(11,575)	608,068	73474	682,108	82420
1979	26,099	(10,804)	625,130	75371	714,321	86125
1980	25,867	(11,201)	631,500	75993	717,786	86376
1981	23,878	(14,823)	625,638	75197	707,906	85085
1982	23,360	(21,688)	620,183	74496	714,515	85828
1983	22,545	(29,605)	596,164	71577	716,450	86019
1984	24,893	(35,542)	577,467	69266	737,349	88443
1985	25,064	(33,351)	565,172	67685	746,862	89445
1986	35,109	(20,975)	566,249	67652	763,408	91208
1987	38,875	(13,956)	597,177	71109	784,763	93446
1988	41,604	(12,635)	597,117	70782	804,866	95408
1989	46,856	(18,878)	619,544	72948	823,686	96984
1990	55,288	(28,322)	617,608	72159	821,499	95981
1991	56,132	(32,168)	597,988	69396	811,337	94155
1992	59,713	(49,371)	594,995	68643	811,651	93638

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The Stockholm Environment Institute (SEI) was established by the Swedish Parliament in 1989 as an independent foundation for the purpose of carrying out global environment and development research. The Institute is governed by an international Board whose members are drawn from developing and industrialized countries worldwide.

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- *Environmental Technology*, including clean production and low waste, energy technology, environmental technology transfer, and agricultural biotechnology;
- *Environmental Impacts*, including environmentally sound management of low-grade fuels, climate change and sustainable development, and coordinated abatement strategies for acid depositions;
- *Environmental Policy and Management*, including urban environmental problems, sustainable environments and common property management; and
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