An Index of Sustainable Economic Well-being for the South East Region

A draft report for SEEDA

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July 2006

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Executive Summary

This study sets out the basis for a Regional Index of Sustainable Economic Well-Being (R-ISEW) for the South East. Even at the national level, constructing such indicators is a formidable task. At the regional level, the task is compounded by limitations in the availability of regional data. The results reported here should therefore be viewed as a first pilot, to be refined and revised appropriately as regional data become more robust. Subject to these inevitable caveats, we believe that the exercise reported here represents a valuable step in developing an indicator of sustainable economic well-being for the South East region.

The results of the study (Figure 1) indicate that between 1994 and 2004 the South East R-ISEW rose by approximately 53%, mainly driven by strong consumption growth, net capital growth, public expenditure on health and education, and significant reductions in air pollution. These factors ensured that R-ISEW rose faster in relative terms than GVA over the period. The South East R-ISEW also performed better than a UK ISEW constructed on the same basis.

Nonetheless, there is little room for complacency here. The R-ISEW remains lower than GVA in absolute terms and during the last few years the gap between GVA and R-ISEW has widened. Sensitivity analyses reveal that on less optimistic assumptions, this gap could be considerably wider. A robust effort to tackle climate change and resource depletion will be necessary if the long-term vision is to be achieved.

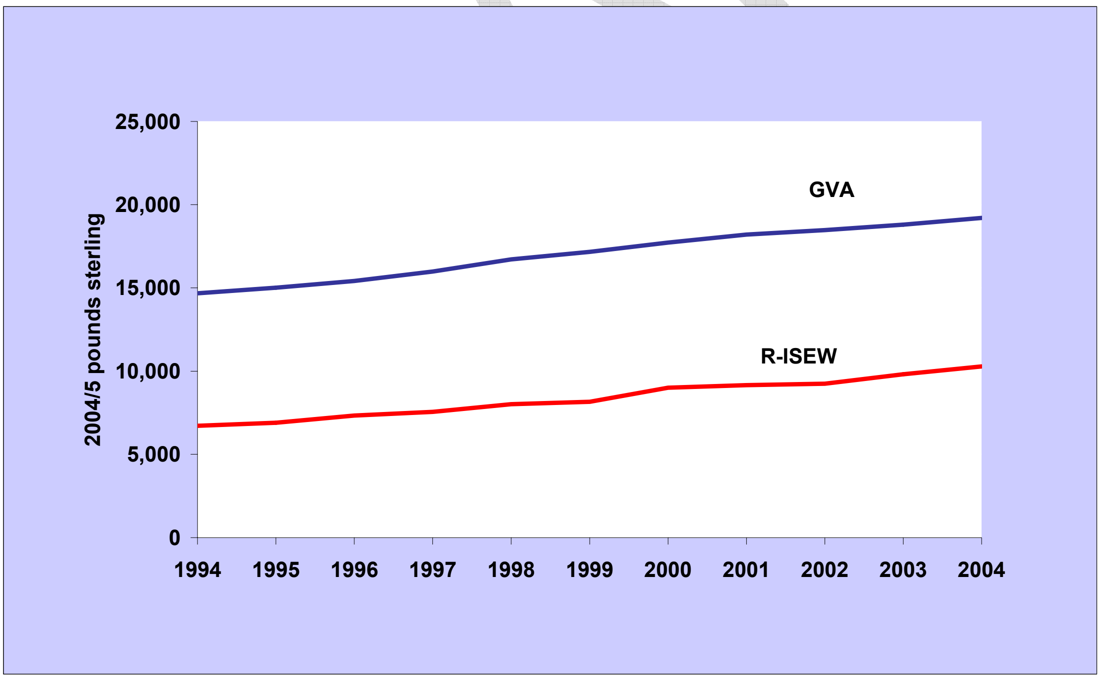

Figure 1: The South East R-ISEW per capita v. GVA per capita (1994 – 2004)

1 Introduction

The vision set out in the South East Draft Regional Economy Strategy (RES) is that by 2016, the South East will be a 'world class region achieving sustainable prosperity'.[1] Measuring progress towards this vision will be vital. The draft RES recognises that the region stands at a cross-roads. Four alternative scenarios have been articulated, only one of which delivers the vision. The other three would lead eventually to the decline of the region. As the RES suggests:

> 'The main conclusions from assessing these scenarios are that, despite its headline affluence, the region is at a challenging juncture. We could be heading towards the tipping point on the one hand, or flirting with slow death through complacency on the other. Despite the South East's undoubted advantages, the future is not assured.' (SEEDA 2006, 24).

This report describes the first Regional Index of Sustainable Economic Well-being (R-ISEW) for the South East region. It was commissioned by the South East England Development Agency (SEEDA) with the aim of contributing to the measurement of progress towards the region's vision. In particular, this exercise hopes to inform the development of a Regional Economic Strategy for the South East region that is consistent with the UK Government's sustainable development strategy and achieves the dual aims of prosperity and sustainability.

In Section 2 of this report, we discuss the problem of measuring progress towards these aims and outline the rationale for developing 'alternative' indicators of prosperity and sustainability. We establish the basis for constructing 'adjusted' measures of economic well-being and describe in particular the Index of Sustainable Economic Welfare (ISEW) piloted by Daly and Cobb for the US and subsequently applied in a number of different countries including the UK.

In Section 3, we present the results of a pilot Regional index of sustainable economic well-being for the South East region, setting out the key adjustments and describing the quantitative results and trends over the period between 1994 and 2004. Section 4 discusses the key findings from the exercise, highlights sensitivities to certain parameters and compares trends to the national UK average.

Technical Appendices provide a detailed breakdown of the different components of the South East R-ISEW (Appendix A.1), a number of sensitivity analyses for specific parameters in the R-ISEW (Appendix A.2) and supporting numerical results (Appendix A.3).

[1] Draft Regional Economic Strategy. South East England Development Agency. Available on the web at: http://www.seeda.co.uk/res/

2 Adjusted Measures of Economic Well-Being: a conceptual background

Rising GDP traditionally symbolises a thriving economy, more spending power, increased family security, greater choice, richer and fuller lives, more public spending and better public services. As a measure of progress, the GDP appears initially to have much to recommend it. At the regional level, this function has in recent years been taken over (in the UK at least) by the indicator known as Gross Value Added (GVA) which operates at the regional level as a kind of proxy for GDP.

There are, however, a number of reasons to view with caution the simplistic equation of national or regional income with well-being. Numerous authors have pointed to the (sometimes rising) social and environmental costs associated with rising economic output.[2] Others have pointed to the potential divergence between material gains and psychological or social well-being.[3] At the very least, it is clear that there are a number of factors - such as physical and mental health, family security, environmental quality and social cohesion - which contribute to well-being, but which are not captured by conventional measures of economic output at all.[4]

None of this has gone entirely unnoticed over the years, even by the original proponents of the GDP. The economist Simon Kuznets – one of the architects of the system of national accounts – declared that ‘the welfare of a nation can scarcely be inferred from a measurement of the national income.’ The 1993 revision of the System of National Accounts declared categorically that ‘neither gross nor net domestic product is a measure of welfare’.[5] It is even possible to find criticism of the growth project in the 19th Century writings of John Stuart Mill – one of the principal architects of classical economics.[6]

Concern over using GDP (or its regional proxy) as a measure of social well-being confronts national and regional policy-makers with one fundamental question: how exactly are we to assess our progress towards an improved quality of life? ‘Alternative’ measurements of well-being have generally followed one of four quite distinct approaches in attempting to answer this question.

The first of these has been to develop extended indicator sets, measuring a wide variety of ‘objective’ physical or socio-economic factors which are deemed to contribute to or detract from personal or collective well-being. The second attempts to aggregate a selection of ‘objective’ factors into some kind of composite indicator of quality of life. Next, a variety of attempts have been made to capture the more subjective psychological aspects of people’s quality of life by measuring ‘subjective

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2 The literature on this dates back to the early Club of Rome report (Meadows, D et al 1972. The Limits to Growth. A Report to the Club of Rome. London: Pan Books. It is beyond the scope of this paper to review this literature in detail.

3 For a summary of some of this evidence see Kasser, T 2002. The High Price of Materialism, MIT Press, Cambridge, Mass.

4 Diener E and M Seligman 2004. Beyond Money: towards an economy of well-being. *Psychological Science in the Public Interest* 5(1).

5 SNA 1993. System of National Accounts 1993. Prepared under the auspices of the Inter-Secretariat Working Group on National Accounts; Studies in methods - United Nations. Series F; 2:Rev.4. New York.

6 Daly for example cites Mill as arguing for a ‘stationary condition of capital and population’ in which there would be more likelihood of ‘improving the art of living... when minds ceased to be engrossed by the art of getting on.’ (Daly, H 1996. *Beyond Growth*. Washington, DC: Island Press, p3).

well-being'. Finally, attempts have been made to develop monetarised accounts of the factors deemed to impact on well-being and to use these monetarised accounts to adjust conventional consumption-based or output-based measures of economic welfare.[7]

The principal focus of this report – and the basis for the measure developed in this report – is on this fourth kind of indicator. Specifically, we set out in Sections 3 the elements of a Regional Index of Sustainable Economic Well-Being (R-ISEW) for the South East region. This indicator takes as its starting point a conventional economic accounting framework but incorporates adjustments to account for social and environmental factors excluded from a simple assessment of industrial output.

The history and development of this kind of measure is outlined briefly below.

2.1 Early Attempts to Adjust the GDP

Amongst the earliest attempts to address the shortfalls of GDP as a measure of economic welfare was a landmark paper published in 1972 by Nordhaus and Tobin, entitled *Is Growth Obsolete?* In that paper, the authors constructed a 'measure of economic welfare' (MEW) by adjusting GDP to account for certain economic and social factors not normally included in the GDP. The original MEW was less concerned with the environmental factors affecting economic welfare. The results of the exercise indicated that between 1929 and 1965, economic welfare – as measured by the Nordhaus and Tobin index – increased consistently; but that the growth rate in MEW was somewhat slower than the growth rate in GDP. The authors concluded from this analysis that growth was not obsolete; that, on the contrary, it continued to deliver increasing levels of welfare; and that as an indicator of well-being, GDP could still be regarded as robust.

When Nordhaus examined the same question from an environmental perspective in 1992, in a paper entitled *Is Growth Sustainable?*, he discovered that his (revised) MEW began to diverge more substantially from GDP in the later years of the study. Nordhaus attributed this increased divergence to 'conventional sources' such as declining productivity growth and dwindling savings rather than to the unsustainable use of natural resources. But the importance of the study was already clear enough: by making certain economic, social and environmental adjustments to the conventional measure, it had been possible to show that GDP could not necessarily be regarded as a robust indicator even of economic welfare, let alone of social well-being or quality of life.

A more radical attempt to incorporate environmental and resource effects into an adjusted economic indicator for the US was pioneered by Zolotas.[8] Even in the mid 1970s Zolotas was able to demonstrate that his index of the Economic Aspects of Welfare (EAW) rose more slowly than GDP. Zolotas argued that there would come a time – as the quotation at the top of this section suggests – when an increment of economic output would produce no increase in welfare at all.

In the concluding section, we shall return briefly to this hypothesis which appears, at one level, to have been reinforced by the broadest set of studies to attempt to construct an adjusted economic measure – the Daly and Cobb Index of Sustainable Economic Welfare (ISEW).

[7] For an overview of these different kinds of indicator, see also nef 2004 (op cit, ref 4).

[8] Zolotas, X 1981. *Economic Growth and Declining Social Welfare*. Athens: Bank of Greece.

2.2 The Daly and Cobb Index of Sustainable Economic Welfare

The Index of Sustainable Economic Welfare (ISEW) was first developed for the United States for the years 1950 and 1988 by Herman Daly and John Cobb and printed as an appendix to their landmark book *For the Common Good*.[9] A slightly revised version of the index, updated to 1990, was published by Clifford Cobb and John Cobb in a collected volume of papers on the *Green National Product* which also incorporated some early criticisms of the ISEW methodology.[10]

Daly and Cobb's aim was to develop an indicator capable of reflecting the range of criticisms which had been directed at GDP as a welfare measure. They wanted for example not only to incorporate a correction for the depreciation of natural and human-made capital, but also to account for reduction of welfare associated with the unequal distribution of incomes.[11] They aimed to include the contribution to welfare from the 'informal' economy,[12] correct for the social and environmental costs of production, and take account of so –called 'defensive' expenditures: 'expenditures necessary to defend ourselves from the unwanted side-effects of production'.[13] As Robert Kennedy's Kansas speech pointed out, the GDP includes a variety of these kinds of expenditures. An increasing proportion of the national income may be spent on cleaning up environmental damage resulting from the production of goods and services, or on treating illnesses arising from impaired environmental quality or social degradation. These 'defensive expenditures' may be vital to maintain our quality of life against the adverse welfare impacts of other expenditures. But it is surely then inappropriate to count both sets of expenditures as positive contributions to welfare.

The Daly and Cobb ISEW starts out from the standard economic measure of private consumer expenditure or 'personal consumption'. For various reasons, many of which are discussed elsewhere,[14] 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 to pay for (and hence the value they assign to) the goods and services through which welfare may be provided.

Using this basis in personal consumption, the ISEW then makes several specific kinds of adjustment to reflect the various elements discussed above. These adjustments fall into six broad categories.

- Firstly, the total personal consumption is adjusted to account for inequalities in the distribution of incomes in the economy.

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9 Daly, H and Cobb 1989. *For the Common Good*. London: Green Print.

10 Cobb C and J Cobb 1994 *The Green National Product*.

11 See Stymne, S and T Jackson 2000. Intra-generational equity and sustainable welfare. *Ecological Economics* 33, 219-236

12 The integration of unpaid housework into GDP was recommended for example by the closing Nairobi Conference of the United Nations Decade for Women. Agenda 21, the Rio Earth Summit's 'blueprint for sustainability', declares that 'unpaid productive work such as domestic work and child care should be included, where appropriate, in satellite national accounts and economic statistics'.

13 Daly and Cobb 1989.

14 See for example discussions in Daly and Cobb 1989, various contributions to Cobb and Cobb 1994, and Jackson and Marks 1999.

- Secondly, an account is made of the non-monetarised contributions to welfare from services provided by household labour.

- Thirdly, account is taken of the environmental costs arising from the annual emission of certain types of air and water pollution and noise pollution.

- Fourthly, account is taken of certain 'defensive' expenditures: specifically private expenditures on health, education, commuting, car accidents and personal pollution control are subtracted from the account, and government expenditures are included in the index only to the extent that they are regarded as *non*-defensive.

- Next, the index makes several adjustments to account for changes in the sustainability of the capital base. Specifically, it includes a 'net capital growth' adjustment to account for changes in the stock of human-made capital.[15] It also includes the net transactions in overseas assets and liabilities in order to provide an indication of the robustness (and sustainability) of the economy in international terms.[16]

- In addition, 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.

- Finally, the index attempts to account for the depreciation of natural capital as a result of the depletion of natural resources, the loss of habitats and the accumulation of environmental damage from economic activity.

Taken together the adjustments which comprise the Daly and Cobb ISEW can be expressed in the following equation:[17]

ISEW =	**Personal consumer expenditure**	
	-	**adjustment for income inequality**
	+	**public expenditures (deemed non-defensive)**
	+	**value of domestic labour**
	+	**economic adjustments**
	-	**defensive private expenditures**
	-	**costs of environmental degradation**
	-	**depreciation of natural capital.**

The results of applying this methodology to the United States revealed a trend in sustainable economic welfare which differed markedly from the trend in GDP over

15 The term human-made capital refers to the stock of conventional economic capital assets, and should not be confused with the term 'human capital' which refers to the stock of human resources. It might be noted that the GDP 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.

16 In the conventional expenditure-related calculation of GDP, 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.

17 Appendix 1 presents a more detailed account of the composition of the Daly and Cobb ISEW and subsequent variations on it.

the period examined (1950-1990). While GDP in the United States increased substantially over the period, the ISEW began to level out, and even decline slightly from about the mid-1970s onwards (Figure 2).

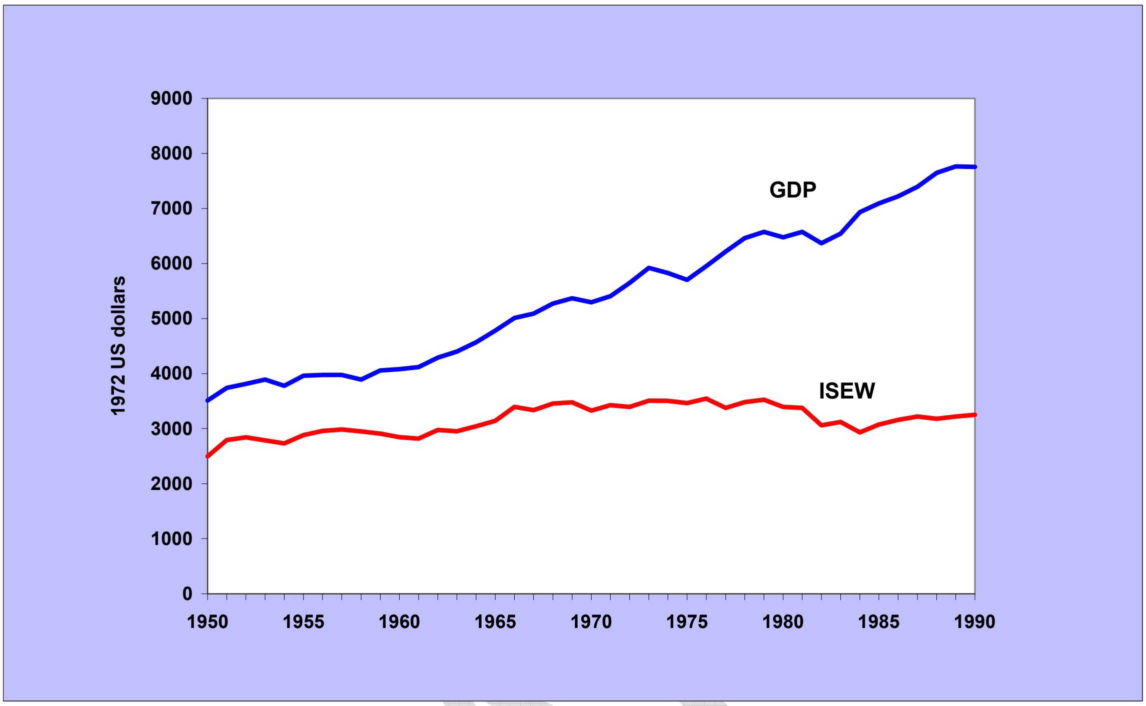

Figure 2: US Index of Sustainable Economic Welfare (ISEW) 1950-1990[18]

2.3 Genuine Progress and Beyond

Since the publication of the original US ISEW, several similar studies have been carried out – both in the US and in other countries. Many of these studies have incorporated some additions or revisions to the original methodology. One of the less significant but potentially more confusing revisions of the ISEW has been a kind of 'rebranding' of the original idea.

In 1995, Clifford Cobb and his colleagues at an organisation called *Redefining Progress* decided that the terminology of ISEW was not particularly attractive to ordinary people and published an index – based substantially on the ISEW methodology – called the Genuine Progress Indicator (GPI).[19] The idea of the 'rebranding' was quite specifically to have a shorter more accessible acronym, which specifically identified the index as a better indicator of national progress than the GDP.

At the same time, the GPI also introduced certain additional factors that had been left out of the original ISEW. These included adjustments for social costs such as crime, divorce and unemployment – all recognised as factors affecting the level of well-being in the nation. Some later versions of the ISEW or GPI have extended this set of

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18 Re-drawn from data in Cobb and Cobb 1994 (ref 41)

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

factors to include the psychological and social costs associated with under- and over-employment.[20]

Finally, in 2004, the New Economics Foundation (**nef**) published an updated ISEW variant for the UK which was again re-branded, this time as a Measure of Domestic Progress – MDP (Figure 3).[21] One of the aims of this work was to cast the green GDP measure more specifically as a useful way of measuring a country's progress towards sustainable development. The various components of the index were related explicitly to the different dimensions of sustainability: economic, social and environmental.

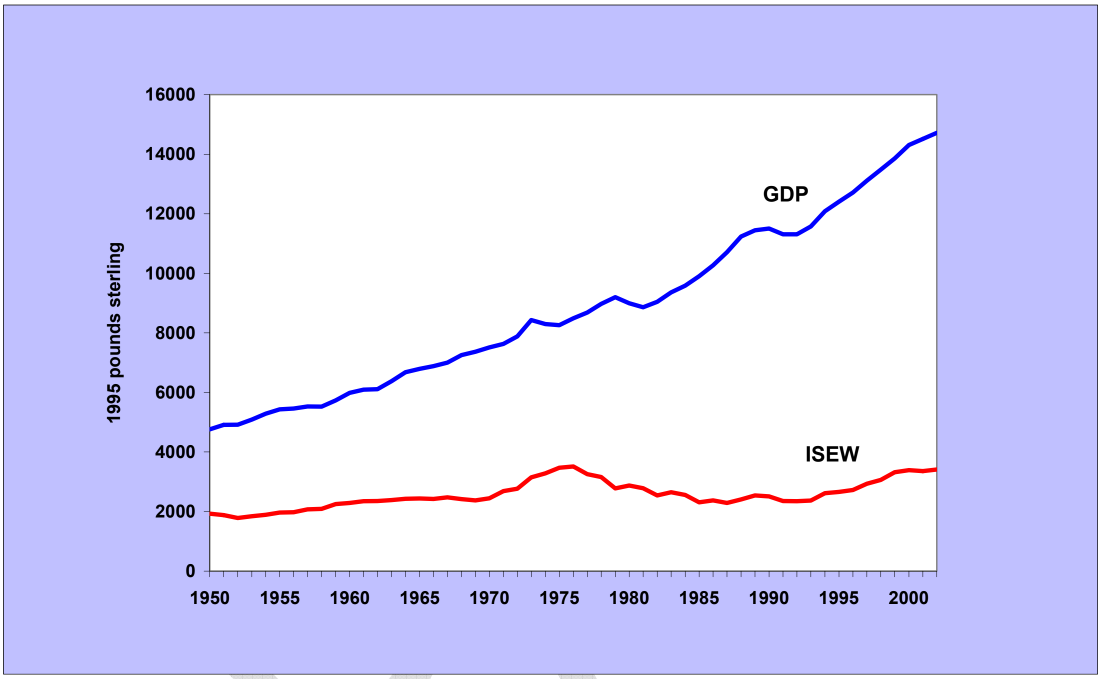

Figure 3: MDP and GDP per capita in the UK 1950-2002

In summary, the last decade has seen a variety of attempts to construct adjusted measures of sustainable economic well-being, based on the Index of Sustainable Economic Welfare developed initially by Daly and Cobb. Subsequent variations on this index have incorporated both revisions to the methodology and a certain 'rebranding' of the index to make it's relevance clearer to a lay public or to relate it more closely to current debates about sustainable development. Some limited attempts have been made to construct regional or local versions of this indicator. This study represents the first attempt to develop such an indicator for the South East region.

[20] These adjustments were first made in the Australian GPI. See Hamilton, C and H Saddler 1997. The Genuine Progress Indicator: a new index of changes in well-being in Australia. Discussion paper 14. Canberra: The Australia Institute.

[21] Jackson, T 2004. *Chasing Progress? Beyond measuring economic growth.* London: New Economics Foundation; see also Jackson, T, N Marks, J Ralls and S Stymne 1997. Sustainable Economic Welfare in the UK: a pilot index for the UK 1950-1996. London: *nef*.

3 The South East R-ISEW

The aim of this study was to develop an economic indicator that could be used to measure progress towards sustainable prosperity in the South East region. In discussion with SEEDA, it was agreed that the basis for the indicator would be a regional variation of the adjusted economic indicator developed initially by Daly and Cobb (Section 2) – an indicator which has already been applied at the national level in a number of different countries. In particular, it was proposed that a Regional Index of Sustainable Economic Well-Being (R-ISEW) would be constructed, based substantially on the economic, social and environmental adjustments incorporated in the recent UK MDP.

In the following subsections we discuss briefly the rationale for each of the factors incorporated into the South East R-ISEW. More detailed descriptions of the methodologies associated with each component in the index are provided in Appendix A.1. We also present results from the analysis and discuss key findings and trends over time.

3.1 Economic Factors

The idea behind adjusted measures of economic well-being is to start from an account of economic consumption (as for GDP). This basis is then adjusted (hence the name) to incorporate a variety of economic, social or environmental factors which are not included in the conventional measure. In this section, we describe briefly both the basis for the R-ISEW and the adjustments made to account for some of the economic factors (identified in Section 2) which are vital for sustainability.

Consumer Expenditure

Consumer expenditure is imperfect as a proxy for well-being for a number of reasons. Nonetheless, it at least provides an indication of the value of goods and services consumed and is therefore a reasonable estimate of the 'standard of living' during the period. Industrial output from businesses in the region (GVA) bears a much less direct relation to the standard of living. Typically, the relationship between GVA and household consumption will be moderated by a number of factors including the level of wages and salaries, the level of unemployment, and the extent to which revenues generated from businesses registered in the region actually accrue to residents in the region.

Estimating the consumer expenditure for the South East is not entirely a straightforward task. Consumer expenditure data are not routinely reported at regional level. So it is necessary to estimate the level of consumption on the basis of data on spending collected from a sample of households by the Office for National Statistics in the Expenditure and Food Survey (formerly the Family Expenditure Survery). Details of the sources and estimations are given in Appendix A.1.

The results of this estimation for the period 1994-2004 are illustrated in Figure 4, which also shows the trend in regional GVA over the same period. Regional consumer expenditure grew from £82 billion to £124 billion in real terms over the period, an increase of £42 billion, while GVA grew from £113 billion to £156 billion, an increase of around £43 billion.

Interestingly, the trend in household expenditure is less smooth than the trend in GVA. Figure 4 shows that while both GVA and real household expenditure in the region grew throughout the period, the rate of growth in consumer expenditure varied slightly from year to year, while that of GVA remained fairly constant, reflecting the potential for decoupling of the two indices. Nonetheless, because of the lower absolute figures, the percentage growth in consumption over the period – an increase of 51% – is considerably greater than the growth in GVA – an increase of 38%.

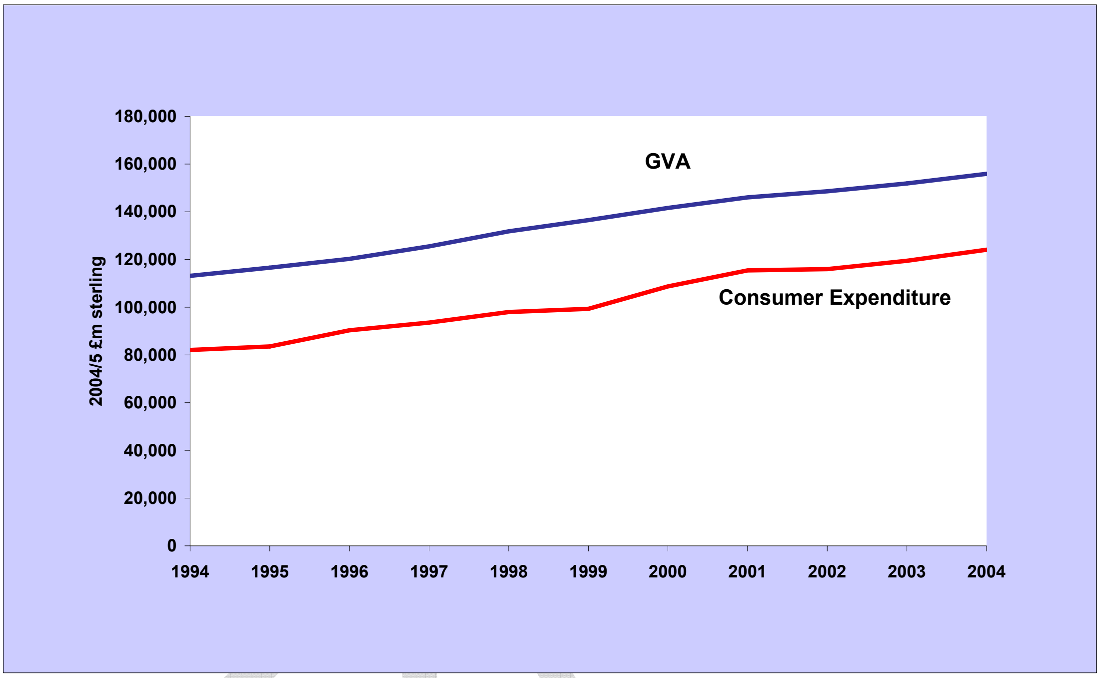

Figure 4: Consumer Expenditure v. GVA in the South East 1994-2004

From this basis, several adjustments are made to consumer expenditure in the R-ISEW to account for economic factors which are vital to the long-term sustainability of the South East economy. These are described briefly in the following paragraphs.

Net Capital Growth

Economic consumption patterns which fail to maintain levels of capital stock cannot be regarded as sustainable. The conventional calculation of GDP incorporates an adjustment to account for gross investment. Daly and Cobb argued that this inclusion neglects two important factors. Firstly, it omits to account for the depreciation of capital over time. Secondly, some account needs to be taken of the increases (or decreases) in capital required to provide for increases (or decreases) in the workforce. An adjustment to the R-ISEW is therefore made to estimate the net increase (or decrease) in capital stock, taking account of the capital requirement imposed by changes in the labour force.

In the South East, the net effect of this adjustment is negligible at the beginning of the period, but by 2004 it contributes quite strongly to the R-ISEW. Investment in the period from 1995 to 2004 has grown faster than the level of depreciation of capital and the change in workforce. As a result this adjustment increases the index over the period. The adjustment represented less than 1% of the R-ISEW in 1994, and this has risen to 9.3% by 2004.

Net International Position

At the national level, it is conventional to take some account of the economic position in relation to other countries. A country which continually imports more than it exports will over time incur increasing foreign debts and become unsustainable. In the conventional SNA, GDP includes an adjustment for net exports to incorporate this factor. Daly and Cobb argued that (like other elements of the accounts) this adjustment should include capital changes in the international position. National ISEWs have therefore used net transactions in (UK) assets and liabilities to account for the net international position of the country.

At the regional level, it is not immediately clear how this adjustment should be made. Should a regional economy be regarded as unsustainable if it has a long term trade deficit with other regions in the same country? Or should it be regarded as unsustainable only if it fails to make contributions to the national balance of payments? Either of these approaches might be taken in principle. In practice however, data on inter-regional trade positions are not yet robust enough to carry out the former calculation.

For the purposes of this study, we have estimated the contribution of the South East to the net international position of the UK. In the absence of any regional data on contributions to UK assets and liabilities (ie to capital transfers), we have used a simple balance of payments estimate to account for this contribution. Here the data are much more robust, at least where the trade in goods is concerned. But we have also been able to make estimates of the contribution of South East to other aspects of UK international trade: for example in services, income and current account transfers. The details of the calculations are given in Appendix A.1.

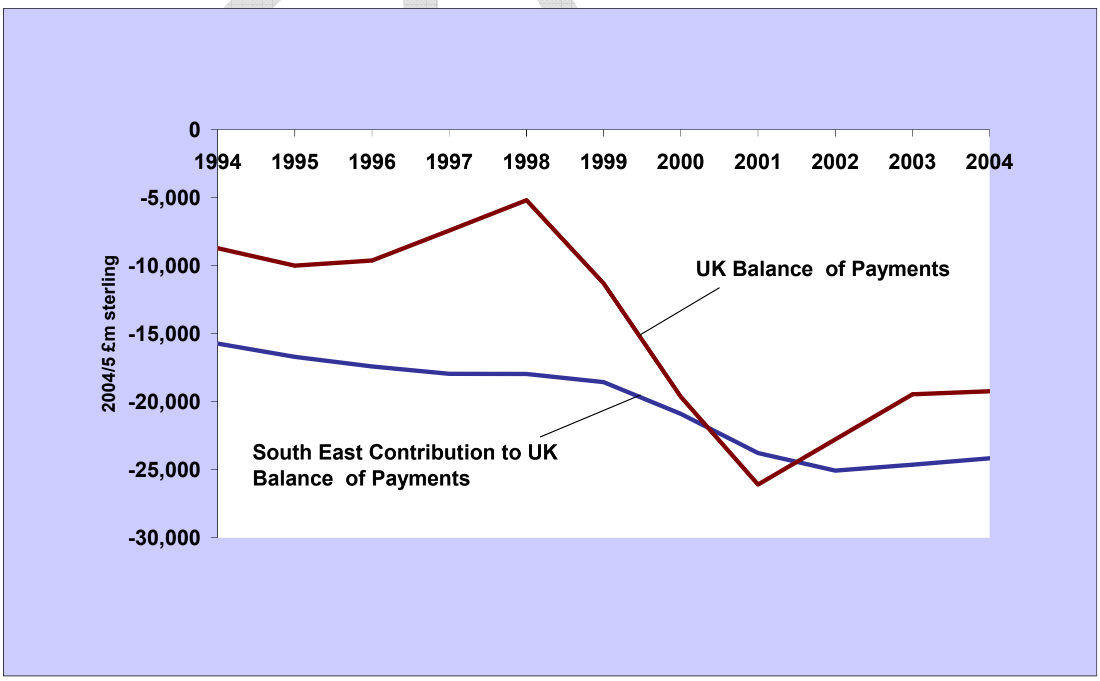

Figure 5: South East Contribution to UK Balance of Payments

The results of this adjustment are quite striking, particularly by contrast with the UK position (Figure 5). Although the balance of payments for the UK as a whole is consistently – and increasingly – negative over the period, the South East region alone is (for all years bar 2001) even more so. Were it not for the balance of payments surplus in other regions offsetting the South East's huge deficit, the balance of payments for the UK as a whole would be even greater. The beginning of the decade was characterised by a trade deficit of just over £15.7 billion, almost twice the UK's £8.7 billion. By the end of the period, the negative contribution attributable to net exports from the South East stood at almost £24.2 billion. The change in contribution to the UK's net international position by the South East between 1994 and 2004 is just under £8.5 billion, representing around 19.7% of the increase in GVA over the period.

Adjustment for Consumer Durables

From a true economic perspective, expenditure on durable goods which last for more than one accounting period represents a capital investment. In the conventional SNA, however, expenditure on durables is counted as consumption in the period. Numerous economists have argued that this anomaly in accounting should be removed and in the Daly and Cobb ISEW an adjustment was made for the difference between expenditure on durables and the estimated service flow from the stock of durables.

No rigorous accounts of the stock of consumer durables exist for the UK, but several attempts have been made to estimate both stock and service flow (see Appendix A.1). We have used these previous studies to estimate the difference between expenditure on and the service flow from consumer durables for the period from 1994 to 2004. This turns out to be a net negative adjustment to the index which varies between about 2.4% and 3.2% of total consumer expenditure over the period.

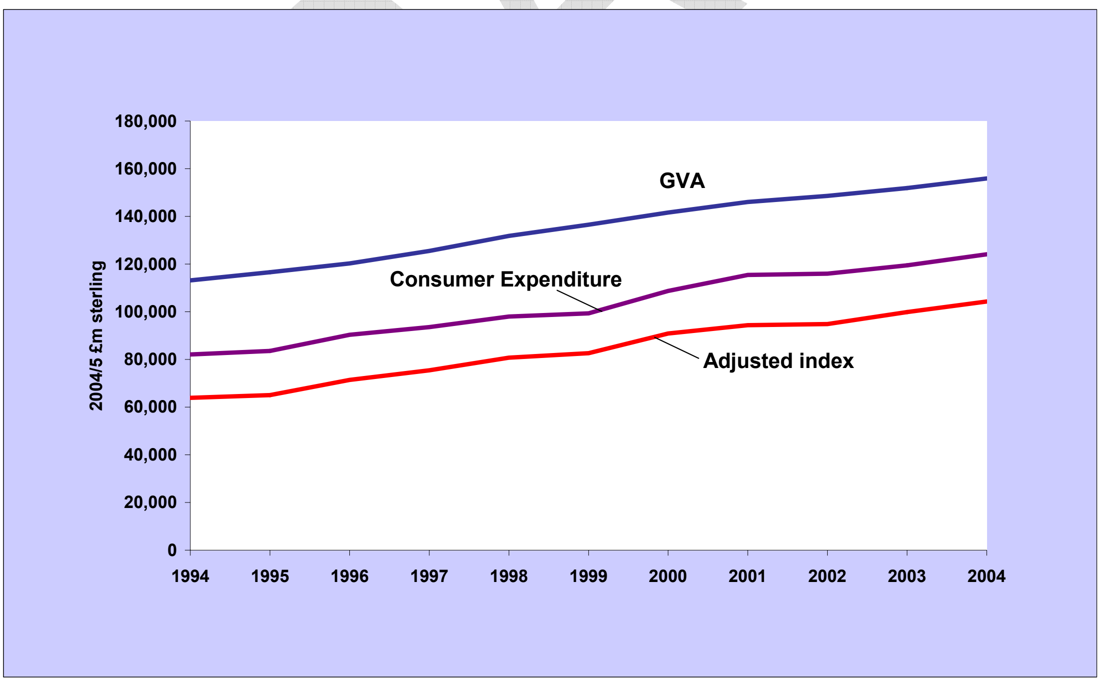

Figure 6: Effect of Economic Adjustments on Consumer Expenditure

Effect of Economic Adjustments

It is now possible to calculate the impact of all three of the 'economic' adjustments to the base indicator of consumer expenditure. The result is shown in Figure 6 above.

Though consumer expenditure and the adjusted index rise along similar trajectories over the period 1994 to 2004, the net impact represents a reduction of 16% of consumer expenditure in 2004, compared to 22% in 1994. In other words, from the point of view of these economic factors (investment, international position and service flow from durables), it could be argued that the South East was performing better in 2004 than it was in 1994. The economic benefits associated with greater consumer expenditure have been increased whilst holding down the corresponding rise in associated economic costs.

3.2 Social Factors

In line with previous measures, the South East R-ISEW incorporates several adjustments to account for social aspects of the economy which are vital to sustainability, but which would normally be excluded from conventional economic accounts.

The first two of these adjustments are broadly positive ones. The first aims to account for the services to the economy provided by unpaid labour from households and volunteers. The second accounts for public expenditures on health and education.

Account is also taken of a number of different kinds of social costs. Specifically we look at the costs associated with income inequality, the costs of crime and divorce, and the costs associated with commuting and car accidents. Each of these factors is described in turn in the following paragraphs.

Services from Domestic Labour and Volunteering

The argument for including some account of unpaid contributions to the economy in national accounts has a long pedigree. The integration of unpaid housework into GDP was recommended by the closing Nairobi Conference of the United Nations Decade for Women. Agenda 21, the Rio Earth Summit's "blueprint for sustainability", declares that "unpaid productive work such as domestic work and child care should be included, where appropriate, in satellite national accounts and economic statistics". In the UK, accounting for housework was the subject of an unsuccessful private member's Bill as far back as 1989. In 1997, the Office for National Statistics published a preliminary monetary satellite accounts in the UK for the year 1995. Most national ISEWs have included this adjustment in their accounts.

The usual way of approaching this is to account for the time spent in different unpaid of voluntary activities and multiply this by a shadow wage rate, based either on the domestic wage rate or on some other appropriate proxy. The results of this exercise, using time use data specific to the South East and a national UK wage labour rate appropriate to domestic labour, lead to a net positive contribution to the index which ranges between just under £26.9 billion (in 2002) and £29.5 billion (in 1995). There is a slight falling trend over the period of the study because people tend to spend less time in domestic labour (and as volunteers) today than they did even a decade ago.

Public Expenditures on Health and Education

In previous versions of the ISEW, expenditures on health and education have been treated in a rather complex way. Daly and Cobb argued that a certain proportion of these expenditures should be excluded both from public and from private consumption accounts, because they were ‘defensive’ (see Section 3). Typically, however, estimates of how much of these expenditures are defensive have relied on arbitrarily assigning a certain percentage (usually 50%) to the defensive category.

Though we agree that some elements in both health and education expenditure may be defensive, we believe it is difficult to defend such arbitrary apportioning between defensive and non-defensive expenditure. It is also, sometimes, difficult to avoid the danger of double-counting: when for instance health costs are incurred as a result of other factors incorporated in the index such as crime, car accidents and air pollution.

Consequently, we decided for this analysis to do away with the Daly and Cobb procedure for allocating health and education expenditures between defensive and non-defensive categories. No deduction is made from consumer expenditure for defensive aspects of private consumption on education and health. We include all public expenditures on health and education as a social benefit. This procedure allows us then to include some additional health-related costs associated with other environmental and social factors in the index (see below).

The result of including public expenditures on health and education in the South East R-ISEW is to enhance both the absolute magnitude and the trend over time in the index. Public expenditures on health and education increased by over 70% during the period between 1994 and 2004 (rising faster than both GVA and consumer expenditure), and by 2004 represented almost 8% of GVA.

The Impact of Incorporating Social Benefits

The overall impact of incorporating both the value of domestic labour and the value of public expenditures on health and education (on top of the economically adjusted expenditure measure) is shown in Figure 7 below. Not surprisingly, the index is now considerably higher than shown in Figure 6. Nonetheless, it remains below GVA for the entire period, whereas in some regions the index often rises above GVA at this stage of construction.

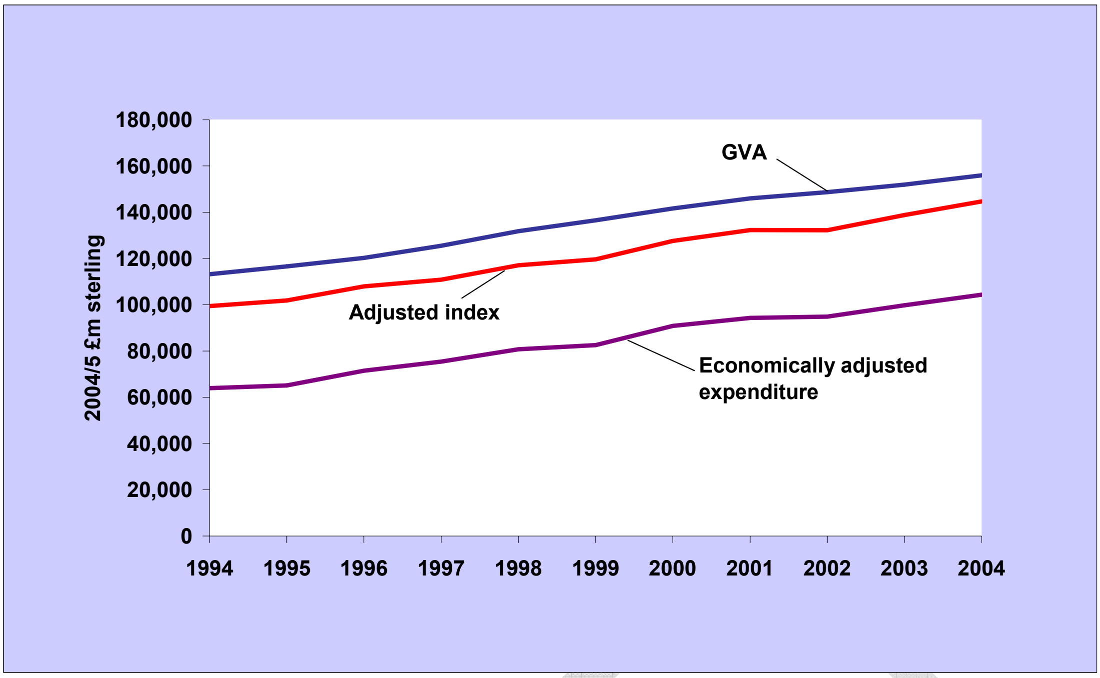

Figure 7: Combined Impact of Social Benefits and Economic Adjustments

Costs of Income Inequality

Amongst the failings attributed to conventional economic accounting is the omission of the welfare costs associated with income inequality. Long-standing arguments suggest that account should be taken of the diminishing returns on income, the social preference people have for equality over inequality and the wider impacts of inequality on social well-being.[22]

The earliest ISEWs used a simple indexing procedure based on trends in the Gini coefficient to incorporate this factor into the index. But in 1997, the revised UK ISEW study[23] employed a method first proposed by the welfare economist Tony Atkinson which estimates directly the welfare loss associated with an unequal income distribution of incomes.[24] The method employs a parameter ε to capture explicitly the social aversion to inequality in the target community and has been widely used in ISEW studies since 1997.[25]

We have used this method for the South East R-ISEW as it has strong foundation in welfare economics, and allows for some sensitivity analysis on the parameter ε. The most widely cited value for this parameter based on UK data is 0.8. At this value, the costs associated with income inequality in the South East over the period rise from just over £11 billion in 1994 to £17.4 billion in 2004. The trend over time during the period has been negative overall, closely mirroring trends at the national level.

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22 See for example: Dalton, H, 1920, The Measurement of the Inequality of Incomes. *The Economic Journal*, vol 30, p348-361.

23 Jackson, T et al 1997, op cit, ref 52.

24 Atkinson, A., 1983. *The Economics of Inequality*, 2nd edition, reprint 1995, Oxford University Press, Oxford; Atkinson, A., 1970, On the measurement of inequality, *Journal of Economic Theory*, vol 2, pp244-263.

25 See for example: Stymne, S and T Jackson 2000. Intragenerational equity and sustainable welfare. *Ecological Economics* 33, 219-236.

Costs of Crime and Divorce

If the argument made by the *Economist* (and cited in Section 2 above) is right, then crime and divorce are to be seen as social externalities of modern society, and it is essential to get some handle on their economic impacts. Consequently, later versions of the ISEW have tended to incorporate some estimates of these kinds of costs at the national level. We have followed this practice for the South East R-ISEW. The data sources and methods are described in Appendix A.1.

The impact from these two factors over time has been noticeable. The costs of crime increased steadily in the South East (reflecting and somewhat exceeding rises across the UK) from around £1.3 billion in 1994 to nearly £2.3 billion in 2004. After steep rises during the 1970s and 1980s, divorce rates in the UK have stabilised in recent years, falling only very slightly over the period between 1994 and 2004. In the South East, the estimated costs of family breakdown fell slightly faster than the UK as a whole, from £1.97 billion in 1994 to £1.86 billion in 2004. The combined impact of these two costs is to reduce the level of the index by between £3.1 billion (in 1997) and £4.2 billion (representing 2.7% of regional GVA) by the end of the period.

Costs of Commuting and Car Accidents

Our continued dependence on a 'car culture' is not without its price. As people drive longer distances, the associated social costs from commuting and car accidents have until recently tended to rise nationally. This is true in part also for the South East. Over the decade from 1994 to 2004, the costs of commuting rose by over 82% (well above the UK average increase) as people travelled longer distances to get to work. By contrast, however, the costs associated with car accidents have fallen from just under £2.5 billion in 1994 to less than £2 billion in 2004, as road safety measures have begun to have an impact on the number and severity of road casualties. In spite of this fall, the overall social costs of car dependency in the region have increased a little from £3.4 billion to £3.7 billion, although they have fallen as a percentage of GVA from around 3% to just under 2.4%.

The Combined Impact of Social and Economic Factors

Taking economic adjustments to consumer expenditure into account, incorporating social benefits and subtracting social costs, we can now see the impact of all these factors on the adjusted measure. This is shown in Figure 8, where the adjusted indicator is again shown in red.

It is noticeable that after making both economic and social adjustments the measure has returned to a level very close to that of consumer expenditure (this is not true of all regions). Overall growth in the adjusted measure is a little lower (at 46%) than growth in consumer expenditure (51%) in spite of starting from a near-identical base. The level of the adjusted measure remains below GVA throughout the period, and the gap is growing slowly in absolute terms – but closing slightly when considered as a proportion of GVA. At this stage of course, the measure still takes no account of environmental adjustments. We discuss the impact of these in the next section.

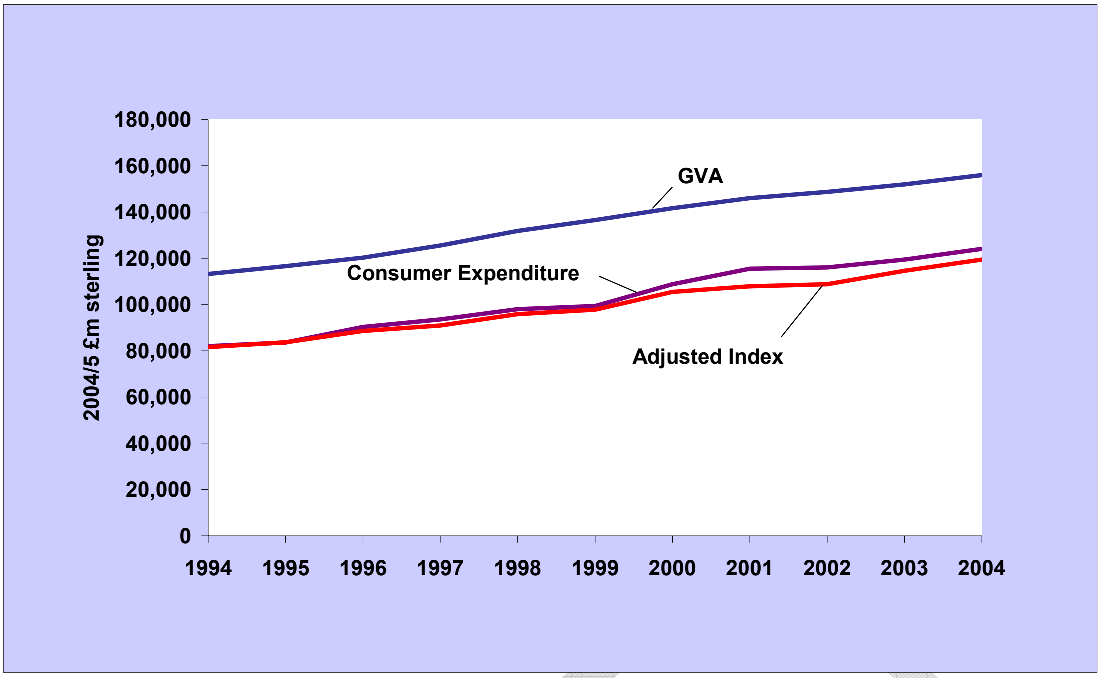

Figure 8: Economic and Social Adjustments to Consumer Expenditure

3.3 Environmental Factors

The emergence of green GDP-type measures has been prompted in no small part by the realisation that sustainable economic progress depends on respecting environmental limits. In the 1970s and 1980s, when the debates about green GDP first arose, concerns were mainly centred on problems such as acid rain and toxic pollution in rivers and lakes. As we shall see below, actions taken in response to these concerns have had some considerable impact in improving matters. But the concerns themselves have given way to more pervasive and less tractable environmental problems such as climate change, pressures on natural habitats and the depletion of natural resources.

In spite of all the difficulties associated with quantifying these kinds of costs, it is clearly important to make some attempt to account for their impact. Measures of progress which fail to incorporate such factors represent a kind of 'fool's paradise', a delusion of progress, and increase the risk that our societies will come to future grief.

Several different kinds of environmental costs are worthy of consideration, even though some of these may be in the process of becoming less important to the economy. These costs include the costs associated with 'local' environmental pollutants (air pollution, water pollution etc), the implicit costs in losses of agricultural land and natural habitats, the accumulated long-term costs associated with climate change, and the depletion of finite (non-renewable) resources, in particular of fossil energy resources. We discuss each of these adjustments in the following sections.

'Local' Environmental Pollution

Conventional 'local' air and water pollutants such as sulphur dioxide, nitrogen oxides, chemical oxygen demand and so on have been the focus for environmental policy initiatives for several decades now. Nonetheless it is important to be able to reflect the costs associated with this kind of pollution when measuring progress towards sustainable development. Improvements in air quality – resulting from reductions in atmospheric emissions – should show up clearly here if they are occurring.

In the South East R-ISEW, as in other national ISEWs, we have accounted for four specific kinds of pollution costs under this category:

- costs of local and regional air pollution (including sulphur dioxide, nitrogen oxides, carbon monoxide, particulates and volatile organic compounds);[26]
- costs of water pollution (based on river quality measures and river quality targets);
- costs of noise pollution (based on estimates of road traffic noise); and
- costs of personal pollution control.

The methodologies employed to calculate each of these cost categories are set out in Appendix A.1. The final two categories represent relatively minor adjustments to the index (around 2.4% of the total adjusted measure shown in Figure 8 at the beginning of the period and just under 2.7% at the end). Interestingly however, evidence suggests that both of these costs may be rising and could therefore become significant in the future.

Water pollution costs are also relatively small by comparison with the adjusted measures (particularly so in the South East) and in fact have been falling consistently over the period as a result of initiatives to protect river quality.

The biggest single component contributing to this category is air pollution. In 1994, the cost of air pollution in the South East was nearly £5.3 billion (representing 4.6% of GVA at the time). But the story in the intervening years is a relatively happy one. These costs have declined significantly over the last decade as a result of EU and UK legislation on sulphur and nitrogen oxides and increasingly stringent local air quality regulations. As a result, the costs of air pollution fell by over 52% during the period and by 2004 were just over £2.5 billion (representing only 1.6% of GVA).

Taken together, the overall trend over time in this category is also a declining one. The estimated cost of environmental pollution has fallen from £6.8 billion to around £5.1 billion within the period of the study. Nonetheless, these costs represent in total a not insignificant reduction (in excess of 6%) from the adjusted measure shown in Figure 8, even at the end of the period. The impact is illustrated in Figure 9.

[26] We have excluded here consideration of global pollutants such as carbon dioxide and methane as these are included in the category of climate change costs. Also excluded are pollutants such as lead and benzene which may be important but for which we found no reliable estimate of cost.

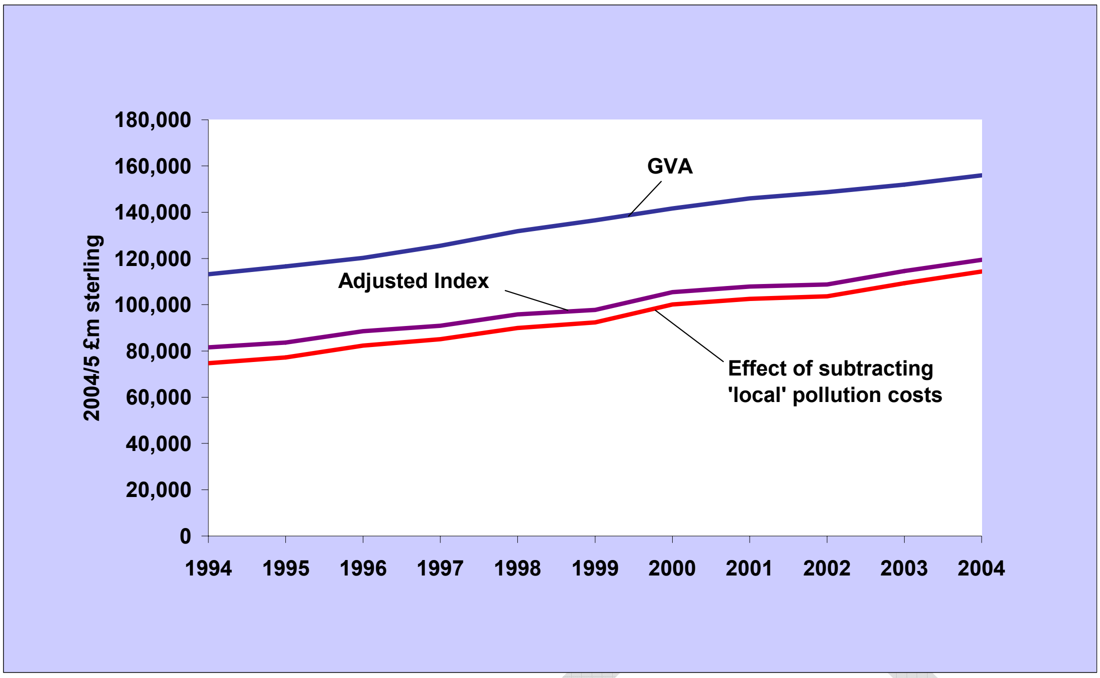

Figure 9: The Impact of 'Local' Pollution Costs on the Adjusted Index

Loss of farmlands and natural habitats

The loss of land through development and the loss of soil quality through erosion are of significant importance to the long-term sustainability of agricultural lands and natural habitats. Consequently these terms have been included in ISEWs at the national level for some time. In the South East, however, they represent a relatively modest adjustment to the overall index. Indeed, in contrast to trends in the UK, the area given over to natural habits actually increased during the period between 1994 and 2004. The loss of land accumulated over previous decades not only slowed down but was actually reversed a little during the period. The overall impact of these changes was in any case very small. This category represents a reduction of well under 1% over the adjusted index shown in Figure 9, throughout the period.

Long-term Costs of Climate Change

The threat of long-term climate change presents society with an unprecedented challenge, not just in environmental terms but in economic and financial terms as well. How are we to deal with the potential future costs associated with climate change? What action should we take now in the face of these costs? Surely, it is appropriate to make some provision for potentially large costs that will arise in the future? What kinds of provision should be made? And whose responsibility is it to make this provision?

The current generation is in the position of being able to 'see' a potentially enormous ecological debt – already incurred – that will have to be paid back at some (unknown) point in the future. But the current generation is not uniquely responsible for that debt. On the contrary it has accrued over numerous generations as a result of over 150 years or so of industrial development. And yet, to fail to make provision for that debt now could be seen as an abdication of our responsibility to the future.

Conventional approaches to the question of making economic provision for the costs of climate change have been divided into two camps. In the first camp are those who accept that each emission of greenhouse gas within the current accounting period should be ascribed a marginal social cost of carbon, based on the estimated marginal damages that will occur in the future as a result of emission of that one tonne of carbon into the atmosphere today.

A whole series of estimates for the social cost of carbon have been carried out, based on estimated economic losses from now until the middle (in some cases) or the end (in other cases) of this century.[27] In the UK the most widely cited social cost of carbon is the one used in the 2002 DEFRA/HMT study, namely £70 per tonne of carbon.[28] According to this camp, the appropriate way to internalise the cost of carbon is to calculate all the emissions attributable to the current accounting period and to multiply these by the social cost of carbon.

The trouble with this approach is that it fails to account for the 'sunk' carbon – emissions that have accumulated over the last 150 years and whose impact is already 'out there' waiting to happen in the form of unpredictable changes that have been set in motion as a result of past economic activities. This has led to suggestions that the entire future cost of climate change damage – discounted to the present day at an appropriate discount rate – should be included in today's accounts. Daly and Cobb made this argument for example in their 1988 ISEW, and many subsequent national ISEWs have subtracted the full accumulated cost of carbon emissions to incorporate this ecological debt in the adjusted index. Critics have argued that this approach mixes up stocks and flows. Proponents claim that at least it makes some account of the real impact of long-term climate-related debt.

In the R-ISEW we pilot for the first time a methodology aimed at addressing the question of long-term ecological debt from a financial perspective. In summary (more details are given in Appendix A.1), this method treats the current accumulated debt as though it could be paid off over time through an annuitised endowment fund which matures when required in the future. Regular payments into this fund over the next 50 years (say) will be sufficient to pay off the debt provided that we start making the payments today. Should we fail to pay the premiums this year, however, the time available to achieve the required sum at payout will shorten and next year's required payments will therefore be higher.

This seems to us to be an elegant way of capturing the true nature of a deferred ecological debt that has its roots both in present actions and in the accumulated actions of the past. It avoids the huge adjustments required to reflect the entire discounted value of estimated future costs within current accounts. But it also avoids the mistake of assuming that paying off only the marginal costs associated with current emissions will be sufficient to ensure sustainability.

The impact of this accounting procedure on the adjusted measure is nonetheless significant. The endowment premiums attributable to an South East climate change fund in 1994 are estimated at £10.8 billion or 9.5% of GVA. By the end of the period these premiums have increased by over 37% – as a result on the one hand of

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27 See for example: Fankhauser, S 1995. The Economics of Climate Change. London: Earthscan; Tol, R and T Downing 2000. The Marginal Damage Costs of Climate Changing Gases. Working Paper D00/08. Amsterdam: Inst for Environmental Studies; AEAT 2005. The Social Costs of Carbon Review – methodological approaches for using SCC estimates in policy assessment. A report to DEFRA. Harwell: AEA Technology.

28 Defra/HMT 2002. Estimating the Social Cost of Carbon Emissions. Government Economic Service Working Paper 140. London: HM Treasury.

continuing emissions and on the other of our failure to implement a payment plan – so that by 2004 they amount to £14.8 billion (which still represents about 9.5% of GVA). For as long as no plans are put in place to reduce emissions and to establish a dedicated climate fund against future costs, these premiums will continue to rise. The additional impact on the adjusted measure is shown in Figure 10.

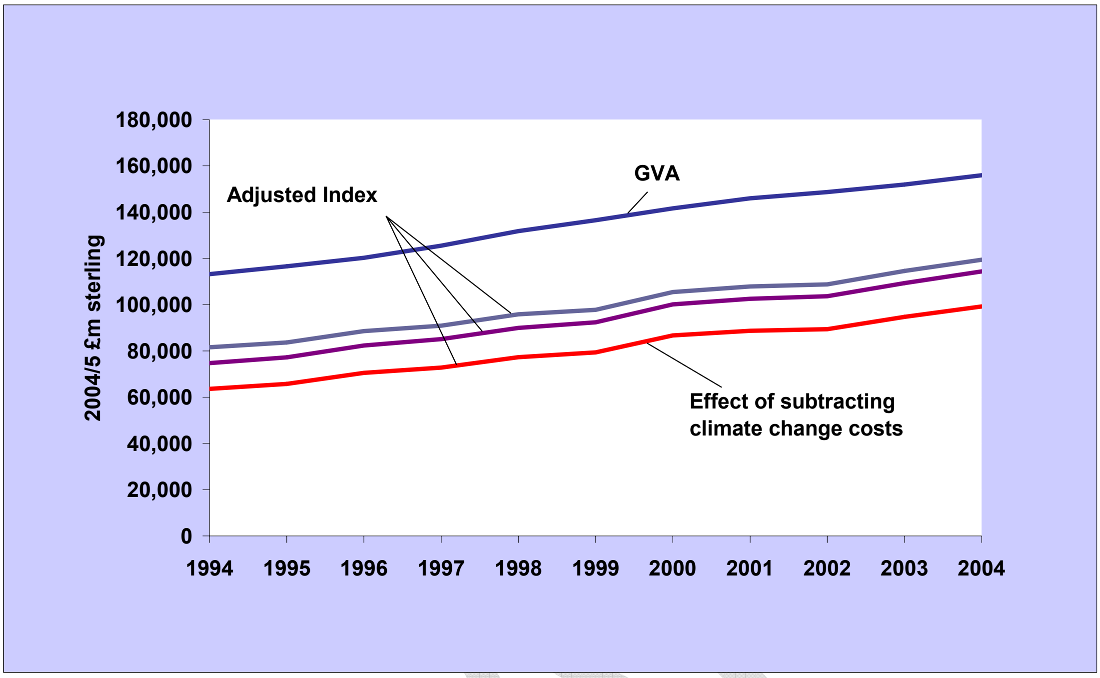

Figure 10: Cumulative Impact of the Climate Change Adjustment[29]

Resource Depletion

The issue of resource depletion is beginning to occupy an increasingly visible place in the public consciousness. Conflict in the Middle East, socio-political pressures in the former Soviet bloc and declining North Sea reserves have placed the question of finite oil and gas supplies firmly beneath the media and policy spotlight. But from the perspective of sustainability, these issues have been important for decades.

Accounting for the costs of resource depletion however, is another area where disagreements are many and consensus is hard to find. In this study, we follow broadly the replacement cost methodology established by Cobb and Cobb in the 1994 revision of the US ISEW (described in more detail in Appendix A.1), except that like the UK MDP we assume a slower escalation for the replacement cost function. And for our central estimate we also chose a lower replacement cost per barrel than was assumed by Cobb and Cobb.

The impact of this factor on the index is nonetheless significant, especially in the South East, where a dense population, concentrated commercial activity and high transport usage combine to create very high energy requirements. The costs of resource depletion increased from £11.8 billion (10.4% of GVA) in 1994 to £15.8 billion (10.1% of GVA) in 2004. The effects of this final environmental adjustment to the index are illustrated in Figure 11.

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29 This figure also incorporates the (very small) adjustments associated with the costs of land loss, described above.

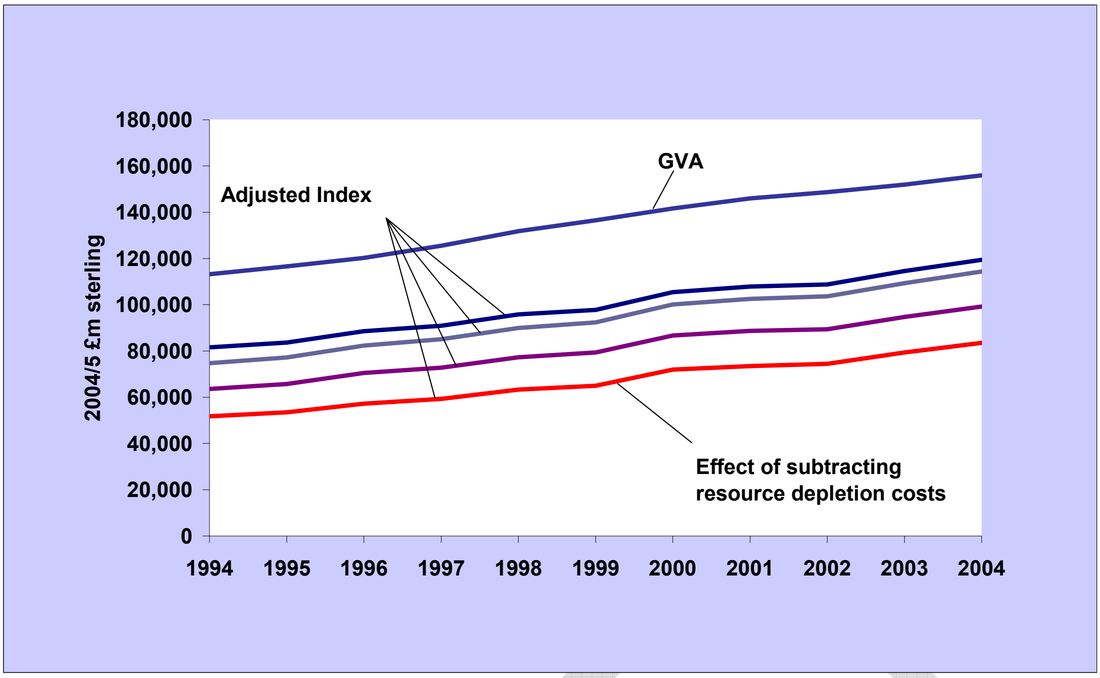

Figure 11: Cumulative Impact of the Resource Depletion Adjustment

3.4 The South East R-ISEW

The impact of these final adjustments reveals the overall shape of the South East R-ISEW over the period between 1994 and 2004. The red line shown in Figure 11 is our central estimate for the adjusted index. The index is re-drawn in Figure 12 on a per capita basis, giving a stronger indication of the level of sustainable economic well-being in the regional population.

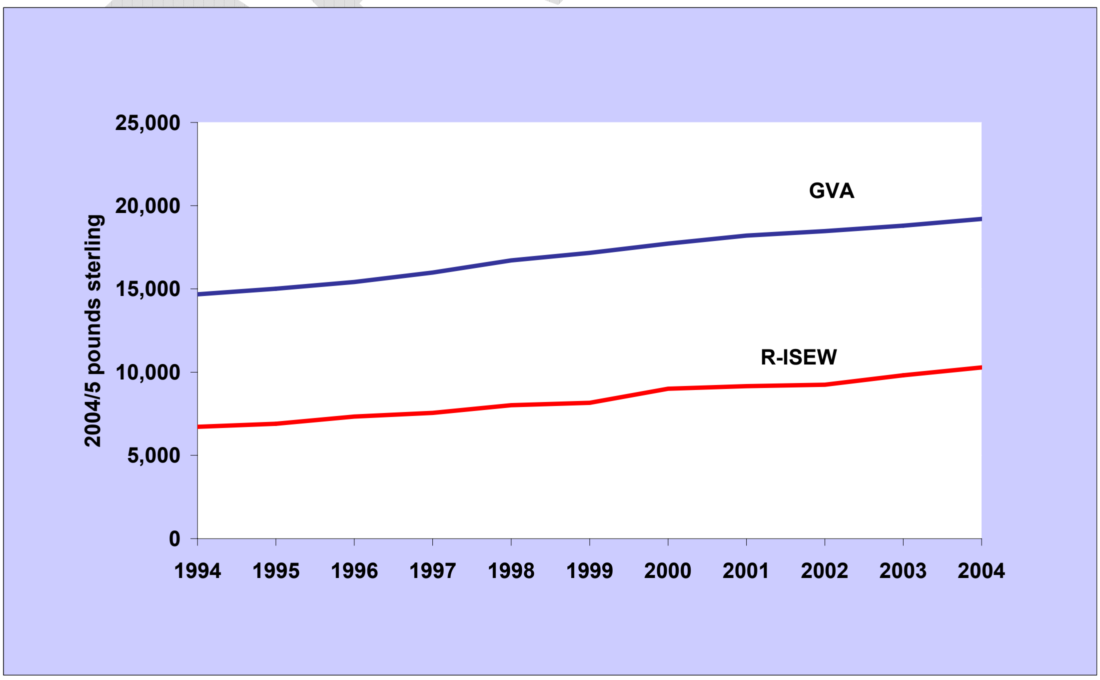

Figure 12: South East R-ISEW per capita v. GVA per capita 1994-2004

The results of the study suggest that the South East R-ISEW rose more or less steadily over the period between 1994 and 2004 from £6,700 per capita in 1994 to £10,300 per capita in 2004. On the basis of discussion in the previous section (and data presented in Appendix A.3), we can conclude that this rising trend was driven primarily by strong growth in consumption and net capital investment, greater public expenditure on health and education, and significant reductions in air pollution. Higher growth in the R-ISEW was held back primarily by rising income inequality, a large trade deficit, and the increasing energy-related costs of resource depletion and long-term environmental damage.

4 Discussion

The South East R-ISEW grew steadily from £6,700 per capita in 1994 to £10,300 in 2004. As a percentage of the R-ISEW per capita, this increase was considerably higher at 53% than the 31% increase in GVA per capita. However, this figure is slightly misleading as an indicator of progress, since the R-ISEW started at a much lower base in 1994. A more realistic assessment of the performance of the region is given by the absolute increase in R-ISEW relative to GVA. For R-ISEW the increase was a little over £3,500 per capita. This was noticeably lower than the increase in GVA, which rose by some £4,500 per capita over the same period. Moreover the gap between R-ISEW per capita and GVA per capita increased by 12% over the period, as indicated in Figure 13 (and illustrated numerically in Appendix A.3).

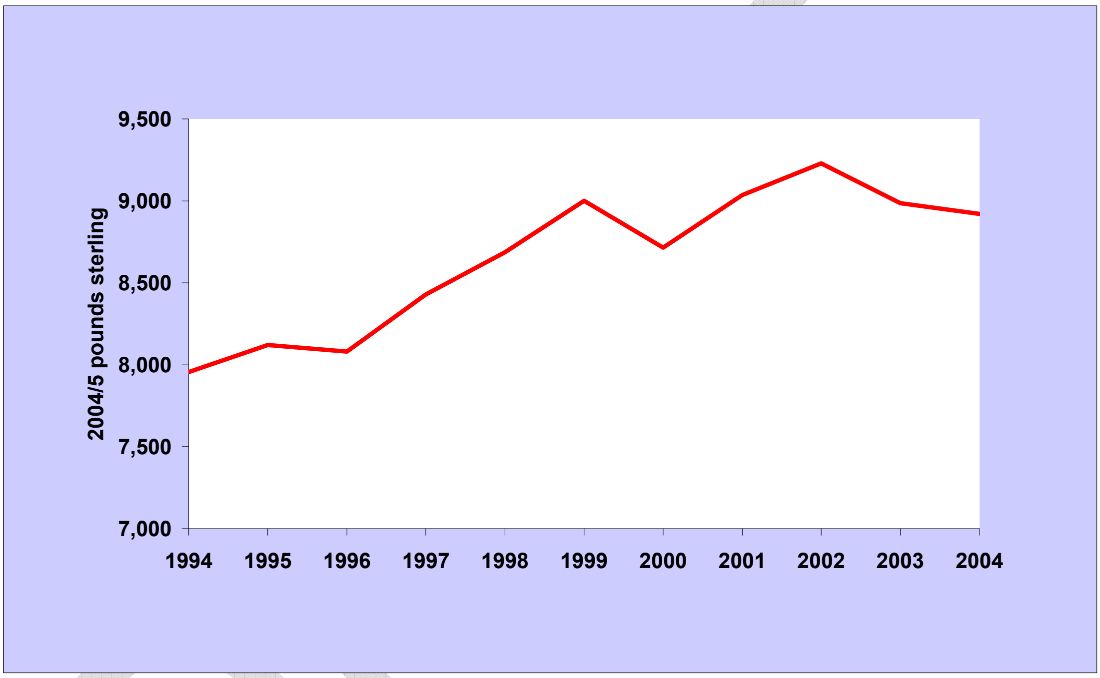

Figure 13: The gap between R-ISEW and GVA per capita (1994-2004)

Clearly, there is little ground for complacency here and, with some costs (eg for climate change and resource depletion) rising consistently year on year, a considerable effort is going to have to be made to achieve a level of progress which can be deemed "sustainable" in any real sense.

It is clearly interesting to question how the South East performs (on the basis of R-ISEW) by comparison with other regions and with the UK as a whole. To this end, we have revised and updated previous versions of the UK ISEW for the period from 1994 to 2004, following as closely as possible the same methodology used in the South East R-ISEW. The preliminary results from this exercise are shown (alongside UK GVA) in Figure 14.[30]

30 These preliminary results may be subject to revision, following the statistical collation of results from an ongoing exercise to calculate R-ISEWs for all the English Regions (as well as for Scotland, Wales and Northern Ireland).

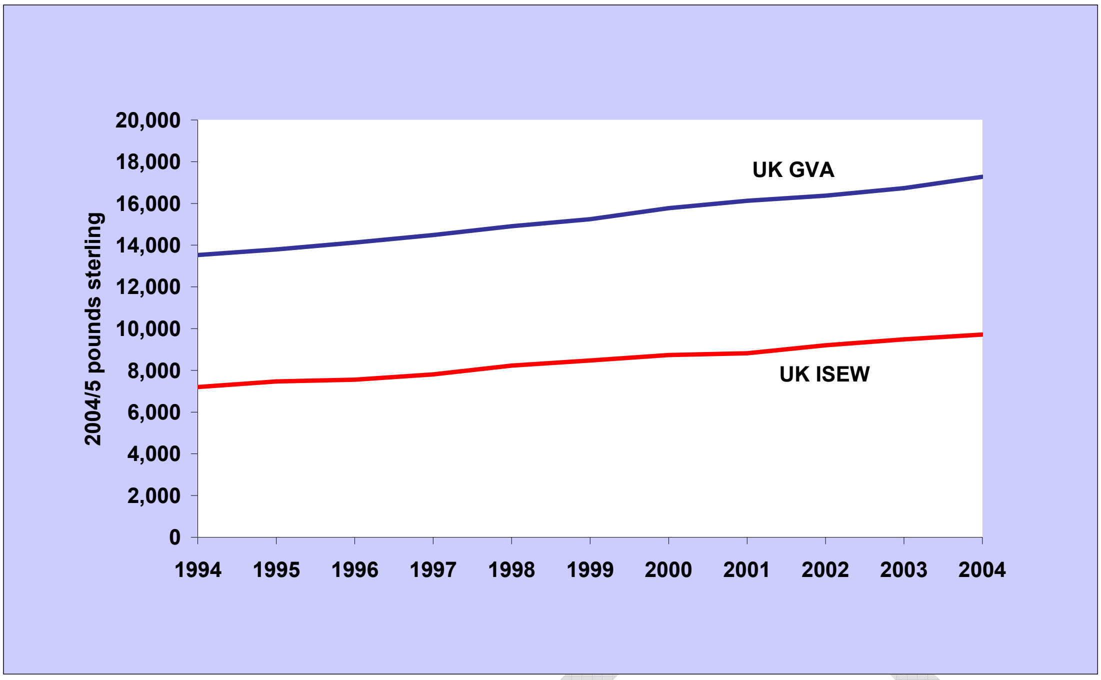

Figure 14: UK ISEW v GVA (1994-2004)

Once again, for this period of time, we see an overall increase in the ISEW.[31] UK ISEW rose by around 35% from £7,200 per capita in 1994 to £9,700 per capita in 2004. By contrast GVA rose by 28% from £13,500 per capita in 1994 to £17,200 per capita in 2004.

As before, the higher relative increase in ISEW over the period than for GVA cannot be taken as a robust indicator of progress, since the starting point for ISEW in 1994 was substantially lower than for GVA. And in fact, when we look at the absolute increases, we find that GVA rose by £3,700 over the period, whereas the rise in ISEW was only just over £2,500. More importantly, the gap between GVA and UK ISEW widened consistently over the period from £6,300 in 1994 to £7,600 in 2004. Sustainable economic well-being in the UK, on this evidence, is still diverging from the overall growth in the economy.

Comparing the South East results to those of the UK as a whole, several points are to be noted. In the first place, it is interesting to note that although GVA per capita is consistently higher for the South East than the UK average, ISEW per capita in 1994 is only 93% of the UK average. This again serves to underline the fact that GVA alone cannot be taken as a reliable proxy for well-being.

Perhaps more interestingly however, the South East R-ISEW outperforms the UK ISEW in terms of year on year growth as Figure 15 illustrates. This faster growth is particularly notable from 1999-2000 and from 2002 onwards, and means that ISEW per capita has caught up with the UK average by 2000 and exceeds it thereafter.

31 This rise is consistent with the rise observed in the UK MDP over the later years of the period (see Figure 3). The limited timescale of this study does not allow us to see the classic divergence between ISEW and GDP that has been observed in many national studies over a longer period.

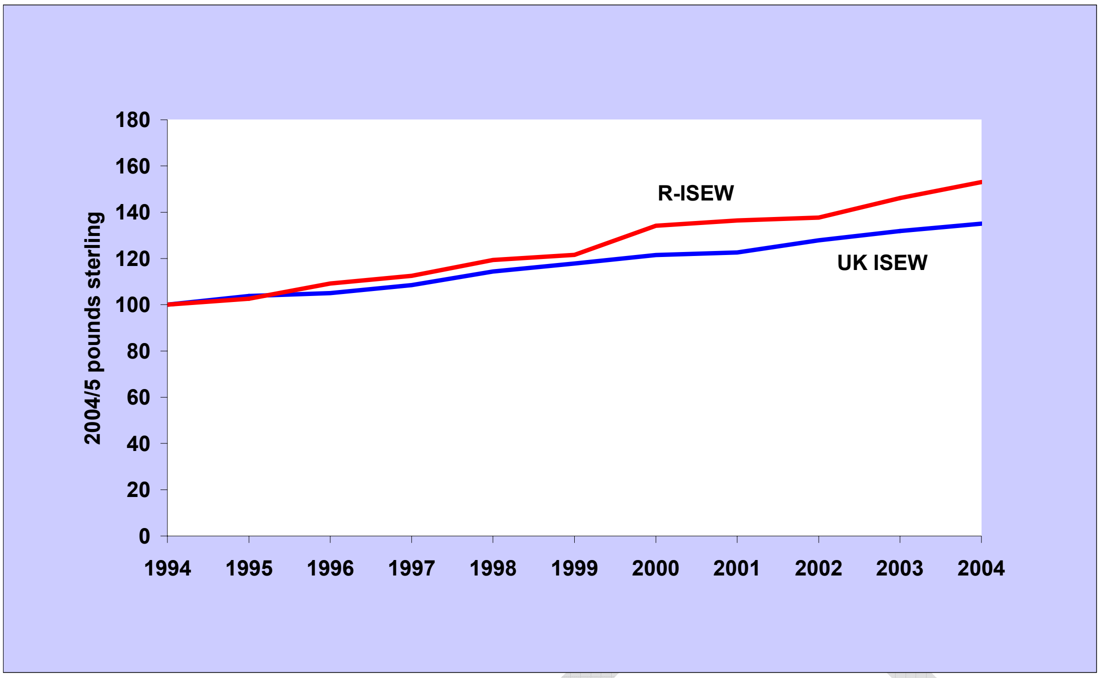

Figure 15: South East R-ISEW v. UK ISEW (indexed to 1994)

The primary positive driver of this performance is the rapid growth of consumer expenditure, which is the baseline measurement on which the rest of the index is constructed. And although the South East's trade deficit is very large compared to other regions (and indeed greater than the whole of the UK for most of the period of the study), it increases at a slower rate than the UK as a whole. This means that the large negative impact of the net international position is reduced over the period in comparison with the UK trend.

In addition, the UK average costs associated with air pollution and long-term environmental damage include data from regions with very different industrial profiles to the South East. Regions which have a lot of energy production and heavy manufacturing have much higher per capita emissions of may air pollutants, particularly sulphur dioxide and nitrogen oxides, and of the principal greenhouse gas, carbon dioxide. These two sets of costs are amongst the largest contributors to the overall shape and magnitude of the ISEW curve, so the South East's relatively low levels of air emissions translate into a substantially healthier R-ISEW.

Nevertheless, this is not to say that the South East can rest easy on these issues: it still has areas of concern, and they are if anything more intractable because they stem from diffuse sources. Per capita emissions of air pollutants and greenhouse gases in the South East are well above average in the transport and non-industrial combustion sectors.

Finally, trends in the loss of agricultural land and natural habitats have been far less damaging in the South East than they have been elsewhere in he UK, perhaps because there is relatively little to lose in the first place, and that which remains is well protected. The region showed a net gain in natural habitats and only a small loss in farmlands, by contrast with steadily accumulating losses in the UK as a whole.

Taken together these regional trends have led to a more robust growth in the South East R-ISEW than in the UK ISEW. This analysis also illustrates how it is possible to use an ISEW type indicator to make meaningful comparisons between different regions, provided that the indicators are constructed on a consistent basis.

The next step in this process is to construct a series of indicators, based substantially on the South East R-ISEW for other English Regions and for the Devolved Administrations (Scotland, Wales, Northern Ireland). Preliminary R-ISEWs have already been constructed for the East Midlands Regional Development Agency (EMDA) and for Yorkshire Futures, who have commissioned R-ISEWs for all three regions making up the Northern Way (North East, North West, Yorkshire and the Humber).

As indicated throughout this study, the R-ISEW is sensitive to assumptions made concerning a number of different parameters in the various environmental, social or economic factors incorporated in the index. In Appendix A.2, we present briefly three sensitivity analysis based on changing parameters associated with a) the aversion to income inequality (ε), b) the replacement cost assumed for fossil resources and c) the assumed social cost of carbon. There is clearly a great deal more work that could be done to test sensitivities to different parameters in the study, but this must remain the focus of future work.

The results of the limited exercise carried out in Appendix A.2 are already sufficient to suggest that the South East could be doing somewhat better than our central estimate suggests. It might also be doing quite a lot worse. Once again, we conclude that there is very little room for complacency.

5 Concluding Remarks

The South East's vision to become a 'world class region achieving sustainable prosperity by 2016' places considerable demands on regional governance. Economic growth has traditionally been predicated on increasing economic output and associated consumption levels. As the draft RES recognises, however, the region must also maintain a healthy infrastructure and remain competitive. It must also address the sustainability of its patterns of production and consumption. Long term well-being depends critically on the ability to reduce inequality, lower environmental impacts, prevent crime, improve health, increase social inclusion, reduce the reliance on finite resources and reverse the breakdown in community and family structures.

The extent of this challenge has been underlined by the exercise undertaken in this paper. We have described a variety of different economic, social and environmental factors which must be taken into consideration, separately or together, in achieving sustainable prosperity.

We have shown how some of these factors have been improving steadily over the study period. However, other factors have demonstrated less welcome trends. Reduced damages from air pollution, rising incomes and vigorous net capital growth are balanced finely against increasing costs associated with resource depletion, the rising costs of crime and the burgeoning long-term environmental debt associated with climate change.

Overall, the balance of evidence suggests that some clear improvements have been achieved in the South East over the last decade. However, the widening gap between GVA per capita and R-ISEW per capita shows that a "business as usual" approach to regional development will only diverge from the ideal of sustainable progress, and that clear actions will need to be taken.

Given the long-term failure to account for – and come up with solutions for – problems such as climate change, there is very little space here for manoeuvre. A vigorous effort will be required to safeguard the gains in well-being achieved so far and put the South East region on a path towards sustainable development in the future.

A.1 Technical Appendix: Methods and Data

A.1.0 Overview

Most of the data used to construct the South East R-ISEW have been taken from UK government statistics, often provided through the Office for National Statistics (ONS). Since the mid-1990s a growing range of statistical publications have been broken down at the level of the Government Office Regions (GOR). The GORs only exist in England, but datasets sometimes also include parallel data from Scotland, Wales and Northern Ireland. They also sometimes include a UK comparator.

Regional data prior to the mid-1990s is patchy at best and makes it difficult to construct a regional index with an acceptable degree of robustness. For the purposes of this exercise we have therefore adopted the time period from 1994 to 2004 as the object of study. This time series still involves some regression or interpolation where datasets begin later than 1994. It has also sometimes involved some forecasting, as the most recent data are sometimes from 2002 or 2003. But trend estimations are limited to the minimum possible, and remain within the bounds of confidence in this context.

The compilation and use of regional datasets is a comparatively new field and is still subject to difficulties (the ONS recently postponed publication of their regional GVA estimates because of uncertainty over the data). However, it is assumed that the quality and range of regional data will continue to improve as the compilation techniques and sources mature, so that the ability to construct the R-ISEW will only strengthen over the coming years.

A continuing source of uncertainty in constructing a R-ISEW is the difficulty of assigning monetary values to social and environmental factors. Monetary estimations can involve assumptions or value judgements which may be difficult to justify on any concrete first principles – for instance, climate change science is still in its infancy and there are simply no definitive answers to the question of how much climate change will "cost".

In these instances we have chosen to use, as far as possible, the most widely accepted or defensible values. We have also explored alternative scenarios for sensitivity analysis during the consultancy phase of this project. The spreadsheet provided as a key deliverable of this contract has a "variables" sheet, on which these assumptions and estimates are listed for reference. Of these, the marginal cost of carbon can still be adjusted by the user: the change is immediately applied through the calculations, and the data tables and charts through the rest of the spreadsheet will show the adjusted R-ISEW figures.

The following sections describe in some detail the assumptions, data sources and methods employed to calculate the individual components of the R-ISEW. All prices have been converted to constant £2004–5 using the GDP deflator series from HM Treasury.

A.1.1 Economic Factors

Consumer expenditure
The initial basis for the index is personal consumption – final household expenditure – as this is an indicator of the value which individuals assign to the goods and services through which welfare is provided. At the UK level, these data are taken from the UK National Accounts *Blue Book*[32] datasets. To derive regional figures we used household expenditure data from the *Expenditure and Food Survey* (formerly the *Family Expenditure Survey*)[33] as a proxy.

Regional household expenditure data are provided as the weekly average spend per household. Data exist only from 1994–2002, so figures for 2003–4 are estimated from 1994–2002 trends. Combining these data with population data (from ONS population estimates)[34] and the average number of people per household (also given in the *FES/EFS*), gives an estimate of total consumer expenditure for the region. We perform the same calculations for the UK spending data and then divide the regional figure by the national to show the region's household expenditure as a proportion of the UK total. This ratio is then applied to the UK *Blue Book* data to give an estimation of total regional personal consumption.

Net capital growth
Capital formation needs to be offset against growth in the labour market, if we assume an equal amount of capital per worker is necessary to maintain productivity. We use UK data on net capital stocks from the ONS *National Accounts* datasets,[35] and derive regional estimates using regional data on net capital expenditure by industry, which is reported in the *Annual Business Inquiry*.[36] The net stock per worker is calculated for each year, then multiplied by the change in the available labour force (population of working age)[37] in that year to derive a capital requirement to maintain the status quo. The remaining capital formation is the net capital growth.

Regional data on net capital expenditure is available for the years 1998-2003. We calculate the ratio of South East expenditure to UK expenditure for these years, then extrapolate the trend in this ratio to cover the whole time period. These percentages are multiplied by the UK data on net capital stocks (excluding dwellings, are these are not part of the production process) to give regional estimates. To reduce sampling errors we take a rolling five-year average to derive the change in stocks, or net capital growth, for each year.

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32 *Household final consumption expenditure, Blue Book time series data, ONS*. Data available online at http://www.statistics.gov.uk/statbase/tsdtables1.asp?vlnk=bb

33 *Family Expenditure Survey / Expenditure & Food Survey, CSO, Family Spending 1994-02*, Data for 1999-2002 available online at http://www.statistics.gov.uk/statbase/explorer.asp?CTG=3&SL=&E= 4366#4366, earlier years supplied by email.

34 *Population Trends 122 (Table 1.3), ONS 2005*. Data available online at http://www.statistics.gov.uk/ StatBase/ssdataset.asp?vlnk=9175

35 *Net Capital Stock By Sector And Asset At Current Prices, ONS National Accounts Time Series Data, ONS*. Data available online at http://www.statistics.gov.uk/statbase/tsdtables1.asp?vlnk=capstk.

36 *Annual Business Inquiry Regional Data, ONS*. Data available online at http://www.statistics.gov.uk/abi/downloads/east_midlands.xls.

37 *Population Trends, op cit.*

This is multiplied by the change in the available labour force each year to give the benchmark capital requirements for that year, then this figure is subtracted from the capital growth to give net capital growth.

Net international position

The purpose of this component in national MDP / ISEW type indicators is to assess whether the country is maintaining a sustainable balance of payments or is running up international debt. At the sub-national level, this does not hold in the same way, because it is impossible to obtain sufficiently detailed data to treat the South East as a trading bloc in its own right, and establish "imports and exports" to other *regions* as well as outside the UK. However, it is useful to show how the South East contributes to the UK's net international position rather than simply omitting it.

To do this, we start with UK balance of payments data taken from the ONS' *Economic Trends* datasets,[38] and derive regional estimates using GVA and data on regional imports and exports as a share of the UK total. The import/export data was sourced from HM Revenue and Customs' regional trade statistics for 1996-2004,[39] and extrapolated assuming linear trends for 1994-95.

The balance of payments data are broken down into imports, exports, and income and current account transfers. We multiply the UK import and export figures for each year by the relevant South East percentages of UK imports / exports. We use these percentages calculated from the HM Revenue & Customs data rather than using the reported data, because these latter only count imports and exports of *goods*, not goods *and services*. We assume that the percentage of UK trade in services is the same as that in goods. This is problematic in that it will under-value exports in regions with a strong service sector (e.g. financial services in London) and over-value them elsewhere. However, in the absence of other data sources at the regional level, we make this assumption rather than excluding services altogether.

To estimate the regional share of income and current account transfers we use regional GVA as a proxy. The resulting three figures are summed to give a total for each year which represents the "net international position" of the South East. A 3-year rolling average is used, as this dataset is prone to sharp swings which can have a disproportionate effect on the overall ISEW.

Services from consumer durables

Expenditure on durable goods is included in the personal consumption data, but this in itself does not accurately reflect the welfare contribution of durable goods, because this may be enjoyed over the period of several years rather than just this year's accounting period. To adjust for this, we calculate the difference between expenditure on consumer durables and the service flows from the net stock of durables in each year, and subtract this from top line expenditure. These estimations are problematic given the scarcity of estimates of the net stock of durables, and service flows from that stock.

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38 *Economic Trends Time Series datasets, ONS*. Data available online at http://www.statistics.gov.uk/ statbase/tsdtimezone.asp?vlnk=et.

39 *UK Regional Trade in Goods Statistics Q3 2005, HM Revenue and Customs*. Available online at http://www.uktradeinfo.com/downloads/rtsdataq305.pdf.

We take the total value of service flows in the UK as calculated by Williams (1997)[40] from 1950-1995 and extrapolate from there. We do this using two methods: firstly, by following the long-term trend in service flows, because the trend is – to 1995 – quite clear. However, in the last ten years expenditure on durables has risen quite sharply,[41] and we could assume that the service flows would also rise, which is not taken into account using this method. So as a second estimate we extrapolate the trend in the ratio of service flows to expenditure and then apply this to the expenditure data. The true increase in service flows will be less pronounced than the increase in expenditure however, because the flows from any increased expenditure in each accounting period are spread over a number of years, flattening the curve.

So the first method is likely to underestimate service flows, but the second will overestimate them: to correct these deficiencies we have simply taken the average of these two estimates for each year to yield an extrapolation of the Williams data which seems reasonable. This is a less than ideal approach, but in the absence of any more recent data it seems the most defensible solution.

A.1.2 Social Factors

Household Labour and Volunteering
The value of services from domestic labour and volunteering are added to the index, as this is a major source of productive value which goes uncounted in conventional economic measures. Valuing an hour of household labour and volunteering is problematic: we use the UK average wage for "domestic staff and related occupations" (source: *ASHE*[42]). This hourly wage is then applied to time use data from a number of time use surveys, principally the ONS' *UK Time Use Survey* of 2000 [43] and its pilots in 1995 [44] and 1999.[45]

Time use data are sporadic and subject to many uncertainties involving the coding of time slots, especially where the coding is done directly by the individuals surveyed rather than via interview with survey staff. Categories are not always directly comparable between different surveys, and the margin of error due to sample size in all but the 2000 survey is large. We therefore also use data from earlier surveys in 1961, 1974 and 1983 to estimate long-term trends in time use.[46]

When the available UK data are plotted over time, the resulting trends in time use are far too erratic to reflect true trends. Given the high margins of error discussed above, we assume a linear best-fit trend through all points and use this to derive estimated figures for each year. The 2000 survey has regional data too, and we use the ratio of South East average time to the UK average in each relevant category that year to estimate South East data for the other years.

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40 Williams, 1997 (paper title tbc by TJ)
41 *FES/EFS, op cit.*
42 *ASHE, op cit.* Note that we use the *national* rather than *regional* wage so as to avoid regional distortions: as with other columns we want a constant means of valuing each unit.
43 *United Kingdom Time Use Survey, 2000* - available to subscribers from the Data Archive at Essex University http://www.data-archive.ac.uk/findingData/snDescription.asp?sn=4504
44 *OPCS Omnibus Survey, Time Use Module, May 1995* – available to subscribers from the Data Archive http://www.data-archive.ac.uk/findingData/snDescription.asp?sn=3951
45 *ONS Omnibus Survey, May 1999* – available to subscribers from the Data Archive http://www.data-archive.ac.uk/findingData/snDescription.asp?sn=4224
46 Also available at the Data Archive, study numbers SN2170, SN1581 and SN1425.

Time use data are given in the form of average minutes per day per person. This is then converted to hours per year and multiplied by the population of working age (16-60/65) to give a total figure for domestic labour and volunteering person-hours for the region. This is then valued using the UK average wage in the category "domestic staff and related occupations".

Note that over the time period, there are two methodological changes which affect this price, though neither seems to give rise to a significant disjuncture in the data trends. Firstly there is the change from *NES* to *ASHE* data; this takes place in 2003, but the data from 1999-2001 are ASHE-weighted. Secondly, the category "domestic staff and related occupations" disappears in 2002; we use the new category "personal service occupations" as the nearest match in both content and average wage rate.

Public Expenditure on Health and Education

There is some debate in the literature over the way to treat public expenditure – whether some proportion should be considered defensive spending which does not actually contribute to welfare. Rather than deeming an arbitrary proportion of expenditure to be defensive, we consider *all* expenditure on health and tertiary education to be a non-defensive benefit. In this model, defensive expenditures on health are subtracted elsewhere in the index, for instance by counting the health costs of crime, car accidents and atmospheric pollution.

The data for this component are taken from the Treasury's *Public Expenditure Statistical Analyses* (*PESA*) datasets.[47] Data are available at UK level for all years, but only from 1996 at GOR level. For the years 1994-1995 we back-cast from 1996 using the UK trends.

Effects of income distribution

The measure used to determine the costs of unequal income distribution is the Atkinson Index. This has the advantage over other inequality measures of containing an explicit variable *epsilon (ε)* which represents the degree of aversion to inequality.

Income inequality is usually measured using net income after tax and benefits in order to capture redistributive effects. Unfortunately the data were not available at the regional level, so we begin with gross pay (weekly) and correct for the effects of tax and benefits later. The data give a mean income across the whole population, and then upper earnings limits for each population decile.

This was sourced from the *New Earnings Survey* (*NES*) prior to 1998 and from its replacement the *Annual Survey of Hours and Earnings* (*ASHE*) after that.[48] The *ASHE* methodology is significantly different to the *NES*, and one of its main effects is to correct an underestimation of income inequality in the *NES* data. For this reason the two datasets are incomparable, and we have extrapolated the 1998–2004 trends back to 1994. R^2 values for this extrapolation are all in excess of 0.99.

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[47] *PESA 2001-2005*, HM Treasury. Data available online at http://www.hm-treasury.gov.uk/economic_data_and_tools/finance_spending_statistics/pes_publications/pespub_index.cfm

[48] *Annual Survey of Hours and Earnings / New Earnings Survey,* ONS 1994-2004. Data for 1998-2003 available online at http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=13101, earlier years *NES* data supplied by email. In fact, *ASHE* replaced *NES* in 2003, but *NES* data from 1998–2002 has been re–estimated using *ASHE* methodology so there is a continuous data series from 1998–2004.

The Atkinson Index requires mean incomes in each group, so we have to estimate these from the data available – i.e. upper limits of each group. By plotting the upper limits against percentiles for each year, we see an extremely robust trend (Figure 16 below) and can thus reliably interpolate median values for each decile group from this, assuming a linear trend between each decile point.

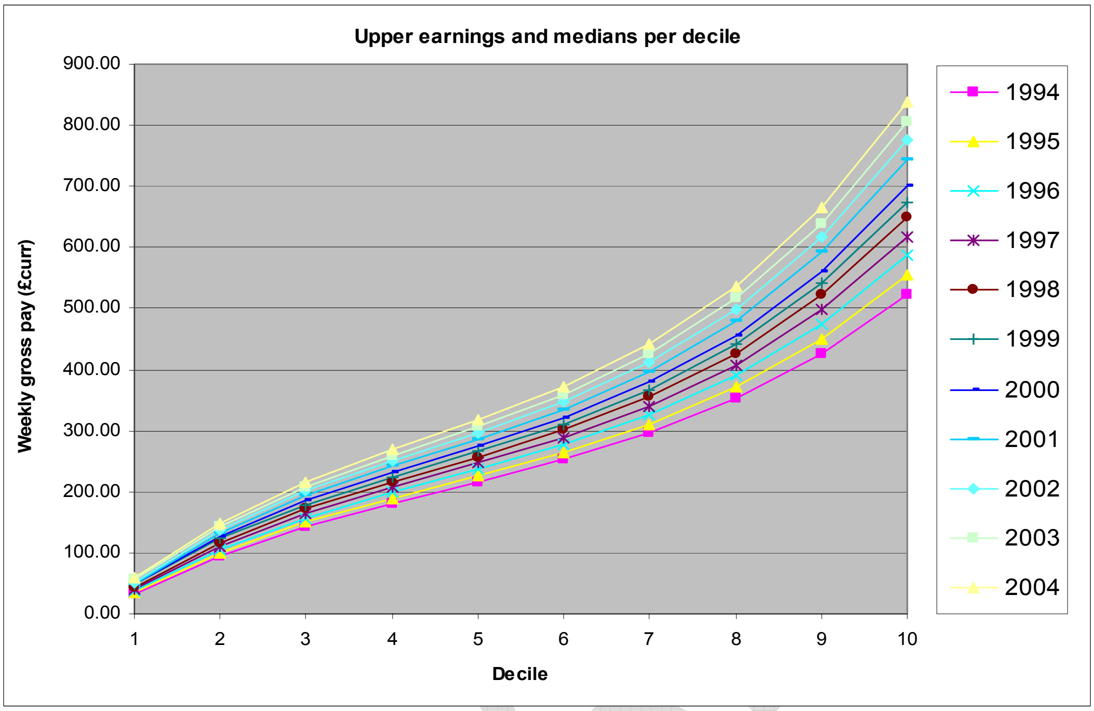

Figure 16: Deriving medians from upper limits in each decile

The median values clearly cannot be assumed to be equal to the mean, and there is no way to reliably estimate the mean from the median. But since means are affected more by outliers than medians, we can use the medians as a proxy for the means – once we have adjusted for tax and benefits – knowing that the estimates thus produced are a conservative estimate of inequality.

To adjust the gross pay, we compare the data from 2003 against equivalised disposable income (mean incomes for each decile, post-tax and benefits) for the same year, taken from the ONS dataset *Effects of Tax and Benefits on Household Income*.[49] The percentage difference is applied to the gross pay medians, bringing the lower income values up and the higher incomes down.

To check the validity of this method, we compare the results thus obtained for the UK against the values calculated from national data for the recent UK MDP (Jackson 2004). The average difference between the two is 8.9%, and the new estimations are lower (as expected, these estimations are conservative due to the use of medians rather than means).

The Atkinson Index is calculated using the following equation:

$$I = 1-(\sum(Y_i/Y^{(1-\varepsilon)} \times P_i))^{1/(1-\varepsilon)}$$

49 *Effects of Tax & Benefits on Household Income (Table 14),* ONS 2003-04. More details on this data is available online at http://www.statistics.gov.uk/STATBASE/Analysis.asp?vlnk=165&More=Y.

where Y_i is the average income in the *i*th group of the income population, Y is the average income in the whole income population, P_i is the proportion of the income population in the *i*th group, and e is the aversion to inequality.

A value of ε of 0.8 is generally used as the norm in the literature, though acceptable values range from -0.5 (indicating a preference for some inequality) to 2.5 (strongly anti-inequality).

The resulting values are then multiplied by the consumer expenditure figures to give the social cost of inequality: this cost is subtracted from the original consumer expenditure to give income-adjusted personal consumption.

Costs of crime

Data for this component come from various sources, principally the Home *Office's British Crime Survey*[50], but also the Department of Transport for some vehicle-related theft data.[51] These all give the numbers of reported crimes in various categories; there are some disjunctures in the data where offence categories change, and also where certain offences (e.g. common assault) become notifiable. No attempt has been made to adjust for these disjunctures as there seems to be no defensible method for doing so; and because the effects are not large. Data on most costs come from a report from the Home Office research department which gives estimates of the economic and social costs of crime. This report was updated in 2003-4,[52] and we use the costs from there. Other cost data related to commercial victims of crime come from the Home Office's *Commercial Victimisation Survey* from 2002.[53]

The costs of crime estimated by the Home Office are broken down into categories, some of which are not included in the ISEW. Health service costs *are* included, because we are including public health expenditure as a benefit elsewhere in the index; victim services and legal costs are not, because the public expenditure on these services is not included in the index to begin with. These are therefore removed from the cost for each category of crime to give an average allowable cost per incident before combining this with the numbers of incidents.

In addition to the preventative cost components estimated by the Home Office report, we also have data on the average defensive expenditure by businesses against crime. To simply include this in its entirety would be to double-count some costs, but it is appropriate to include *some* of it. Commercial properties require greater expenditure per incident to protect against crimes such as theft (they are larger, more likely to be empty of people but full of valuable goods, and in business districts there

50 *British Crime Survey 1996-2005, Home Office*. Data available online at http://www.homeoffice.gov. uk/rds/bcs1.html. Additional data from *Crime in England and Wales: South East Region 2005/05, Home Office* (http://www.homeoffice.gov.uk/rds/pdfs05/eastmidlands05.pdf) and *Notifiable Offences in England and Wales 1996-2000, Home Office*.

51 *Theft of and from Vehicles (Table 7.8), Transport Trends 2001-2004*, DfT. Some data available online at http://www.dft.gov.uk/stellent/groups/dft_transstats/documents/ divisionhomepage/035611.hcsp.

52 *Estimates of the economic and social costs of crime in England and Wales: Costs of crime against individuals and households, 2003/04, Economics and Resource Analysis, Research, Development and Statistics, Home Office*. Available online at http://www.homeoffice.gov.uk/rds/pdfs05/rdsolr3005.pdf

53 *Crime against retail and manufacturing premises: findings from the 2002 Commercial Victimisation Survey Supplementary web report 1: costs of crime, Economics and Resource Analysis, RDS, Home Office*. Available online at http://www.homeoffice.gov.uk/rds/pdfs05/rdsolr3705.pdf

are no neighbours to watch over them). They also have to spend money to protect themselves against fraud and forgery, which is not covered in the Home Office costs.

To ensure we have made some accounting for these factors, we take 50% of the average crime prevention expenditure per business, and multiply it by the number of VAT-registered businesses in the region.

Costs of family breakdown

Divorce statistics are taken from HM Courts Service,[54] and from the ONS' *Annual Abstract of Statistics*.[55] Regional data are only readily available from 2001 onwards so we estimate data for earlier years. Estimating the cost of divorce is problematic, as it is extremely multi-faceted. Some aspects are covered by other components of the ISEW: for instance, lost output will be reflected in lower consumer expenditure. But the true costs also include the emotional impact on divorcees and their families, greater pressure on housing stock and thus rising prices, "unnecessary" consumption (a married couple only need one kettle but a divorced couple need two), as well as the arguable and almost certainly unquantifiable effects on social cohesion in general.

For this reason, we have taken a benchmark estimate of the total UK cost of divorce from the Home Office in 2000 (£10bn at 2000 prices, as used in the recent UK MDP)[56] and calculated a regional share of this using regional divorce data.

The number of divorces in the South East for 1994-2000 is estimated by comparing data for the South East and England and Wales as a whole for 2001-2004 and taking the average ratio, then applying this to the E&W data for 1994-2000. The resulting numbers are then indexed against the UK total number of divorces in 2000, and a total regional cost estimated for each year by multiplying the index for each year by the UK total in 2000.

Costs of commuting

To estimate these costs we rely on two kinds of dataset: travel data from the Department for Transport's *National Travel Survey*[57] and their *Regional Transport Statistics Bulletins*,[58] and expenditure data from the *FES/EFS*.[59] The travel data are used to calculate what proportion of travel via three main types of transport (private motor vehicle, bus/coach and rail/tube) is due to commuting, then to take that proportion of the relevant household expenditure as the cost. This does *not* include any estimation of the loss of leisure time due to commuting; other negative externalities such as car accidents and harmful emissions are covered elsewhere in the ISEW.

Data on commuting were not available for all years, so some figures are interpolated from the trends; moreover, one of the key datasets was also not available at the regional level. We have data on the proportions of *trips* made due to commuting and

54 *Matrimonial Proceedings datasets, HM Courts Service 2005*, supplied by email.
55 *Annual Abstract of Statistics 2002-2005, ONS*. Data available online at http://www.statistics.gov.uk/ statbase/Product.asp?vlnk=94
56 Jackson, T 2004 *Chasing Progress, op cit ref 52;* See also Jackson et al 1997, op cit, ref 52.
57 *National Travel Survey 1999-2004, DfT*. Data available online at http://www.dft.gov.uk/stellent/ groups/dft_control/documents/contentservertemplate/dft_index.hcst?n=7216&l=3
58 *Regional Transport Bulletins 2001-2005, DfT*. Data available online at http://www.dft.gov.uk/ stellent/groups/dft_transstats/documents/divisionhomepage/038060.hcsp
59 *FES/EFS, op cit.*

other purposes, but not the *distances*. Since journeys to work are generally longer than shopping trips or the school run, these proportions do not accurately reflect the proportions of total travel costs which ought to be assigned to commuting. National data do however exist for both the number of trips *and* distance travelled.

So the first step in processing the regional data is to calculate for each category of trip purpose the ratios of (% of distance travelled) to (% of journeys made) for each year. We apply these ratios to the regional data on commuting as a proportion of journeys made. The inaccuracies in this approach mean that the resulting percentages of total travel for each purpose sum to more than 100% (the range is from 100.6% to 106.7%). We then adjust the percentages proportionately to each other so that they do sum to 100%.[60]

In addition to this data we also use the data on mode of transport to filter out the three modes we can derive costs for. These data are directly available at the regional level.

Finally, we take household expenditure on these three mode of travel (including motor insurance in the private vehicle category) from the *FES/EFS*.[61] We use the survey sample metadata (number of people per household) and regional population data to translate this weekly household expenditure into a regional total per year. The totals for each mode of travel are then multiplied by the proportion of travel due to commuting, and then again by the appropriate proportion of commuting by that mode of transport to give an estimate of the total costs of commuting for each; these are then summed to give an overall cost.

Costs of car accidents
Data for this component are taken mainly from the DfT's *Regional Transport Statistics*,[62] but also from the ONS' *Annual Abstract of Statistics*.[63] Costs are taken from a briefing paper from the DfT published in 2003.[64] This paper gives an average cost per incident in the four categories of accident for which statistics are commonly reported: accidents involving damage to vehicles and property only; accidents producing slight injury; accidents producing serious injuries; and accidents producing fatalities.

Data on the number of accidents in 2004 were not available, and have been extrapolated from 1994-2003 trends. Accidents which resulted in serious injury or death are bracketed into a single KSI (Killed or Seriously Injured) category at the regional level. However, costs are substantially different for serious injury and for death, so we estimate a breakdown of this figure at the regional level using the average split at the UK level for 1994-2003. The costs given in the DfT's briefing paper are broken down into categories; following the reasoning outlined in the comments on the costs of crime outlined above, we include medical and ambulance costs but exclude police costs.

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60 This of course does not rule out error from the method chosen to estimate commuting as a proportion of distance travelled, since it may be that in some regions the average commute is far longer (relative to trips for other purposes) than the national average. However, the error is small compared to not trying to account for this factor: the national figure for commuting *trips* in 2001 was 15.31%, but for *distance* it was 19.43%. Using the first figure as a basis would give us a total some 20% lower than it should be.

61 *FES/EFS op cit.*

62 *Regional Transport Statistics, op cit.*

63 *Annual Abstract of Statistics, op cit.*

64 *Highways Economics Note No. 1: 2003 Valuation of the Benefits of Prevention of Road Accidents and Casualties, DfT 2004*.

A.1.3 Environmental Factors

Costs of air pollution

The National Air Emissions Inventory (NAEI) maintains a time series database of certain pollutants in the UK.[65] The most recent of which are for 2002 and are available at a granularity of 1km x 1km across the country, but previous years are available at the national level only. We use the regional data from 2002 to estimate regional emissions for previous years, applying the 2002 proportions of the UK totals to the national data for each year. Emissions measured in this way are: carbon monoxide, carbon dioxide, methane, nitrous oxides, sulphur dioxides, particulate matter smaller than 10 micrometres (PM-10s), volatile organic compounds (VOCs), lead, benzene, and 1,3-butadeine.

Of these, we have sourced estimates of the social/environmental costs per tonne for all but lead, benzene and 1,3-butadeine, which are therefore omitted from the air pollution costs in the ISEW. Carbon dioxide and methane are not used in this component but are costed in the long-term environmental damage component instead. Nitrous oxide is also costed for its climate change effects in that component, but the immediate pollution effects of all oxides of nitrogen are costed and used in this component. Unit costs are taken from a paper published by the Royal Commission on Environmental Pollution (RCEP), *Environmental Impacts of Energy*,[66] which surveys the literature and derives plausible working values from it.

The NAEI database can be interrogated by local authority area to produce results for each 1km square in each authority: these were then summed to give regional totals for each pollutant. Total emissions are multiplied by the cost per tonne for the selected pollutants, and these are summed to give an overall total cost.

Costs of water pollution

The DETR produced a breakdown of environmental protection expenditure by UK industry in 1997,[67] which we combine with regional GVA[68] as a proxy to estimate the regional expenditure. However, this only estimates the cost of reducing pollution levels from what they *would be* to what the actually are. We combine these costs with an index based on Environment Agency data[69] to produce estimates of the additional costs not accounted for in the industry expenditure.

In the EA data, a given stretch of river is measured for chemical and biological quality and the results given separately, as the percentage of total river length which falls into each category. There are two methods of creating an index from these data, one which places the emphasis on the length of *good* quality river, and one which

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65 *National Air Emissions Inventory Data Warehouse* at http://www.naei.org.uk/data_warehouse.php.

66 *Environmental Impacts of Energy, Nick Eyre, Royal Commission on Environmental Pollution, 1998.*

67 *Environmental Protection Expenditure By UK Industry: A Survey Of 1997 Expenditure, DETR 1997*.

68 *Regional GVA, ONS*. Data available at http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=7359

69 England and Wales data from the *Environment Agency: http://www.environment-agency.gov.uk/yourenv/eff/1190084/water/213902/river_qual/gqa2000/?version=1&lang=_e;* Scottish data from the *Scottish Environment Protection Agenc:y http://www.sepa.org.uk/data/classification.* Northern Ireland data supplied by email from the *NI Environment and Heritage Service*

stresses the length of *poor* quality river. It is not clear which if these yields the "truest" reflection of costs, so we take an average of the two methods to form our index.

So far, this only accounts for existing clean-up costs and does not make any account of the social costs of the remaining pollution. A DEFRA paper was published in 1999 looking at possible policy measures to control pollution.[70] This estimated the benefits associated with bringing a stretch of river up from one quality grade to another, which we use in conjunction with the EA data. The target quality of all lengths of river is set at "good".

Firstly, the UK total expenditure by industry on "Control of liquid discharges" was multiplied by the South East GVA as a proportion of UK total GVA to give a regional estimate of actual industry expenditure in 1997. To derive figures for other years, we need to create an index of water pollution using the EA data on river quality.

We first take an average of the two percentages to give a single figure for each year. We then create one index using the reciprocal of the proportion of river length in the highest grade, and another index using the total length of river in the lowest two grades. Both indexes are based on 1997 (as this is the year we have industry expenditure from) and an average is taken of the two. The index is then multiplied by the regional expenditure in 1997 to give an estimate of expenditure in the other years.

The costs estimated by DEFRA for a change in river quality are based on a model which has four scenarios and thus four sets of costs: (i) low density population, agricultural; (ii) high density population, agricultural; (iii) clean industry and (iv) traditional industry. We take an average of the costs given by the last three scenarios as they best characterise the South East region. The costs are only calculated for improving a stretch of river by a single quality grade, so we derive the necessary additional figures from these to be able to cost the improvement from the worst grade to the best.

The costs give are per kilometre of river: for each category *below* the target quality of "good", we derive the cumulative cost of bringing 1km up to the target standard, and then multiply those costs by the lengths of river in each sub-target category. We have to estimate the total lengths of river in each quality grade because the EA is only responsible for monitoring some 40,000km of the UK's estimated total 150,000km of river, as many waterways are out of the EA's monitoring remit, (e.g. they may be on private land). The lengths reported by the EA are therefore multiplied by 15/4 before use, assuming that pollution levels are the same in the remaining stretches of river.

Costs of Noise Pollution

Most noise pollution studies focus on very specific instances when attempting to cost it, measuring distances from noise sources, size of dwelling, thickness of walls, etc. There is little in the way of general or aggregated costs to work from, so we take the total UK cost estimate from the UK MDP study[71] and use this together with an index of noise pollution based on traffic statistics. These are sourced from the DfT[72] - regional data are not available for all years so some data points are interpolated.

70 *Economic Instruments for Water Pollution Discharges, DEFRA 1999.* Available online at http://www.defra.gov.uk/environment/water/quality/econinst2/index.htm

71 *Chasing Progress, op cit, ref 52.*

72 *Transport Trends, op cit; Regional Transport Statistics, op cit.*

A cost of £2,263m (1990 prices) is estimated for the year 1993. We take total vehicle kilometres as the proxy for traffic noise and index them on the 1993 UK result and multiply the index by the cost in 1993 (converted to 2004-5 prices) to give a cost of noise pollution for each year.

Costs of personal pollution control
Since some consumer expenditure is defensive spending to mitigate the effects of environmental degradation, we include an estimate of this. We use the estimated costs from the UK MDP[73] and adjust to a regional cost using consumer expenditure as a proxy.

The costs of personal pollution control in the UK MDP 2002 were estimated using an index based on data from the US, in the absence of suitable UK data. We take this dataset, extrapolate it to 2004 from the 1994-2002 trend, and then calculate a regional share using regional consumer expenditure (final household consumption) as a proxy.

Costs of loss of natural habitats
To value the loss of natural habitats, we use a willingness to pay model to estimate a cost per hectare: the RSPB paid £2000 per hectare to preserve an area of wetlands in 1996, and this agrees with a study from 1994 giving a range of WTP values from £1,529-£5703 per ha). As natural habitats should be considered a capital stock which we have been depleting for some time without accounting for it, a cumulative model is appropriate here. The actual data on habitat loss are not available for all years: UK data were estimated from several sources for the *MDP 2002*,[74] but regional data are only available for 1990 and 2000 in the *Countryside Survey* (*CS 2000*).[75] We use this together with the UK data to extrapolate back to a starting point of 1930, prior to which we have no data.

The *MDP 2002* data and the *CS 2000* data are measured on a different basis, so we need to reconcile these first. The *CS 2000* gives regional data as well as national, and it is a single measured source rather than a dataset estimated from a number of sources. Clearly this is our preferred source and we want to use the *MDP 2002* data as little as possible in this context: we have data points in 1990 and 2000 and we estimate a further data point from 1930 using the UK MDP data. We do this by comparing the loss of habitats between 1990 and 1998 as measured by the *CS 2000* and the UK MDP. We assume that the ratio of these two estimates (~143%) will be the same for the two estimates of loss between 1930 and 1990, so we multiply the 1930-90 loss as measured by the UK MDP by this ratio to get an estimate of the loss as we might expect it to be measured by the *CS 2000*.

This leads to our 1930 data point for the stock of UK habitats, from which we estimate the South East stock using the average ratio of South East to UK stocks in 1990 and 2000 (as measured by the *CS 2000*). We put a trend line through this and the other two reported data points for South East stocks. The function of this trend line is used to interpolate the other years. Note that in some regions there has been an *increase* in farmlands in recent years, which leads to a U-shaped curve in the

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73 *Chasing Progress op cit, ref 52.*
74 *Chasing Progress, op cit, ref 52.*
75 *Countryside Survey 2000, DEFRA and National Environment Research Council, 2000.* CS2000 datasets & mapping tool (Countryside Information System, CIS) available at http://www.cs2000.org.uk.

trend line, giving a rate of increase in the years 1998-2004 which is still rising. This extrapolated trend seems dangerously unlikely, so in these cases we use the curved trend only for the years 1930-1990, and then assume a linear trend from 1990 onwards, based on the measured *CS2000* change from 1990-1998. The cumulative total loss since 1930 is calculated for each year and multiplied by the cost per hectare. It is an approximate estimate, but sufficient to yield a reasonable measure of the cumulative loss of habitats to date, given the absence of other reliable data.

Costs of loss of farmlands

The loss of farmlands is costed using two components: firstly, soil erosion and loss of productivity due to intensive agriculture and secondly, loss of land actually given over to agriculture. We take the UK MDP[76] estimates of both costs and scale to the regional level using the area of land under agriculture as a proxy. Data for land use are taken from the *CS 2000*,[77] the Eurostat regional statistics database[78] and DEFRA's *June Agricultural Census*.[79] These sources have some gaps over the period which require interpolation of data points.

To estimate soil erosion costs, we use the UK MDP estimates of UK annual productivity loss and the cumulative loss at 1950, and scale them down to the regional level using the ratio of area of land under agriculture in the South East to that in the UK. We then multiply this by the total area of land under agriculture in the South East to get a cost of soil erosion for each year, and accumulate it.

The annual loss of farmland to other uses is very erratic according to the data we have, possibly due to sampling errors, so we use a five-year rolling average to smooth out the trend. We estimate a starting cost of land loss for 1989 by multiplying the cost per hectare by the average rate of loss from 2004 back to 1978 when the Eurostat data begin, and then by 49 (years) to take the series back to 1950. Each year's cost is then added to the cumulative total from 1994 to 2004 to give a cumulative cost. Finally, the soil erosion and loss of farmland costs are combined to give a single total cost for each year.

Long-term environmental damage

The data sources and methodology for this component are almost identical to those for the air pollution component described above.[80] Regional data for methane and nitrous oxide are not available. Following suggestions from the NAEI statisticians we have used population as a proxy to derive estimates for methane. For nitrous oxide we use all oxides of nitrogen as a proxy. Estimates for the social and environmental cost of atmospheric carbon are taken from the same RCEP study. Costs for methane and nitrous oxides are based on this cost plus information from the NAEI *Greenhouse Gas Inventories* reports[81] which estimates the Global Warming Potential (GWP) of these gases as a multiple of the effect of carbon dioxide.

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76 *Chasing Progress op cit, ref 52*; See also Jackson et al 1997 *op cit, ref 52.*

77 *CS2000, op cit.*

78 *General and Regional Statistics/Regions/Agriculture/Land Use, Eurostat database*. Data available at http://epp.eurostat.cec.eu.int/pls/portal/url/page/PGP_QUEEN/PGE_QUEEN_TREE?screen=welcomeref&open=/&product=EU_MASTER_regions&depth=2

79 *June Agricultural Census 1990-2004, DEFRA*. Data available at http://www.defra.gov.uk/esg/work_htm/publications/cs/farmstats_web/Publications/complete_pubs-unmodified-300905.htm

80 *NAEI Data Warehouse, op cit; Environmental Impacts of Energy, op cit..*

81 *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2003, NAEI*. Available online at

The estimated cost per tonne is a marginal social cost, so we can calculate the marginal cost each year very simply. However, this does not reflect the true cumulative cost of emissions past, present and future, nor does it make good sense in accounting terms, since the damage done by each tonne emitted takes place over its lifetime in the atmosphere (around 100 years), and the cost is not truly borne until some time in the future. The most accurate way to account for this would be to use the damage function which yielded the original cost estimate to plan payments into a kind of climate change insurance fund. This fund would ensure that sufficient money was available to cover the costs as and when they become due.

However, this is problematic: the damage functions are not given explicitly in the literature, and although it is likely that they can be sourced given time, there will still be an issue over what kind of insurance instrument is most appropriate to each. Under the circumstances we have assumed a simplistic model, under which the full cost of each tonne of carbon becomes due in 2050. This allows us to calculate the amount required to offset damage at that point, and therefore what annual payments into an "endowment fund" would be required to ensure that sufficient funds are available then.

Total emissions of carbon dioxide, methane and nitrous oxides are calculated as for air pollution described above. We multiply the methane emissions by 21 and the nitrous oxide emissions by 310 to give their GWP in terms of tonnes of carbon dioxide, and then by 12/44 to derive the carbon equivalent. These figures are then summed to give total GHG emissions in GWP tCe.

The value in 2050 of the marginal cost each year is calculated using the same discount rate used in the study which derived the cost estimate. This cost is accumulated each year, and the resulting amount is used to calculate the annual payments required into an endowment fund which matures in 2050, given a constant interest rate. This interest rate is an assumption which reflects risk aversion, and can be varied between 0% and 3% for sensitivity analysis.

Depletion of non-renewable resources
This column calculates the costs associated with replacing fossil energy used in the region with renewable energy, in line with the replacement cost methodology proposed first proposed by Cobb and Cobb in the revised US ISEW. Regional data on energy usage are extremely scarce. There are gas figures for 2002 and 2003, and experimental electricity usage for 2003.[82] However, national data are strong and available from the UK Department of Trade and Industry (DTI) in a variety of forms including a breakdown by sector.[83] This allows us to choose suitable proxies for regional estimates, such as GVA (industrial component) for industry usage, and population for domestic usage. GVA figures are taken from the ONS' regional

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http://www.airquality.co.uk/archive/reports/cat07/0509211321_Reghg_report_2003_Main_Text_Issue_1.doc.

82 *Energy Trends, DTI*. Regional gas consumption from Dec 2004 issue; electricity from March 2005. See http://www.dti.gov.uk/energy/inform/regional_energy/index.shtml for more detail and links.

83 *Digest of UK Energy Statistics 2005, Energy Consumption by Final User (Table 1.1.5), DTI*. Data available at http://www.dti.gov.uk/energy/inform/energy_stats/total_energy/dukes05_1_1_5.xls.

datasets,[84] and population from their *Population Trends* datasets.[85] The energy usage is converted to barrel of oil equivalents and then cashed out using a replacement value per barrel. This unit cost is an average of the recent (2005) crude oil peak price of US$60/bbl[86] and a cost derived from the US Green National Product (Cobb & Cobb) estimate of $75/bbl[87] (in 1988: this is increased using an escalation factor of 2% per year). The crude oil price underestimates the true costs of replacing fossil fuels with renewable resources; the Cobb and Cobb figure is probably an overestimate now, as the cost of renewables has come down in recent years due to improvements in technology. An average of the two gives a defensible estimate.

National energy consumption data are scaled down to the regional level using the following figures as proxies for energy consumption by sector:

- **Industry:** Industrial components of South East GVA as proportion of UK total industrial GVA
- **Transport:** Transport component of South East GVA as proportion of UK total transport GVA
- **Domestic:** Population of South East as proportion of UK total population
- **Services (public sector):** Public sector components of South East GVA as proportion of UK total public sector GVA
- **Services (private sector):** Private sector services components of South East GVA as proportion of UK total private sector services GVA

These energy usage figures are given as tonnes of oil equivalents using the calorific values of each energy source: we convert these to barrels of oil (at 7.315 barrels per tonne) and then multiply by the cost per barrel.

Costs of ozone depletion
CFC emissions have almost completely ceased from developed countries, and although existing concentrations continue to do harm, there is no longer any policy lever which can affect outcomes in this component, so we have excluded this component from the R-ISEW.

84 *Regional GVA, ONS, op cit.;* Also *Regional Trends 38, ONS*. Data available at http://www.statistics.gov.uk/statbase/explorer.asp?CTG=3&SL=4788&D=4800&DCT=32&DT=32#4800.
85 *Population Trends, op cit.*
86 http://www.energybulletin.net.
87 *The Green National Product, Cobb C., and Cobb, J., University of Americas Press, 1994.*

A.2 Technical Appendix: Sensitivity Analyses

As indicated throughout this study, the R-ISEW is sensitive to assumptions made concerning a number of different parameters in the various environmental, social or economic factors incorporated in the index. In this final appendix, we present briefly three sensitivity analysis based on changing parameters associated with a) the aversion to income inequality (ε), b) the replacement cost assumed for fossil resources and c) the assumed social cost of carbon.

a) Variations in the value of epsilon

Figure 17 illustrates the results first of all of varying ε between 0 (no aversion to income inequality) and 1.6 (which lies well within the range of accepted values for high aversion to income inequality). As can be seen, the omission of aversion to income inequality reduces the gap between R-ISEW and GVA and also slightly increases the growth rate. This is because income inequality rises in the South East over the period, and taking out that accounting factor makes the index perform slightly better over time than before. By contrast, the higher aversion to income inequality increases the gap between R-ISEW and GVA, *and* dampens its trend performance, because more weight is given to a trend which is worsening over time.

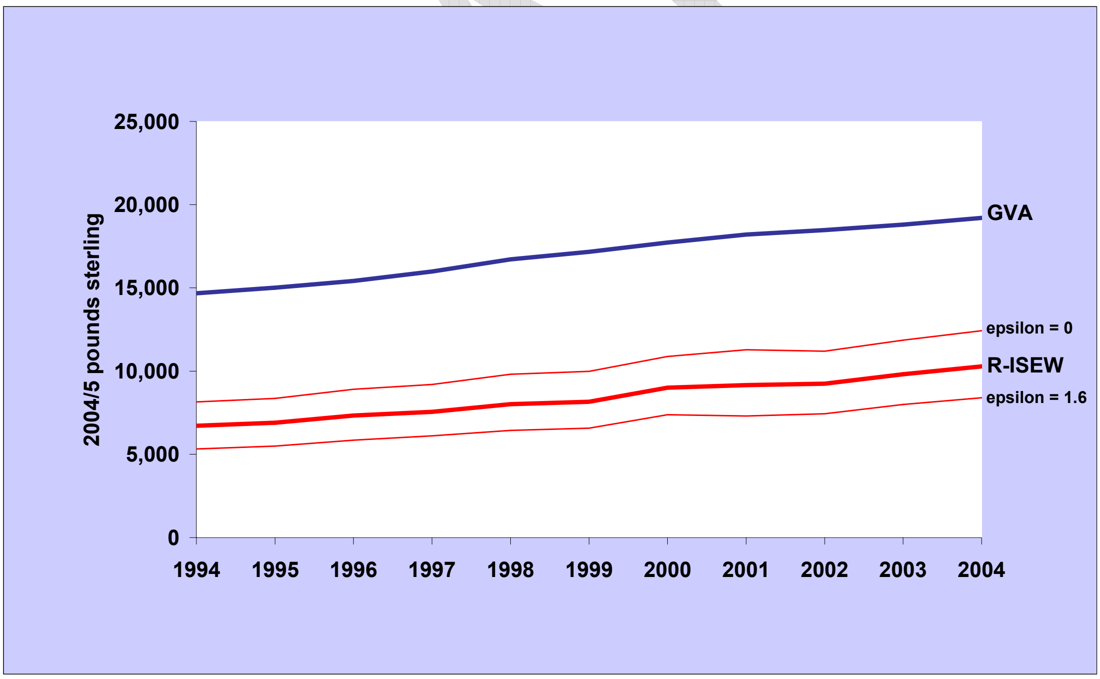

Figure 17: South East R-ISEW with variations in the value of epsilon (ε)

b) Variations in the escalation factor in resource depletion

The escalation factor used in the original Cobb and Cobb revised US ISEW was 3% per annum. They justified this escalation factor on the grounds that a steadily increasing cost would be expected as higher and higher levels of energy consumption were met using renewable energy. At the margin, renewable energy source might replace fossil quite cheaply, but for greater levels of penetration this would no longer be the case. In our study, we have adopted a lower escalation factor of 2%. We have also adopted a lower replacement cost per barrel than assumed by Daly and Cobb. In this sensitivity analysis, we investigate the effect of range of replacement costs based on the higher Cobb and Cobb estimate on the one hand and the 2005 oil price peak (around £33 per barrel in September) on the other. Figure 18 illustrates the impact of this range on the R-ISEW. There is clearly some variation in the R-ISEW as a result of this exercise with the higher per barrel replacement cost leading to a very slight divergence between R-ISEW and GVA over the period, by contrast with the central case.

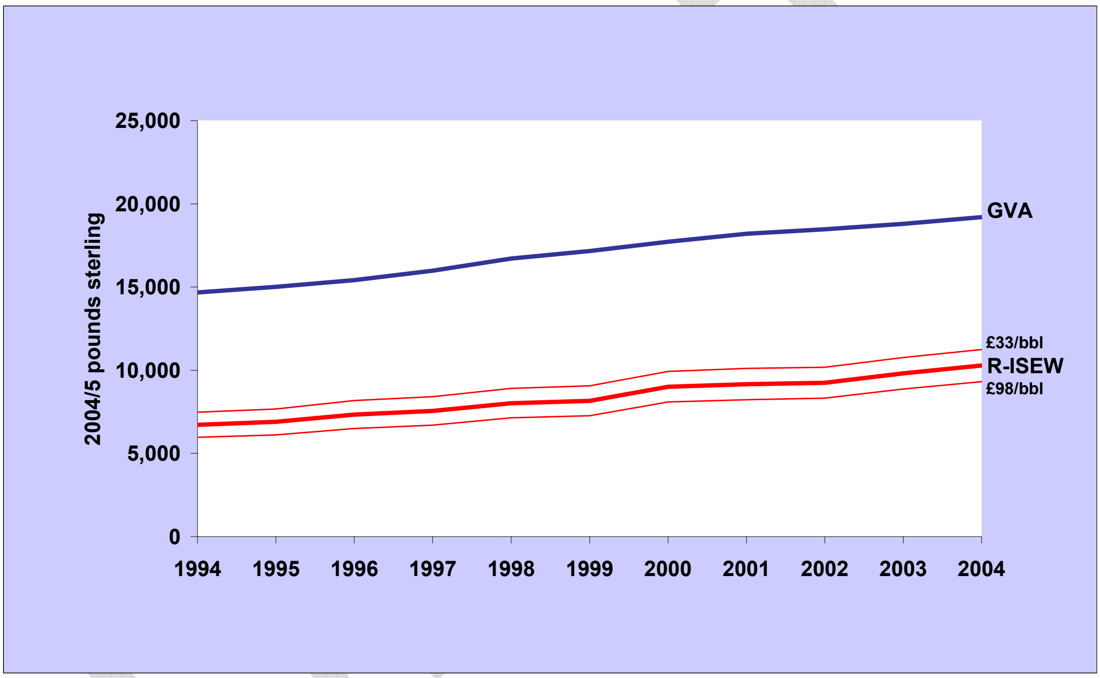

Figure 18: South East R-ISEW with variations in the replacement cost

c) Variations in the Social Cost of Carbon

The R-ISEW uses the Treasury estimate of £70/tonne of carbon as the social cost of carbon for the year 2000. The Treasury document reports a range of estimates however between £35/tonne of carbon and £140/tonne of carbon, with £70/tC as the central estimate. Figure 19 illustrates the impact of choosing a social cost of carbon at the two ends of this range. Clearly, the higher social cost of carbon has a significant depressive effect on the index, and the gap between R-ISEW and GVA widens progressively over the study period by comparison with the central estimate.

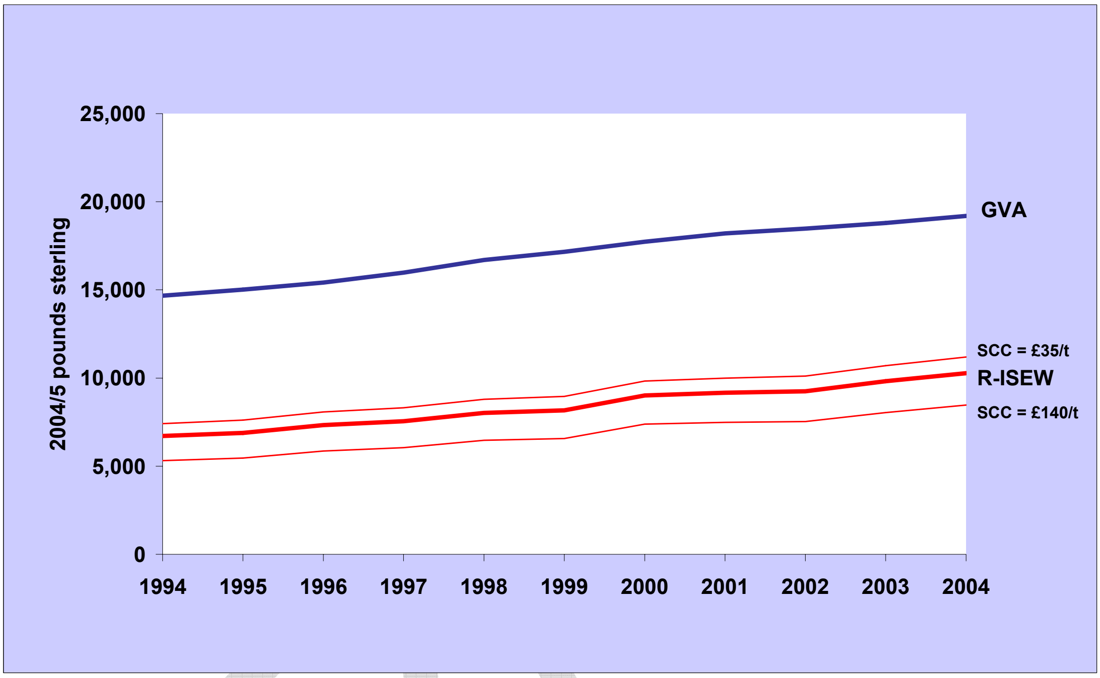

Figure 19: South East R-ISEW with variations in the Social Cost of Carbon

A.3 Numerical Appendix

A.3.1 South East R-ISEW per capita: economic, social and environmental adjustments

All values in £2004-5

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Economic benefits											
Consumer expenditure	£10,638	£10,765	£11,579	£11,914	£12,423	£12,482	£13,611	£14,390	£14,419	£14,787	£15,274
Economic adjustments											
Net capital growth	-£55	£37	£145	£356	£463	£603	£759	£780	£901	£995	£954
Change in net international position	-£2,040	-£2,152	-£2,232	-£2,287	-£2,277	-£2,335	-£2,616	-£2,964	-£3,116	-£3,051	-£2,975
Under utilisation of consumer durables	-£253	-£269	-£330	-£379	-£374	-£373	-£380	-£447	-£411	-£376	-£405
Social benefits											
Services: household labour and volunteering	£3,661	£3,794	£3,750	£3,558	£3,632	£3,585	£3,458	£3,502	£3,338	£3,414	£3,450
Public expenditure on health & education	£939	£945	£931	£952	£975	£1,070	£1,135	£1,232	£1,306	£1,410	£1,517
Social costs											
Negative effects of income distribution	-£1,434	-£1,459	-£1,578	-£1,640	-£1,797	-£1,820	-£1,864	-£2,116	-£1,947	-£2,040	-£2,143
Defensive expenditures on commuting	-£125	-£131	-£154	-£184	-£182	-£182	-£178	-£208	-£196	-£209	-£216
Costs of divorce, crime, car accidents	-£743	-£739	-£742	-£692	-£706	-£728	-£717	-£716	-£753	-£740	-£747
Environmental costs											
Costs of pollution: air, water, noise & personal pollution control	-£881	-£830	-£800	-£757	-£742	-£684	-£669	-£667	-£651	-£645	-£622
Loss of habitats, farmlands and soil erosion	-£50	-£50	-£49	-£48	-£48	-£47	-£47	-£46	-£45	-£45	-£44
Long-term environmental damage	-£1,397	-£1,432	-£1,472	-£1,510	-£1,551	-£1,587	-£1,630	-£1,676	-£1,724	-£1,772	-£1,819
Depletion of natural capital: non-renewables	-£1,530	-£1,573	-£1,697	-£1,717	-£1,786	-£1,812	-£1,840	-£1,893	-£1,861	-£1,903	-£1,941

A.3.2 South East R-ISEW per capita: summary sheet

All values in £2004-5

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Economic benefits	£10,638	£10,765	£11,579	£11,914	£12,423	£12,482	£13,611	£14,390	£14,419	£14,787	£15,274
Economic adjustments	-£2,347	-£2,384	-£2,418	-£2,311	-£2,188	-£2,105	-£2,237	-£2,631	-£2,626	-£2,432	-£2,426
Social benefits	£4,599	£4,739	£4,681	£4,510	£4,607	£4,655	£4,593	£4,734	£4,644	£4,824	£4,968
Social costs	-£2,301	-£2,329	-£2,474	-£2,516	-£2,686	-£2,729	-£2,759	-£3,039	-£2,897	-£2,989	-£3,105
Environmental costs	-£3,858	-£3,885	-£4,019	-£4,032	-£4,127	-£4,130	-£4,186	-£4,281	-£4,282	-£4,365	-£4,426
Per capita ISEW	£6,731	£6,906	£7,350	£7,565	£8,029	£8,173	£9,021	£9,172	£9,257	£9,825	£10,284
Per capita GVA	£14,672	£15,013	£15,416	£15,981	£16,706	£17,163	£17,726	£18,199	£18,477	£18,802	£19,197
Gap between ISEW and GVA (Figure 13)	£7,941	£8,106	£8,067	£8,416	£8,676	£8,990	£8,706	£9,026	£9,220	£8,977	£8,913

A.3.3 UK ISEW per capita: economic, social and environmental adjustments

All values in £2004-5

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Economic benefits											
Consumer expenditure	£9,397	£9,567	£9,862	£10,144	£10,513	£10,918	£11,358	£11,631	£11,793	£11,965	£12,237
Economic adjustments											
Net capital growth	-£299	-£272	-£191	-£14	£122	£172	£263	£299	£310	£300	£295
Change in net international position	-£151	-£172	-£165	-£127	-£89	-£193	-£333	-£442	-£384	-£327	-£322
Under utilisation of consumer durables	-£234	-£242	-£294	-£321	-£320	-£324	-£329	-£350	-£322	-£297	-£316
Social benefits											
Services: household labour and volunteering	£3,557	£3,684	£3,637	£3,454	£3,525	£3,481	£3,365	£3,430	£3,271	£3,350	£3,405
Public expenditure on health & education	£1,109	£1,120	£1,106	£1,110	£1,122	£1,198	£1,284	£1,366	£1,452	£1,578	£1,692
Social costs											
Negative effects of income distribution	-£1,233	-£1,271	-£1,324	-£1,383	-£1,514	-£1,605	-£1,603	-£1,763	-£1,559	-£1,596	-£1,745
Defensive expenditures on commuting	-£106	-£106	-£118	-£136	-£136	-£140	-£158	-£157	-£152	-£158	-£161
Costs of divorce, crime, car accidents	-£714	-£697	-£698	-£673	-£659	-£686	-£689	-£686	-£697	-£728	-£706
Environmental costs											
Costs of pollution: air, water, noise & personal pollution control	-£1,021	-£956	-£912	-£853	-£831	-£767	-£740	-£725	-£699	-£687	-£650
Loss of habitats, farmlands and soil erosion	-£153	-£155	-£157	-£160	-£162	-£164	-£166	-£167	-£169	-£170	-£171
Long-term environmental damage	-£1,489	-£1,532	-£1,579	-£1,626	-£1,673	-£1,720	-£1,769	-£1,819	-£1,870	-£1,923	-£1,976
Depletion of natural capital: non-renewables	-£1,470	-£1,501	-£1,611	-£1,613	-£1,672	-£1,694	-£1,743	-£1,799	-£1,776	-£1,820	-£1,867

A.3.4 UK ISEW per capita: summary sheet

All values in £2004-5

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Economic benefits	£9,397	£9,567	£9,862	£10,144	£10,513	£10,918	£11,358	£11,631	£11,793	£11,965	£12,237
Economic adjustments	-£683	-£686	-£649	-£462	-£287	-£345	-£400	-£493	-£396	-£324	-£342
Social benefits	£4,666	£4,804	£4,743	£4,564	£4,647	£4,680	£4,648	£4,796	£4,723	£4,928	£5,097
Social costs	-£2,052	-£2,074	-£2,140	-£2,191	-£2,310	-£2,431	-£2,450	-£2,606	-£2,408	-£2,482	-£2,613
Environmental costs	-£4,132	-£4,145	-£4,259	-£4,252	-£4,338	-£4,346	-£4,418	-£4,510	-£4,514	-£4,600	-£4,664
Per capita ISEW	£7,195	£7,466	£7,557	£7,804	£8,225	£8,476	£8,738	£8,817	£9,198	£9,488	£9,714
Per capita GVA	£13,523	£13,791	£14,129	£14,495	£14,911	£15,252	£15,782	£16,123	£16,369	£16,739	£17,272
Gap between ISEW and GVA	£6,328	£6,325	£6,572	£6,691	£6,685	£6,775	£7,044	£7,306	£7,171	£7,251	£7,557