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Project Report

A Welsh Index of Sustainable Economic Welfare

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1. Background

Wales is the only region of the UK with a *duty* (legal obligation) towards sustainable development, and is one of very few European regions with such a duty. The sustainability agenda and debate in Wales has moved forward rapidly with the advent of this duty, with many (particularly public sector) institutions and organisations in Wales now incorporating 'sustainable thinking' into their ways of working. Sustainable development has been defined in Welsh Assembly Government documents as *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*. Importantly, sustainable development in Wales is defined to include economic, environmental and social progress.

The duty has also brought a number of new challenges, not least the explicit need to test new and existing policies and spending against broad principles of sustainability. Also, as important are principles of monitoring and evaluation of progress under this legal duty. However, at present there is an underdeveloped suite of alternative indicators of regional economic progress.

The revised National Economic Development Strategy for Wales, *A Winning Wales*, (published by the Assembly in 2001) recognised the need to assess a wider set of economic and social measures and indicators, including an Index of Sustainable Economic Welfare (ISEW).

2. ISEW – A Description

The original research into the development of an ISEW was undertaken by Daly and Cobb (1989) in the USA, and built upon several critiques of conventional approaches to monitoring economic progress. For example, commonly used indicators of the strength of the economy are gross domestic product (GDP), and GDP per head. However, increases in real GDP may not accurately reflect improvements in welfare. GDP growth takes no account of the costs of growth, for example in terms of environmental degradation, use of irreplaceable resources, pollution, and social externalities. GDP also reveals little about the distribution of resources in society, or the nature of activities which add to welfare but are outside the market system, for example the value of household labour services.

An ISEW represents an attempt to quantify factors which contribute to, or take away from welfare. An ISEW has as its base personal consumption spending, then a series of adjustments are made to consumption to arrive at the index value for a given year. A summary of the types of adjustments is given in Box 1.

3. ISEW and the Welsh Assembly Government's Headline Indicators of Sustainable Development

The Welsh Assembly Government has published its own set of sustainability indicators for Wales. The headline sustainability indices comprise indicators of employment activity, educational attainment, crime rates, housing (unfit dwellings), climate change (greenhouse gas emissions), air and water quality, wildlife population, waste recycled, Welsh language, electricity production from renewables, and ecological footprint values (see *Welsh Economic Review*, 14.2, p21). The Welsh Assembly headline indicators comprise a diverse mix of information. Whilst these monitoring indicators are useful, one problem is that they are in mixed units of account, and hence fail to deliver any overall picture of sustainability (the ecological footprint measure excepted) and welfare trends.

The development of the individual headline indicators represents an incremental step in the process of assessing, measuring and monitoring sustainable development. However, a developed ISEW could be an additional headline aggregate indicator as it provides a summary of long term trends in welfare. Moreover, an ISEW can be linked to some of the Assembly's sustainability indicators as it contains components that account for the costs of environmental degradation (i.e. air and water quality and climate change), and the degradation of the environmental capital base (i.e the use of non-renewables). An ISEW has some advantages as an indicator:

- An ISEW attempts to incorporate social and welfare aspects of sustainable development.
- Unlike more conventional measures

Box 1. An ISEW in Summary Form

$ISEW = C_{adj} + P + G + W - D - E - N$

Where

C_{adj}	= consumer spending with an adjustment to account for income inequality in society
P	= non-defensive public expenditures (e.g. health and education spending that adds to welfare)
G	= growth in capital (growth of physical capital potentially improves human welfare)
W	= non-monetarised contributions to welfare (e.g. the services provided in the household)
D	= defensive private expenditures (e.g. monies that people spend to offset the harmful effects of pollution)
E	= costs of environmental degradation
N	= depreciation of environmental capital base

Full details of these adjustments are available in (CCW, 2003) and on the WERU website at www.weru.org.uk. However a summary of each individual component of the ISEW is given in Table 1. The first column of Table 1 lists each component and also indicates whether this is added to (+) or subtracted from (-) adjusted consumption expenditure. The second column provides a rationale for including each component within the ISEW.

Table 1 ISEW Components (Adjustments)

ISEW Component Consumption expenditure	**Basis for inclusion** Estimate of welfare derived from goods and services
Adjusted consumption (income inequality) (-)	Adjusting for the social effects of uneven income distribution
Services from domestic labour (+)	Adding non-monetarised aspects of the regional economy that add to welfare
Non-defensive public expenditures on health and education (+)	Adding health and education spending that adds to welfare
Services from consumer durables adjustment (-)	Adjusting for the service value of a given level of consumer durable spending
Defensive private expenditures on health and education (-)	Subtracting defensive spending
Cost of commuting (-)	Subtracting defensive spending
Costs of personal pollution control (-)	Subtracting defensive spending
Cost of car accidents (-)	Subtracting defensive spending
Cost of water pollution (-)	Subtracting costs due to environmental damage
Cost of air pollution (-)	Subtracting costs due to environmental damage
Cost of noise pollution (-)	Subtracting costs due to environmental damage
Cost of loss of natural habitat (-)	Adjustment for loss of natural capital
Cost of loss of farmland (-)	Adjustment for loss of natural capital
Cost of depletion natural resources(-)	Adjustment for loss of natural capital
Cost of long term climate change (-)	Adjustment for long term damage to the environment affecting future generations
Cost of ozone depletion (-)	Adjustment for long term damage to the environment affecting future generations
Net capital growth (+/-)	Adjustment to take into account development of man-made capital

of progress, an ISEW considers the distribution of resources in a society, transactions outside the market process adding to welfare, and takes account of the usage of natural capital.

- An ISEW provides an indication of the net benefits to society of its production and consumption.
- ISEW provides a time-series measure that captures in one indicator the main components that together contribute to quality of life in Wales.

4. An ISEW for Wales 1990-2000

The construction of the Welsh ISEW for 1990-2000 built upon earlier pilot work undertaken by Midmore *et al.*, (2000) (see also *Welsh Economic Review* 13.1, pp25-27 for a summary). A critical problem in creating an ISEW for a small region is data availability. The ISEW for 1990-2000 represents a partial approach to construction whereby inference was drawn from UK and international research where regional data was not available. As Midmore *et al.* (2000) highlighted, the use of pro rata calculations based on UK data for the production of regional statistical aggregates has been established in other areas. Importantly, the marginal costs of developing an ISEW using a combination of regionally based adjustments and nationally based estimates is relatively low. The information base on which to estimate an ISEW is improving all the time. In the interval since the construction of the pilot ISEW for Wales (undertaken in 1999-2000), several new data sources have become available at a regional level providing information on household working patterns, income inequality, levels of pollutants and losses of natural habitat.

The trend in the ISEW for Wales for 1990-2000 is shown in Figure 1, all data is valued in 1995 prices. The value of the ISEW was a little over £6bn in 1990. Figure 1 shows that the ISEW increased between 1993 and 1997 but that this was followed by a sharp fall for 1998 and 1999, and then an increase into 2000. The net result of these movements was that by 2000 the value of the ISEW was just over 9% higher than it had been in 1990. Figure 1 also shows the steady upward trend in real GDP over the period. The value of the ISEW is typically within a range of 23-28% of GDP between 1990 and 2000. Trends in an ISEW can be compared to GDP trends, the latter being the most used indicator of regional development.

Figure 2 provides an index for GDP and ISEW per capita with 1990 GDP per capita equal to 100. This shows that ISEW per capita grew a little faster than GDP per capita between 1993 and 1995, but then fell sharply, whilst the trend in GDP per capita has continued steadily upwards. At the start of the period the ISEW per capita stood at £2,100, and increased to £2,241 in 2000. This compares with GDP per capita values for 1990 and 2000 of £8,359 and £9,553 respectively. In overall terms the gap between GDP per capita and ISEW per

capita increased during 1990-2000. Whilst the ISEW per capita was 6.7% higher in 2000 than it had been in 1990, GDP per capita had increased by 14.3%.

The relative influence of individual ISEW components can be assessed by examining the proportionate value of the component compared with the value of the consumption expenditure (the basis for ISEW) in the year 2000. The first column of Table 2 lists the component, and the second and third columns give the value (in £bn) in 1990 and 2000 respectively. The fourth column measures the proportionate change in the value of the component in that period. The final column indicates the relative importance of the component in ISEW by relating its value in 2000 to the value of consumption expenditure.

The final column of Table 2 demonstrates that there are four "big hitters" in the defined ISEW:

- Adjusted consumption for income inequality;
- Cost of depletion of natural resources (primary fuels) (a cost which increased by 47% over the period, which is subtracted from the value of consumption);
- Cost of long-term climate change (a cost which increased by 27% over the period, which is subtracted from the value of consumption);
- Services from domestic labour (this adjustment is added to the index, and increased by 7% over the period).

Whilst the analysis of the individual components shows some good news in terms of falling costs of air and water pollution, and costs associated with ozone depletion, the majority of cost items are still rising. ISEW research in other countries including Australia, USA, and the Netherlands reveals for the early 1990s a sharp divergence between GDP and ISEW. In Wales this pattern seems to be maintained into the late 1990s with little evidence that the ISEW-GDP gap is closing.

5. Some Conclusions

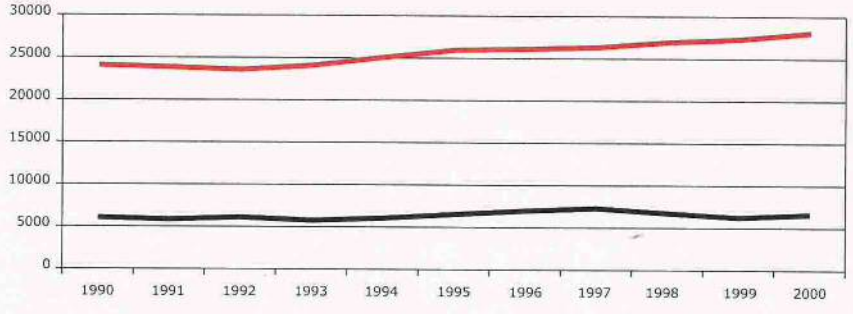
The Welsh Assembly Government still has relatively limited information on which to assess its progress towards sustainable economic development. The developed ISEW is one addition to a much larger suite of information that would be required to make a more thorough assessment. The information contained within an ISEW, as well as the final index value can assist policymakers to make more informed judgements in relation to policy and planning.

The overall trend in the ISEW for Wales is not encouraging. If current patterns of consumption and activity are maintained in Wales there is every indication that the gap between the ISEW and GDP will increase. It is unlikely that this long term trend in the ISEW can be arrested completely. A reasonable strategic aim of policy in the shorter term might be to arrest the rate of decline in the ISEW, or investigate the increases occurring in those components which take away from welfare. The nature of the relationship between GDP and ISEW could also be the context of broad policy objectives. Policy could focus on closing the gap between the GDP trend and the ISEW trend (whether the trend is expressed in absolute terms or in *per capita* terms). This would then require a policy objective committing the Assembly to securing, year on year, a more than proportionate increase in the value of ISEW compared with the proportionate increase in GDP. However, simply expressing policy objectives in terms of 'closing the gap' is imprecise – such an objective could be achieved within a period of falling GDP, which is clearly undesirable in terms of achieving the economic objectives of sustainable development.

The Welsh Assembly Government may have limited ability to influence some of the component trends. However, for other components, regional government choices can have an important implications, examples include:

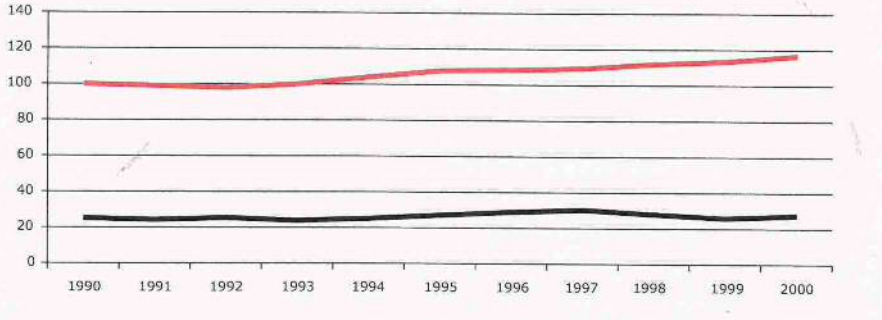
- An ISEW demonstrates the importance of regional income inequality in determining welfare. Elements of Assembly policy are already addressing this problem indirectly, for example, through initiatives to improve activity rates, assist disadvantaged areas within Wales, and through promoting equality in the workplace. However, at present very little is known on the extent to which the various policies adopted in Wales and/or Westminster serve to increase or decrease equality.
- Development of several elements in the ISEW can potentially be related to planning processes and decisions including costs associated with air and noise pollution, as well as costs associated with loss of farmland, and habitat. Indeed legislation has already been associated with

Figure 1 ISEW and GDP* (Wales) 1990-2000 (£1995m)



*GDP figures for 2002 are estimated.

Figure 2 GDP* and ISEW per Capita (1990 GDP per capita =100)



*GDP figures for 2002 are estimated.

Table 2. ISEW: Movements in Components

Component	Value 1990 £1995m	Value 2000 £1995m	% change in components 1990-2000	Value 2000 as % of Cons. 2000
Consumption expenditure	18689	22864	22%	
Adjusted consumption (income inequality)	16171	19416	20%	85%
Cost of depletion natural resources	5569	8178	47%	36%
Cost of long term climate change	4722	5988	27%	26%
Services from domestic labour	4403	4725	7%	21%
Cost of ozone depletion	1815	1964	8%	9%
Non-defensive public expenditures on health and education	1252	1875	50%	8%
Net capital growth	1207	1576	31%	7%
Cost of commuting	1146	1274	11%	6%
Services from consumer durables adjustment	585	1270	117%	6%
Cost of air pollution	1952	1024	-48%	4%
Cost of loss of natural habitat	312	388	24%	2%
Defensive private expenditures on health and education	232	238	3%	1%
Costs of personal pollution control	107	195	82%	1%
Cost of loss of farmland	169	193	14%	1%
Cost of water pollution	262	164	-37%	1%
Cost of noise pollution	94	100	6%	>1%
Cost of car accidents	14	10	-29%	>1%
ISEW	**6050**	**6603**	**9%**	**29%**

reductions in some of these items.

- Cost of commuting and car accidents where trends can be influenced by encouragement of different patterns of commuting, enhanced road safety measures, and improvements to public transport infrastructure.

- Improving education on the nature of sustainable economic development, and the costs of economic development. Encouraging new patterns of consumption.

An ISEW is not a complete answer to monitoring trends in sustainability and welfare in Wales. ISEW is one part of a potential sustainability indicator set. Unfortunately, at the end of the Welsh Assembly Government's first full term there is still little information on which to assess progress towards sustainability objectives.

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Project Report

Welsh Input-Output Tables for 2000 and Development of a Computable General Equilibrium Model for the Welsh Economy

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This brief article reports on the current development of the Welsh Input-Output project and then on co-operation between the Welsh Economy Research Unit and the Fraser of Allander Institute to produce a Computable General Equilibrium (CGE) model for the Welsh economy. This project is being supported by the Welsh Development Agency.

1. The Welsh Input-Output Project

Regional Input-Output tables provide a financial picture of an economy, showing intra-regional, national and international trade flows between different industries, consumers and government sectors during a particular year. This accounting framework enables inter-industry transactions (sales and purchases) to be mapped and quantified, enabling detailed descriptions of economy interactions, whilst manipulation of these tables allows the effects of changes in that economy to be estimated, via calculation of economic multipliers.

During the 1990s three sets of Input-Output tables were developed for Wales, relating to the years 1994, 1995 and 1996. With the continuing support of the Welsh Development Agency a new set of Input-Output tables is being developed for the year 2000. The new tables will contain 72 industry groups comprising 37 manufacturing sectors, 28 service sectors, plus energy, agricultural and construction sectors. These tables are being constructed using industry survey data generated from purpose designed Input-Output questionnaires as well as information obtained from various WERU projects, together with other published and unpublished data.

Input-Output tables enable the sectors of an economy to be described in terms of size (employment, output and GDP contribution), import or export intensity, local purchases and labour intensity. The other main use of the tables is to predict the economic consequences of changes by tracing impacts though supply chains. For example, if a manufacturing industry expands, perhaps because of a new export order, then that industry will require extra inputs (including labour) to satisfy the extra demand. Suppliers to the industry in turn will then also require extra inputs etc. The tables allow the effects of these changes to be estimated by calculating the flow-on, or multiplier, impacts. Multipliers can be calculated for output, income, employment (including by occupation) and GDP. In a similar way the tables can be manipulated to explore the possible outcomes of policy changes, and to assess the relative significance (including indirect incomes, jobs, etc supported) of different sectors.

The new set of Input-Output tables for Wales will also include a series of satellite modules including:

- A tourism satellite account. Tourism, being a category of 'final demand' rather than a single defined industry, is poorly described in most economic accounting systems. For example tourism expenditures are often not fully differentiated from other exports or from household demand; meanwhile, accounts do not differentiate between, for example, demand for hotel services due to tourism, and that due to other users. By fully disaggregating and reporting such figures, the new Welsh Input-Output framework provides a basis from which it is possible to construct an outline set of tourism satellite accounts, which can then be used to account for, and to understand the scale and effects of different tourism activities.
- An environmental module. The development of this module will provide insights into the direct resource use and pollution created by Welsh industries. However connecting this environmental information with the Input-Output tables, will enable the indirect environmental impacts (i.e. those generated within the supply chains) of industry activity to be estimated.

The new Input-Output tables for Wales, and associated modules, will become available during the summer of 2003.

2. Strengths and Weaknesses of Input-Output Tables

An Input-Output approach to economic modelling has many advantages. Input-Output tables are relatively transparent, and the structural relationships underpinning the tables can be readily identified. Moreover, the direct, indirect and induced income effects of changes in final demand can be easily identified. However, when using Input-Output tables to analyse the effects of changes in final demand there are a number of limitations.

A key problem is that the general Input-Output approach assumes a 'passive' supply side. If, for example, there was an increase in final demand for electronics products, the assumption is that the electronics sector could find the required amount of labour and any extra inputs within the economy to produce the extra output at the prevailing prices. It also assumes that there are no changes in relative price and in response to any distrubance or change in economic conditions. Hence the approach assumes there are no supply shortages. Such assumptions might be reasonable when there are high levels of excess capacity, and where there is high unemployment. However, there is a strong expectation the supply conditions in the regions are not passive, such that increases in the demand for goods and services are unlikely to be accommodated without any upward pressure on prices. For example, as the electronics sector seeks more labour, then the price of that labour (wage rate) may increase. Moreover, increased demand for labour may affect migration flows into the region. The Input-Output approach also assumes a directly proportional relationship between inputs and outputs. This may be appropriate for small changes in final demand. However, in reality the relationship between the volume of outputs and required inputs is unlikely to be linear. So, a doubling of outputs as a result of a change in final demand in electronics may not require a precise doubling of the value of inputs because of real and pecuniary economies of scale.

The absence of a supply-side limits the use of Input-Output models as a framework for analysis of policy issues. Most regional policy instruments typically focus on the supply-side of the economy. Input-Output systems are less able to analyse these policies in a coherent manner.

3. The Computable General Equilibrium (CGE) Approach

The Input-Output framework can however, be extended to develop the

supply side of the economy, with a more flexible treatment of both production and consumption behaviour and simultaneous modelling of both prices and quantities. First, the input-output database is augmented with additional information on income transfers in a more comprehensive social accounting matrix (SAM). This is combined with additional data on the structure of the labour market and investment demands, to provide the core database for the CGE modelling framework.

The next stage is to specify behavioural relationships that are more theory-consistent and relevant to the target economy than the universal fixed coefficients of an Input-Output model. That is to say, in a CGE framework it is possible to relax the restrictive assumptions noted above that are inherent in the Input-Output approach. (Note that Input-Output results will in fact be produced in the CGE framework if zero substitutability among inputs and an absence of supply constraints is imposed in the model set-up). For example, wages in a CGE framework are determined by the specific labour market conditions in the local economy. An increase in the demand for labour could result in wages increasing, and as these wages increase, this can be linked through to changes in household consumption. In addition, the assumption of a linear relationship between inputs and outputs can be relaxed, meaning that the various factors of production can be employed in various proportions. For example, following an increase in final demand, firms may substitute capital for labour if they are faced with labour shortages.

The CGE approach is therefore flexible, whilst offering many of the benefits of the Input-Output framework. For example, it retains the multisectoral, data-driven focus which has been identified as a key advantage of the Input-Output accounts. However, the CGE framework can then provide a comprehensive means of:

- capturing the regional competitiveness effects of demand disturbances,
- analysing the impact of supply-side policies,
- accommodating relevant econometric analysis where it is available (e.g. estimates of substitution possibilities between inputs to production),
- conducting a more complete evaluation of the effects of policy instruments.

There has been extensive use of CGE techniques in North America, Northern Europe, Australia and many other countries, particularly for trade, development and energy/environment analyses.

4. CGE Developments in Wales

The *Fraser of Allander Institute for Research on the Scottish Economy* (FAI) has been developing a regional CGE framework for over 15 years. FAI research in *regional macro-modelling* has centred on AMOS (A Macro-Micro Model of Scotland). As the name suggests, this framework has mainly been calibrated on Scottish data. However, it has been developed as a very general modelling *framework,* encompassing a range of possible behavioural specifications, with the implication that it can be applied to any small open regional economy for which appropriate data are available. For example, the FAI has recently completed construction of a model of the Jersey economy using the AMOS framework. Nevertheless, the widest application of the AMOS framework has been for the case of Scotland. For example, it has been used to assess the economic impacts of the 'Tartan tax', the regional effects of increases in foreign direct investment, and the effects of Scottish Enterprise policies and initiatives.

The Fraser of Allander Institute is now collaborating with the Welsh Economy Research Unit to develop a CGE for Wales. The newly developed Input-Output tables for Wales will be a core component of the CGE. The project will include the development of a Social Accounting Matrix for Wales. This is an extended Input-Output table that traces the sources and receipts of funds by all transactor groups in the Welsh economy (i.e. households, firms and government). The CGE model of Wales will incorporate 25 sectors (then requiring some aggregation in the new Input-Output framework), and although based on the Scottish framework, the model will be calibrated to Welsh data and parameter values.

Research to develop the CGE model of the Welsh economy will be completed during the summer of 2003. There will be updates on this project in future editions of the *Welsh Economic Review.*