



GREENING THE NATIONAL ACCOUNTS FOR SCOTLAND

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Summary

This briefing note summarises recent work funded by **scotecon** on using insights from economics to measure “sustainability” for Scotland. The main questions we address are:

- How can conventional measures of national income and well being be adapted to take account of our impacts on the environment, and our use of scarce natural resources?
- What does this tell us, if anything, about whether development in Scotland is sustainable?
- How could these green accounts be improved?

Our main finding is that according to green accounting measures, Scotland’s development over much of the past 20 years has not, on the whole, matched up to the standards of sustainability. However, the national picture seems to have improved in the recent past.

How can we incorporate the impacts of the economy on the environment in our conventional measures of national income?

Since the end of the Second World War, countries all over the world have collected data on Gross National Product, or GNP, in order to measure their economic performance. GNP measures the output or income of an economy, and rising GNP per person is usually thought to be consistent with people getting better off. However, many criticisms of GNP as a measure of well-being have been levelled over the years, for instance in terms of *who* gets better off, or in terms of the value of leisure time. Our focus is on the failure of GNP to account for our impacts on the environment. This is important for two reasons:

- i) people's well-being depends partly on environmental quality, but conventionally-measured GNP does not pick this up, nor the impacts of pollution on environmental quality
- ii) economic activity can deplete a nation's natural resources, but this depreciation of a nation's "natural" capital is not reflected in GNP, or its net-of-produced-capital equivalent, Net National Product.

Green accounting is an approach being developed by economists to address these two problems.

Green accounts may be set up by existing accounting procedures (eg to take account of the impacts of pollution), or through the generation of satellite accounts which sit alongside, but separately from, the main national accounts. Such satellite accounts may consist of:

- natural resource (asset) accounts, which measure changes in the quantity/quality of environmental resources, such as oil, forests, wetlands.
- materials/energy/pollution flow accounts, which track resource flows within the economy over a given time period, and which may attribute them to sources;

- monetary flows of environmentally-related expenditures and taxes
- environmental damage accounts, which trace pollution impacts within a given time period. These impacts may be partially monetised in some cases.

For a detailed description of environmental satellite accounts prepared for the UK, see

http://www.statistics.gov.uk/themes/environment/Articles/environmental_accounts.

For the rest of this report, however, we focus on the second of the two approaches to green accounting: direct adjustments to GNP.

National accounts are not routinely prepared for Scotland at present: there is no official Scottish "Blue Book" which is directly equivalent to the Blue Book for the UK. However, a fuller national accounting is a position which is likely to develop following devolution; there is also a set of un-official national accounts for Scotland, the "Caledonian Blue Book" (Gibson et al, 1997).

Two main measures/indicators have been developed in the economics literature: Green Net National Product (GNNP) and Genuine Savings (GS).

What can green accounts tell us about sustainability?

Some principles of green accounting

According to economists, there are two main objectives for developing green accounts:

- 1) to develop a better measure of national well-being ("welfare") than conventional national accounts provide; and
- 2) to develop an indicator of sustainability

Both Green Net National Product and Genuine Savings can be used to track a country's performance over time, and to compare performance across countries, with respect to either or both of these objectives. Both offer a way of bringing the environ-

ment into economic analysis, in terms of the impacts of the economy on the environment, and in terms of the impacts of the environment (eg pollution damages) on the economy.

There is currently much academic debate on the exact way in which environmental adjustments to the national accounts should be made; and on the information content of these adjusted measures (for example, whether it is possible to develop a satisfactory indicator of sustainability). However, we avoid this debate here, and present what many would consider an acceptable way of proceeding, and of interpreting the results. For a recent survey of the arguments see Hanley (2000).

Green Net National Product

A large literature has recently emerged on whether GNP can be transformed to produce both an indicator of sustainability, and a better measure of national welfare. The argument produced has been that green GNP would tell us the maximum level of consumption which was sustainable in any year, being one that leaves enough to be invested in order to preserve the national capital stock, where "capital" is given a very broad definition, to include both produced capital, but also natural and human capital. Since the standard definition of GNP can be thought of as the return on the nation's stock of produced capital, then green GNP could be thought of as the return on all forms of capital. If green GNP is rising, then this is one economic indicator of sustainability.

How is Green Net National Product calculated? Firstly, for non-renewable resources, deduct from conventional NNP an amount equal to the value of annual production multiplied by the difference between price and marginal costs. This difference is referred to as the "Hotelling rent", if calculated correctly. Secondly, for renewable resources, annual production is first deducted from annual growth. This amount (the net change in the stock) is then valued using the same (price minus marginal cost) term. Lastly, for pollution, deduct an amount equal to the change in the stock of each pollutant valued using an estimate of its marginal damage cost. Some authors also recommend adding in the value

of non-market environmental amenity flows, since these are a source of well being to citizens.

Genuine savings

An alternative way of proceeding is the *genuine savings* concept, put forward originally by Pearce and Atkinson (1993) and Hamilton (1996). Genuine savings (GS) compares saving in an economy with depreciation of both natural and man-made capital. It is calculated by evaluating all net changes in capital stocks in the economy over a one-year period. These capital stocks include produced capital (machinery, roads, stocks of unfinished goods...), human capital (added to by education and training), and natural capital.

If GS is negative, then this is a clear indication of unsustainable behaviour, since the economy is consuming too much of its resources, and re-investing too little. Increased investment is needed; this would include investments in pollution treatment, building up fisheries and forest stocks, and searching for new, economically-viable non-renewable resource deposits. It could equally comprise of increased investments in hospitals, schools and railways.

Genuine savings and green NNP are closely linked to each other since they are both derived from the same underlying theory. It is possible to show formally that they are equivalent tests of sustainability in theory: if GS is positive over time, then green NNP cannot be falling. Empirically, however, the two measures may well give different signals, due to measurement problems. GS measures have been calculated for the UK (Hamilton and Atkinson, 1996), and are calculated for many countries world-wide by the World Bank (see www-esd.worldbank.org/eei/).

How good are green NNP and GS as sustainability measures? Two criticisms may be noted. First, both are a measure of "weak sustainability" only. If sufficient substitution possibilities do not exist between the different types of capital (for instance, between produced and natural capital), then a positive GS/rising green NNP will not guarantee non-declining welfare over time. Second, there is a

worry about which values to use to measure environmental depreciation in calculating both indices.

The academic consensus at the moment is that both green NNP and GS are one-sided indicators of weak sustainability in that negative GS or falling green NNP signal non-sustainability. However, the measurement of a positive genuine savings rate/ rising green NNP at a given point in time is not sufficient to lead to the conclusion that the economy is on a sustainable path and further evidence must be sought before any firm judgement can be made.

Results for Scotland

Green Net National Product

As Scotland produces no official national accounts, a first step was to estimate conventional NNP figures for Scotland, based partly on the Caledonian Blue Book. These figures have then been adjusted to allow for the depreciation of Scotland's major resource stocks namely:

- forestry and commercial fisheries
- aggregates (sand, gravel) and coal
- oil and gas (for the purposes of this exercise, we counted all oil, and gas reserves north of the Tweed, as Scottish)
- emissions of common air pollutants and
- environmental service flows provided by Environmentally Sensitive Areas.

The species used in the fisheries estimates are cod, haddock, whiting, mackerel and herring. For aggregates we have considered coal, crushed rock and sand & gravel. In the case of renewable resources account has been taken of annual replenishment of stocks to derive a net depreciation figures. The final Green NNP estimates have been derived both including and excluding the effect of oil and gas discoveries, since academic opinion is mixed on how to treat these discoveries. In all cases the costs and prices have been calculated in constant 1995 values. Data has been found for all years from 1980 to 1998 inclusive.

Figure 1 shows our results.

What can we tell from Figure 1? First, that over most of the period, green NNP was rising, implying an increase in welfare (average well-being) in Scotland and a sustainable pattern of economic activity. Whether new discoveries of oil and gas are included has a big effect. We also note, however, that green NNP was falling through the early part of the period under examination. By the end of the period, however, whether new discoveries are included or not, green NNP is rising, implying that Scotland has become more sustainable. What has driven fluctuations in green NNP? Extraction of oil and gas (running down of reserves) seems particularly important, as Figure 2 shows:

Genuine savings

Net domestic fixed capital formation data is available in the Caledonian Blue Book 1997 for the years up to 1995. Depreciation of natural capital was estimated in the same way as in the preceding section (ie as shown in Figure 2). We end up with the results shown in Figure 3.

What can we observe from Figure 3? Mainly that for the early part of this period, Scotland was not behaving sustainably, in that an insufficient fraction of output was being re-invested in the country's capital stock. Even including new discoveries of North Sea reserves, GS was negative for most of the 1980s. Both measures improve through the early 1990s, but GS starts to fall again towards the middle of this period. By the last year in the time series, the measure is hovering around zero, implying "marginal sustainability".

The pattern of environmental depreciation observed in Figure 2 goes a long way to explain these changes over time. In 1980 the depreciation of natural stock is actually more than three times larger than the net fixed capital formation. This ratio increases over the next three years due to a decreasing capital formation and increasing non-renewable depreciation. However, as with GNNP it is the price of oil that is the most significant driver in the fluctuations. Savings in Scotland over the period follows a similar trend to Genuine Savings, as Figure 4 shows.

How could we improve our green accounting concepts and measures?

One feature of green adjustments to Scotland's national accounts is that movements in world oil prices exert a large influence on environmental depreciation measures, and thus on both green NNP and genuine savings. These changes are outwith the control of Scotland (as indeed are most decisions over extraction rates, due to the ownership of fields). Removing unexpected fluctuations in world prices from sustainability measures would be desirable, since then they would relate more to decisions taken at the national level.

We also need to develop much better data estimates for environmental depreciation. For instance:

- We currently use estimates of average costs of productions for natural capital items such as oil, gas and forests: marginal costs are more correct, but we have few estimates of these
- We should have much more complete coverage of pollutants. Scottish emissions data, rather than a pro-rata of UK emissions, would also improve accuracy.

- We currently only include very incomplete estimates of non-market environmental amenity flows for the economy
- No estimates of changes in the value of human capital are currently included

Green NNP and Genuine Savings measures could also be improved in other ways. These include:

- Finding ways of allowing for the impacts of predicted future technological progress. This is important since technological progress allows us (often) to produce more from less, thus shifting the economy's production possibility frontier
- Finding ways of measuring changes in human capital, in other words in the capabilities and skills of people living in Scotland. How can we express changes in these skills year-on-year in monetary terms?
- Broadening our measures to include indicators of changes in income inequality

Work at the universities of Glasgow and Strathclyde is continuing on all of these issues, funded by a new grant from the Economic and Social Research Council.

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Figure 1

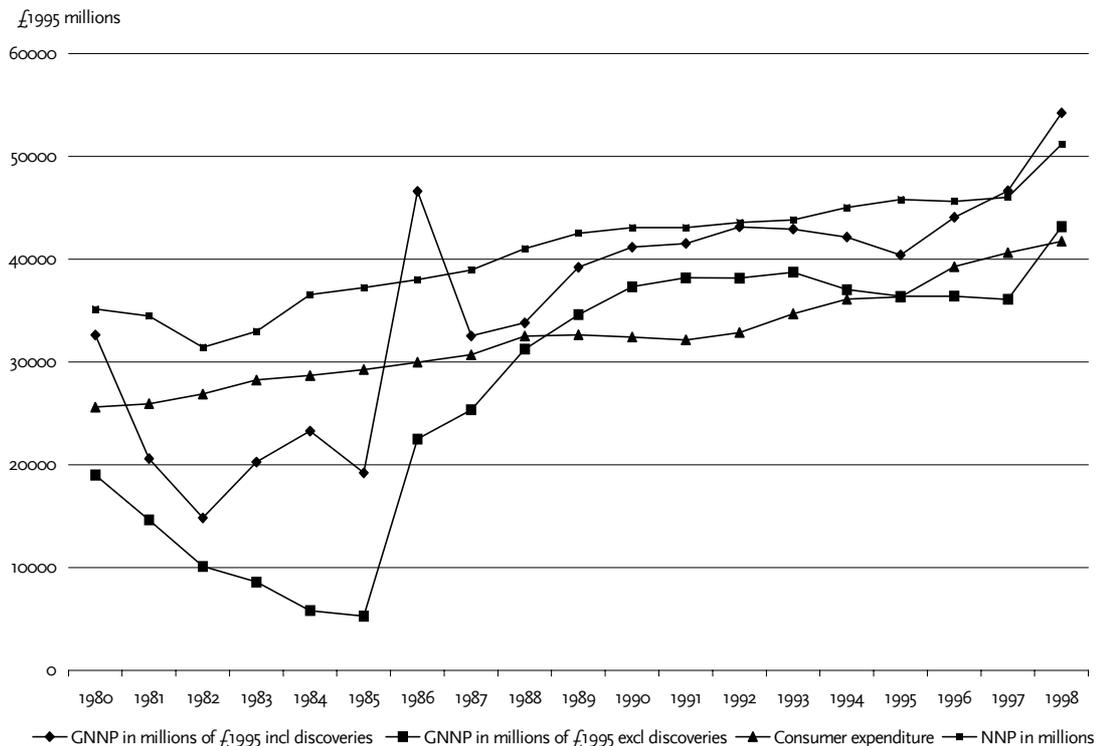


Figure 2 Environmental depreciation

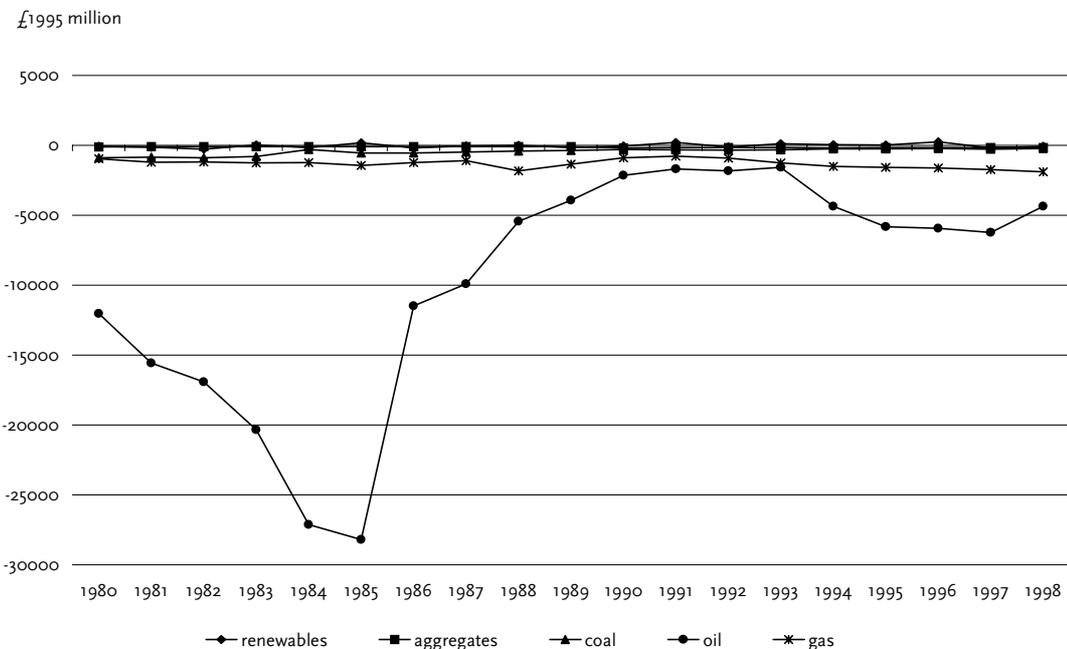


Figure 3

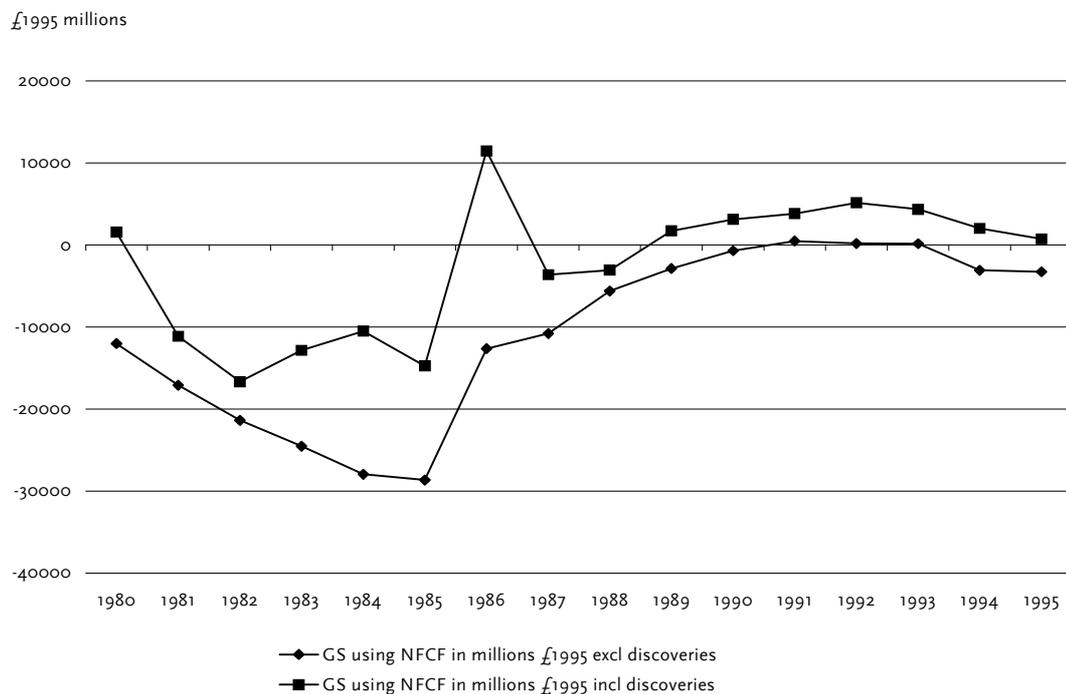
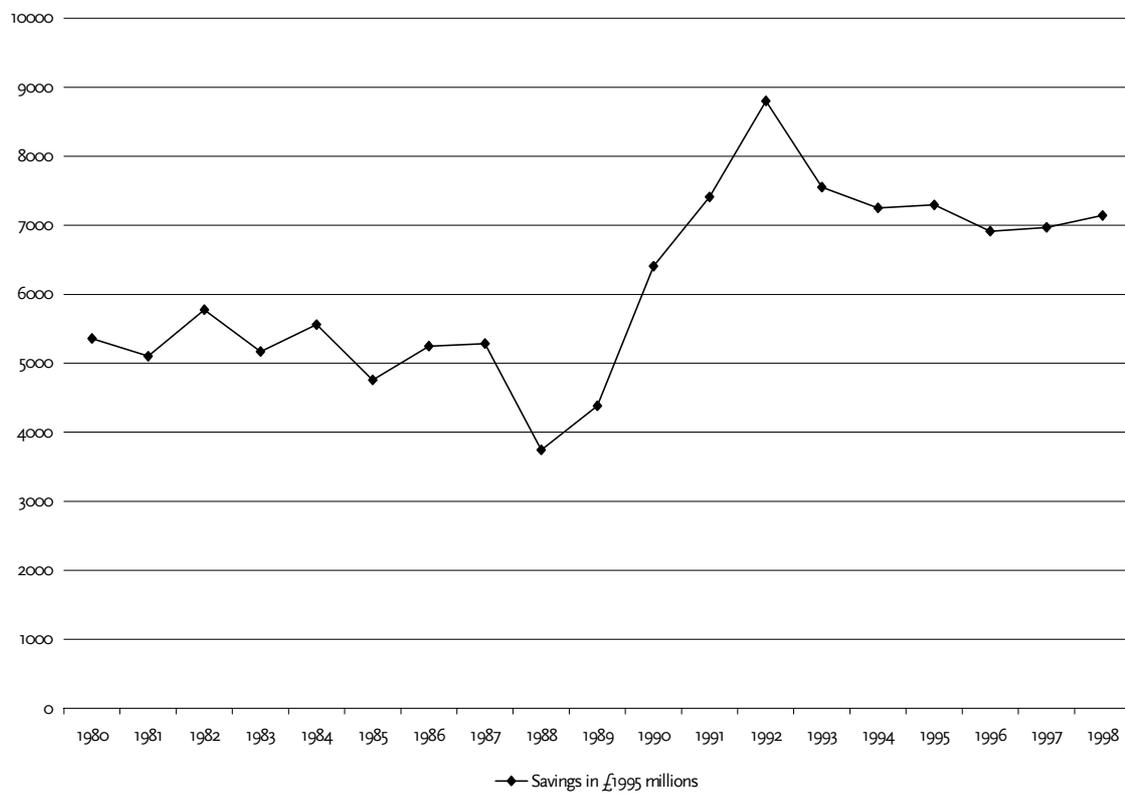


Figure 4 Savings in £1995 millions



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scotecon is the Scottish Economic Policy Network. It is a network of economists based in Scotland's universities, which aims to stimulate academic research on the Scottish economy, particularly in those areas of interest and concern to the Scottish Parliament.

The network concentrates on increasing the quality and quantity of evidence-based research to inform policy and debate in areas such as education, enterprise, the environment, exclusion, health, rural affairs, training and transport.

scotecon is physically located at the Universities of Stirling and Strathclyde, however, it has a strong virtual presence through the web-site **scotecon.net**, which is being developed as a major focus for intelligence on the Scottish economy.

The Scottish Higher Education Funding Council (SHEFC) funds the network under its Research Development Grant Scheme.

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