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NORTH SEA OIL AND GENUINE SAVING IN THE SCOTTISH ECONOMY

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Abstract:

The World Bank has published estimates of sustainability of consumption paths by adjusting saving rates to take account of the depletion of non-renewable resources. During the period of North Sea oil production Scotland has been in a fiscal union with the rest of the UK. The present paper adjusts the World Bank data to produce separate genuine saving estimates for Scotland and the rest of the UK for 1970-2009, based on a 'derivation' principle for oil revenues. The calculations indicate that Scotland has had a negative genuine saving rate for most of the period of exploitation of North Sea oil resources, with genuine saving being positive in the rest of the UK during this period.

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The paradox that the discovery and exploitation of natural resources has, for some countries, been more of a curse than a blessing has spawned a voluminous literature (Torvik 2009, for example – see van der Ploeg, 2011, for a survey). North Sea oil production on the UK continental shelf (UKCS) began in 1967. Some papers analysed 'Dutch disease' effects on the UK manufacturing sector arising from an appreciation in the UK's real exchange rate (Forsyth and Kay, 1980, Corden, 1981). Another strand of the literature has assessed the effects of the UK petroleum tax structure on North Sea exploration, extraction rates and tax revenues (Kemp, 1975, Kemp and Stephen, 2005, 2011).

It is somewhat puzzling that there have been relatively few attempts to assess the impact of North Sea oil on the Scottish economy as a whole. The issues of the hypothetical share of North Sea oil that could be attributed to exploitation of the 'Scottish' portion of the UKCS has been addressed (Kemp and Stephen, 1999, 2008) and a 'geographical' share of North Sea tax revenues is incorporated in a version of the national accounts for Scotland (GERS 2011, Ch.5). As far as we are aware, the only attempt to assess whether Scotland has been on a sustainable development path since North Sea oil came on stream is to be found in the pioneering series of papers by Moffatt and Wilson (1994), Moffatt, Hanley and Gill (1994) and Hanley, Moffatt, Faichney and Wilson (1999). The World Bank (2006) has published estimates of genuine saving for a large set of countries, including the UK. The task of the present paper is to modify the World Bank estimates to produce separate measures of genuine saving for Scotland and the rest of the UK.

The notion of genuine saving (Pearce and Atkinson, 1993, Hamilton, 1994) involves adjusting the traditional notion of saving, net of depreciation in physical capital stocks, to take account of changes in natural resources, human capital and environmental quality. It can be seen as an empirical application of the Hartwick rule (Hartwick 1977, Solow 1986), whereby the rents from natural resource extraction are invested in man-made capital to preserve the total capital stock. To make genuine saving estimates for Scotland, World Bank (2006) data are adjusted by allocating hypothetical 'derivation' shares of North Sea oil revenues to Scotland and the rest of the UK. These hypothetical shares are taken from Kemp and Stephen (1999, 2008). Our estimates indicate that, over the 1970-2009 period, genuine saving has become negative in the Scottish economy, indicating that 'Scottish' real wealth has been falling, implying an unsustainable path for consumption.

The rest of this paper is structured as follows. Section 1 reviews the Hotelling rule and the concept of genuine saving. Section 2 discusses some of the issues involved in constructing separate data for Scotland and the rest of the UK, based on a 'derivation' principle for North Sea oil resources. Section 3 provides genuine saving estimates for Scotland and the rest of the UK, placing them in the

context of similar calculations for Norway and other oil-producing countries. Section 4 offers some concluding remarks.

1. THE HOTELLING RULE AND GENUINE SAVING

The Hotelling rule (1931) implies that the optimal depletion rate for an exhaustible resource such as North Sea oil would involve the rate of change of the marginal oil rents being set equal to some risk-adjusted world interest rate (Dasgupta and Heal, 1979). This arbitrage principle would involve setting the capital gain arising from leaving the oil underneath the North Sea equal to the gain from extracting, selling and investing the proceeds. In a small open economy such as Scotland this rule would have suggested the establishment of Scottish oil fund and an oil depletion strategy geared to the return the fund could earn on its assets in international markets. North Sea oil revenues, however, were not devolved to Scotland, and at the UK level deliberations involving Hotelling rule considerations have been notable for their absence since North Sea oil came on stream (see Kemp, 2011).

The contrast with the Norwegian management of North Sea oil revenues has attracted discussion in Scotland, with the Scottish National Party (SNP) government proposing that an independent or fiscally autonomous Scotland would create a Norwegian-style oil fund (Scottish Government, 2009). The Norwegian government passed legislation to establish a Petroleum Fund in 1990, the fund receiving its first capital transfers from the Ministry of Finance in 1996. This oil fund was renamed the Government Pension Fund-Global (GPF) in 2006 with the stated aim of supporting government saving and promoting the intergenerational transfer of resources (Norges Bank Investment Management, 2011). The fiscal guidelines introduced in 2001 limit the non-oil structural deficit of the central government to 4% of the value of the GPF assets, which are invested mainly in foreign equities and fixed-income securities to try and avoid adverse real exchange rate ('Dutch disease') effects on the Norwegian economy (Veiculescu, 2008). Given that 4% is the estimated long-run real rate of return on GPF assets, this is a capital-preserving endowment fund principle. As Solow put it: "The Norwegians said, here is an asset we are going to use up – the one thing we must avoid is a binge. They tried hard to convert a large fraction of the revenues, of the rentals, of the royalties from North Sea oil into investment....I confess I don't know how well they succeeded but I am willing to bet that they did a better job of it than the United Kingdom" (Solow 1991, p.184).

Implementing a Hotelling rule would require data on marginal oil rents that are not usually available. Data are available on average extraction costs, so in practice unit resource rents are measured as the difference between the world price and the average extraction cost, divided by the

world price (World Bank 2006, Table A.2). As Hamilton and Clemens (1999, p.339) point out, this tends to overstate the calculated resource rents, and bias downwards estimates of genuine saving. The notion of genuine saving is designed as a pragmatic means of making comparisons of sustainability in consumption paths given the data limitations, such as the lack of information on marginal extraction costs and difficulties in estimating investment in the human capital component of man-made assets. "Negative genuine saving rates imply that total wealth is in decline; policies leading to persistently negative genuine saving are unsustainable. In addition to serving as an indicator of sustainability, genuine saving has the advantage of presenting resource and environmental issues within a framework that finance and development planning ministries can understand" (World Bank 2006, p.36).

The calculation of genuine saving is illustrated in Figure 1, using World Bank data for the UK in 2006. Gross national saving is calculated in the usual way as the difference between Gross National Income (GNI) and private and public sector consumption and transfer payments. Net saving involves subtracting estimates of depreciation in the private and public sector fixed capital stocks. As a crude approximation for investment in human capital, current expenditures on education are added to net saving. Natural resource depletion is then subtracted with rents being proxied by the difference between world prices and average costs of extraction, including depreciation of the fixed capital involved and a return on capital. The final adjustment is to subtract an estimate of the value of the damages arising from particulate air pollution and carbon dioxide emissions.

Figure 1. Genuine Saving in the UK (2006)

Source: *World Bank, http://web.worldbank.org/*
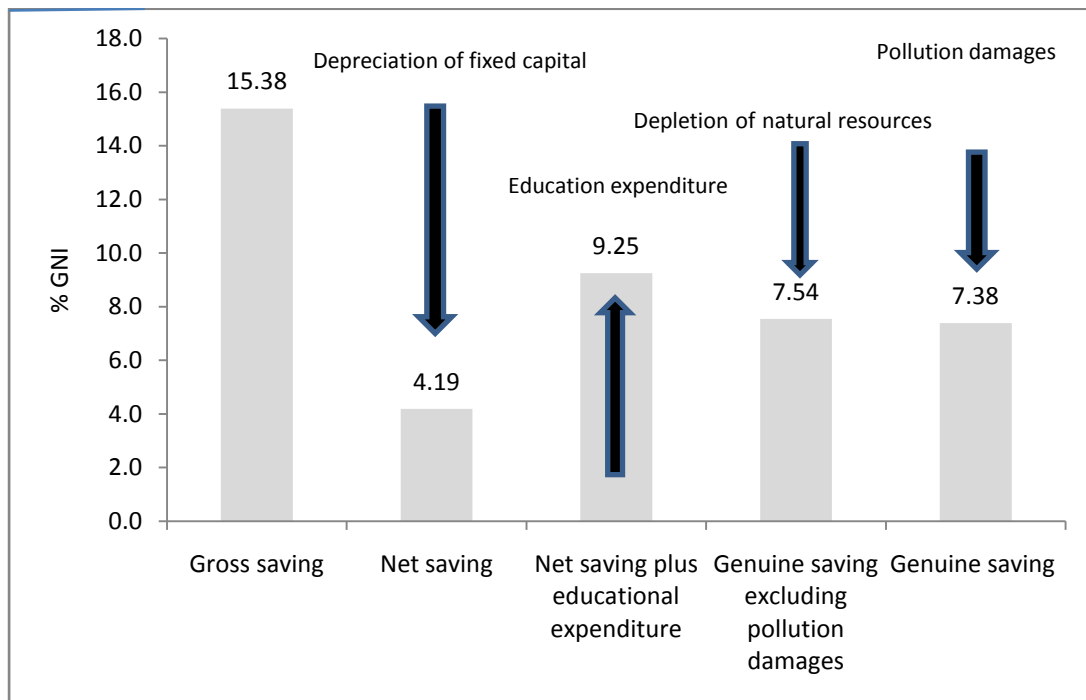
The evolution of genuine saving and its components in the UK over 1970-2006 is illustrated in Figure 2. Starting from 16% in 1970, the genuine saving rate fell to a trough of 3.6% in 1984 when North Sea oil and gas rents peaked at nearly 4.9% of GNI. The rise in the genuine saving rate in the mid-1990s mirrors the rise in gross saving following the exit of sterling from the ERM of the EMS in 1992.

Figure 2. Components of UK Genuine Saving (1970-2006)

Source: *World Bank, http://web.worldbank.org/*
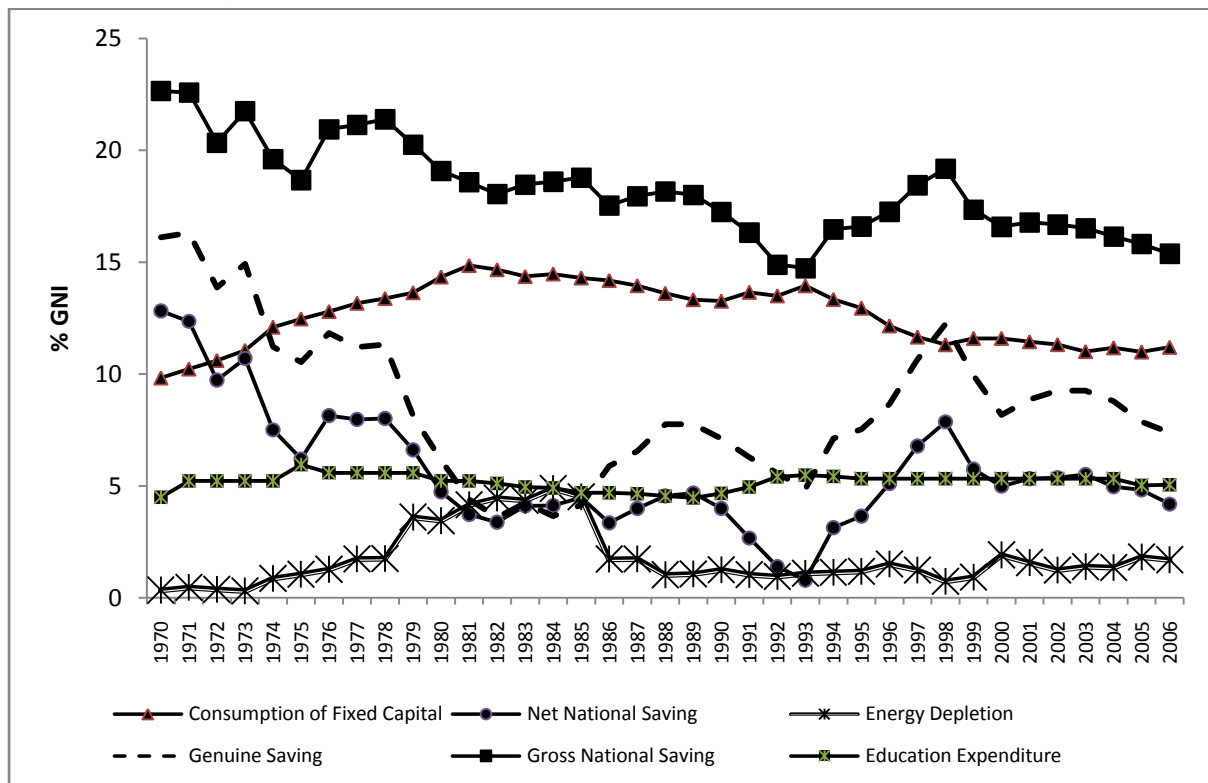
Positive genuine saving indicates that a nation's wealth is increasing, negative genuine saving that the nation's wealth is decreasing. Does this imply that negative genuine saving necessarily implies that a nation's development path is unsustainable? Exceptions to a non-negative genuine saving rule could arise if the real prices of the natural resources were expected to trend upwards in the future, or if continuous improvements in natural resource extraction technology were expected to occur (Asheim 1986, Vincent, Panayotou and Hartwick 1997). Zero negative saving, and a constant consumption path, however, is arguably not a very demanding hurdle.

2. SCOTLAND'S SHARE OF NORTH SEA OIL

Since the 1707 Act of Union Scotland has been part of a fiscal union within the United Kingdom created by the Union of the Crowns in 1603. Fiscal powers have been highly centralised, and remained so after the Scotland Act of 1998 devolved very limited tax-levying powers to the Scottish Parliament, mainly in the form of being able to vary the standard rate of income tax by 3% in the pound. The Scotland Bill currently under consideration by the Westminster and Holyrood Parliaments proposes devolving some further tax levying powers to Scotland, but does not propose devolution of tax powers over North Sea oil and gas resources, nor devolution of a share of the North Sea tax revenues. The Calman Expert Group concluded that the allocation of a 'Scottish' share

of UK Continental Shelf (UKCS) tax revenues to the Scottish Parliament "could be justified by the derivation principle if a proportion of the Scottish budget was to be comprised of Scottish tax revenues" (2009, p.21). The Calman Commission itself, whose recommendations formed the basis for the initial draft of the current Scotland Bill, did not recommend devolution of North Sea oil and gas tax powers or revenues to Scotland. The nearest thing to devolution of North Sea oil and gas tax powers is to be found in the oil fund established by the Shetland Islands Council in 1974, based on a throughput levy on oil passing through the Sullum Voe terminal. This fund is now worth around £180 million and has provided £200 million funding for Shetland Isles projects (Scottish Government 2009, p.27).

Mineral rights to oil resources are usually held by governments, exceptions being found in the US and Alberta in Canada. A common practice is that the landlord is allowed to share the fees, taxation or royalties arising from extraction of oil. In some instances lower tiers of government have the powers to raise revenues from oil exploitation, and, when such powers are held by the central governments, the lower tiers of government are usually assigned shares of such revenues (see the contributions in Davis, Ossowski and Fedelino eds., 2003). The UK government owns the mmineral rights to the UKCS. When the legislation covering the exploitation of the UKCS was framed in the 1960s it was recognised that the existence of Northern Ireland and the Isle of Man extended the size of the UKCS, but, curiously enough, no such recognition was extended to Scotland. Under the Miscellaneous Financial Provisions Act, 1968, the UK government agreed to share petroleum licence fees and royalties from the whole of the UKCS with the Northern Ireland and Isle of Man governments on a per capita basis, though payments to the latter ceased in 1995 (Calman Expert Group, 2009, p.10). Northern Ireland also has devolved power over the granting of onshore petroleum licences. "No such devolved powers have been given to the Scottish Government. One might observe that the UK government's adherence to the derivation principle has waned since the scale of oil/gas resources in the UKCS has become better known" (Calman Expert Group, 2009, pp.11-12).

Any calculation of the 'Scottish' share of North Sea oil resources or tax revenues is hypothetical, given that the 'derivation' principle has not been observed in UK fiscal practice. The oil resources are predominantly offshore, so a method of defining the 'Scottish' share of the UKCS has to be defined. This would be a matter for negotiation, but precedence suggests that a median line could well be used, in that all points on this line are the same distance from the Scottish and the rest of the UK (RUK) coastline. In the Scottish Adjacent Water Boundaries Order of 13th April 1999, such a median line was used to determine the boundary between Scotland and the RUK for fisheries

demarcation purposes (Kemp and Stephen, 2008, p.4). Figure 3 illustrates this boundary line for the UKCS, the 'Scottish' share being the dark shaded area.

**Figure 3. The Scottish Sector of the UKCS**

Source: Scottish Government Marine Directorate

The calculation of a 'Scottish' share of North Sea oil revenues is based on the boundary line illustrated in Figure 3. This is a painstaking task involving analysis of data for the approaching 400 sanctioned and possible oil fields and their block location on the UKCS. Over the 2009-2013 period the 'Scottish' share of UKCS oil production is forecast at around 96% (Kemp and Stephen, 2008). The main levies on North Sea oil production have been in the form of petroleum revenue tax, supplementary petroleum duty, corporation tax, the supplementary charge, royalties and licence fees. The bar chart in Figure 4 graphs the 'Scottish' proportion of UK revenues from North Sea oil

over the 1975-2009 period using the median line of equidistance discussed above to define 'derivation'.

Figure 4. The 'Scottish' Share of North Sea Oil Tax Revenues
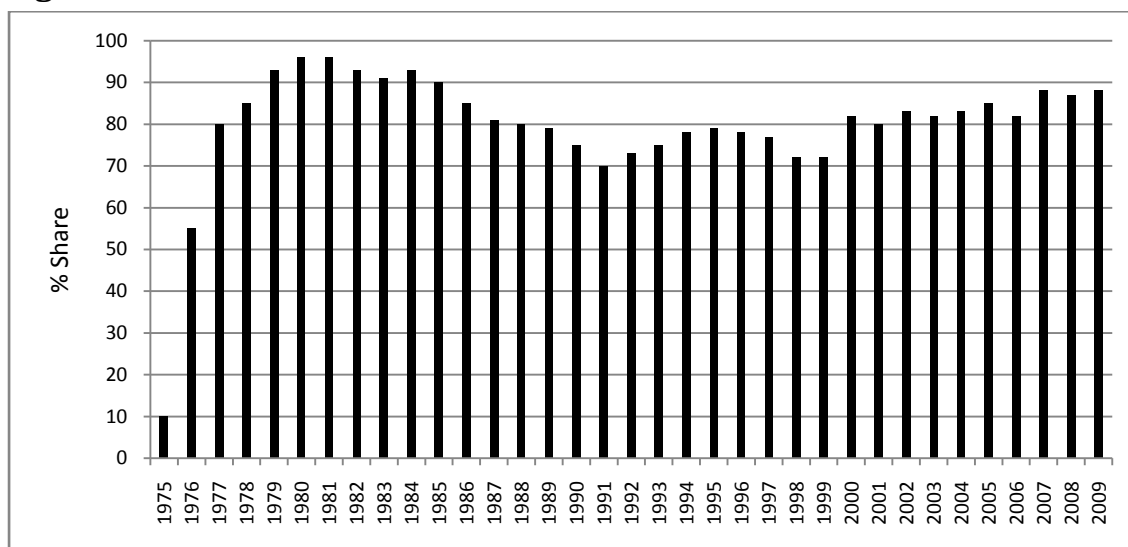
Source: Kemp & Stephen (1999, 2008)

3. GENUINE SAVING ESTIMATES FOR SCOTLAND

The aim of the estimates of Scottish genuine saving presented in this section is to permit comparisons with other oil-producing countries. The approach is to up-date the World Bank (2006, Chapter 3 and Appendix 3) estimates of genuine saving with subsequent World Bank data using the following amended definition of genuine saving:

$$GS \equiv NNS + CEE - OR \qquad (1)$$

Here NNS is net national saving, that is gross national saving by the private and public sectors adjusted for depreciation in the private and public sector fixed capital stocks; CEE is current education expenditures, an albeit crude approximation for investment in human capital; and OR is oil rents, calculated by the unit resource rents, measured as the difference between the world price of oil and the average extraction costs expressed as a percentage of the world price, multiplied by the volume of production. In the diagrams that follow GS (genuine saving) and its components are expressed as a percentage of net national income (NNI).

The purpose of this amendment to the World Bank measure of genuine saving is to focus on the effects that North Sea oil depletion has had on Scotland in a way that allows comparison with the effects on other oil-producing countries. This means, as far as natural resource depletion is

concerned, that we ignore the effects of depletion of gas, mineral and forestry resources. In this attempt to facilitate direct comparisons, the World Bank estimates of the value of the damages arising from carbon dioxide and particulate matter air pollution are also excluded from our estimates of genuine saving. In practice, the World Bank estimates of pollution damage are small in magnitude, amounting to 0.3%, or 30 basis points, of UK GNI in 2000, for example (World Bank 2006, Appendix 3). Excluding the non-oil resource depletion and pollutant damage items means that our estimates will be biased upwards in relation to 'true' genuine saving.

Hypothetical oil rents (OR) for Scotland are calculated by applying the Kemp and Stephen (1999, 2008) estimates of the 'derivation' shares of the oil revenues arising from production in the 'Scottish' sector of the UKCS, as described in Section 2 of this paper. Estimates of net national saving (NNS) and current educational expenditures (CEE) are taken, where possible, from successive volumes of Government Expenditure and Revenue Scotland (GERS). When GERS data is not available other estimates are deployed, sometimes by applying a population share to the UK data. Full details of the data sources, and the main data, are provided in the Data Appendix.

The only, as far as we are aware, previous estimates of genuine saving in Scotland cover the period 1980-1994. They were based on the assumption that 100% of UK oil rents arise from the Scottish share of the UKCS, and took account of non-oil resource depletion and pollution damage (Hanley et.al., 1999, Fig.3). These estimates show genuine saving in Scotland as being negative over the 1980-1994 period, falling sharply to a trough in 1985 before rising to a still negative value in 1994.

Our estimates of genuine saving in Scotland cover the 1970-2009 period and are graphed in Figure 5. The average genuine saving rate, genuine saving expressed as a percentage of GNI, was negative at 14% over this period, indicating that Scotland's net wealth was tending to decline. As in the Hanley et.al. (1999) estimates, there is a sharp decline in 'Scottish' genuine saving during the first half of the 1980s followed by a recovery in the second half of this decade. This fall and subsequent recovery of genuine saving is almost a mirror image of what happened to 'Scottish' oil rents, as indicated by the OR line. During the 1990s Scottish genuine saving recovered towards the zero mark, but has fallen back into the clearly negative zone in subsequent years. Our calculations over-estimate genuine saving by excluding non-oil resource depletion and pollution damage, so the implications for the sustainability of Scotland's consumption path may be even more of a matter for concern than our calculations suggest.

**Figure 5. Genuine Saving in Scotland, 1970-2009**
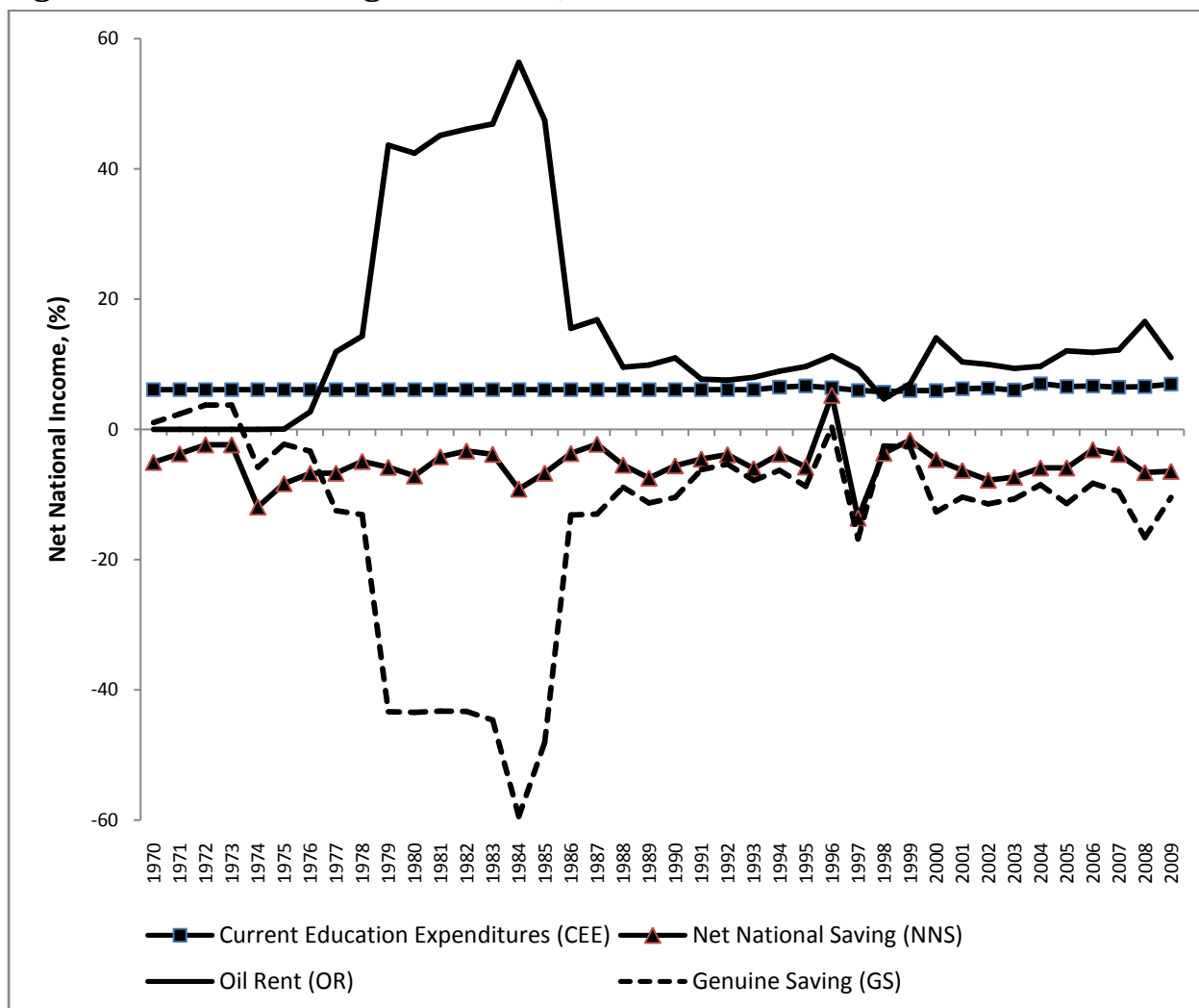
Source: Authors' calculations based on Caledonian Blue Book (1997), GERS (various years) & Scottish Government statistics available at
http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/SNAP/expstats/SNAP2011Q1

The estimates of genuine saving in the rest of the UK (RUK) are graphed in Figure 6. The stark contrast is that RUK genuine saving remains positive during the 1970-2009 period, averaging 9% of GNI. Genuine saving in RUK does fall in the 1970s and 1980s, but the fall is nowhere near as pronounced as that in Scotland. If the RUK and Scotland had been separate fiscal entities over this period, it would have been as though the Scottish fiscal authority had made substantial transfers to the RUK authority to ensure that RUK genuine saving did not become negative. This, of course, was not the political economy context. The centralised UK fiscal authority, HM Treasury, funnelled the rents from North Sea oil resources into general UK government revenues. This meant that UK government spending and transfer payments were higher; that UK tax rates were lower; that UK

government debt was lower (the UK 'full-funding' rule for government budget deficits was enacted in 1985); or that some mixture of the three cases applied – in relation to what would have been the case if there had been no UKCS oil revenues. So Scotland benefited from some mixture of higher government spending, lower tax rates and lower public sector debt that arose at the UK level. But this was a side effect of the UK-wide 'binge', to use Solow's term (1991,p.184). The Barnett formula used to allocate the block grant from the UK to Scotland may have partly reflected 'derivation' concerns in relation to North Sea oil, and UK governments may have allocated more resources to Scotland than a strict application of the Barnett formula would have suggested. Such issues are beyond the scope of the present paper.

## Figure 6. Genuine Saving in the Rest of the UK (RUK), 1970-2009
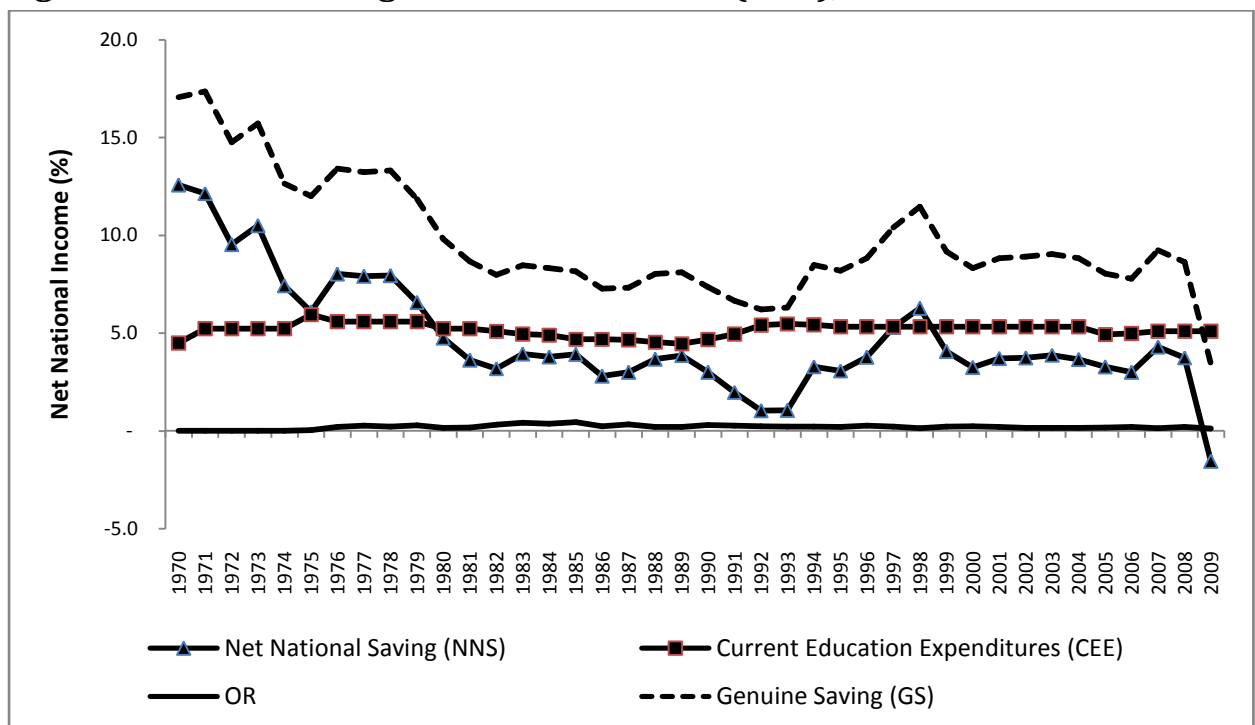
It is impossible to say how an independent or fiscally autonomous Scottish government would have responded to the inflow of North Sea oil revenues over the 1970-2009 period under consideration. It is, however, of interest to look at how genuine saving evolved in a neighbouring country, Norway, that also had substantial North Sea oil production over this period. Over the 1970-2009 period Norwegian oil rents averaged 7.6% of its GDP, compared to the average 'Scottish' rent proportion of 15%. Figure 7 illustrates how genuine saving and its components have evolved in Norway. The key contrast is that genuine saving has remained positive during this period, averaging 14% of GNI, compared to the Scottish average of -14%. This indicates that real wealth has been

increasing in Norway, its consumption path being more than sustainable. Exposed to the same fluctuations in the world price of oil as Scotland, the genuine savings path in Norway has been smoother. Norway has tended to channel the returns from accumulated oil revenues into general government revenues, rather than the oil revenues themselves.

Figure 7. Genuine Saving in Norway, 1970-2009
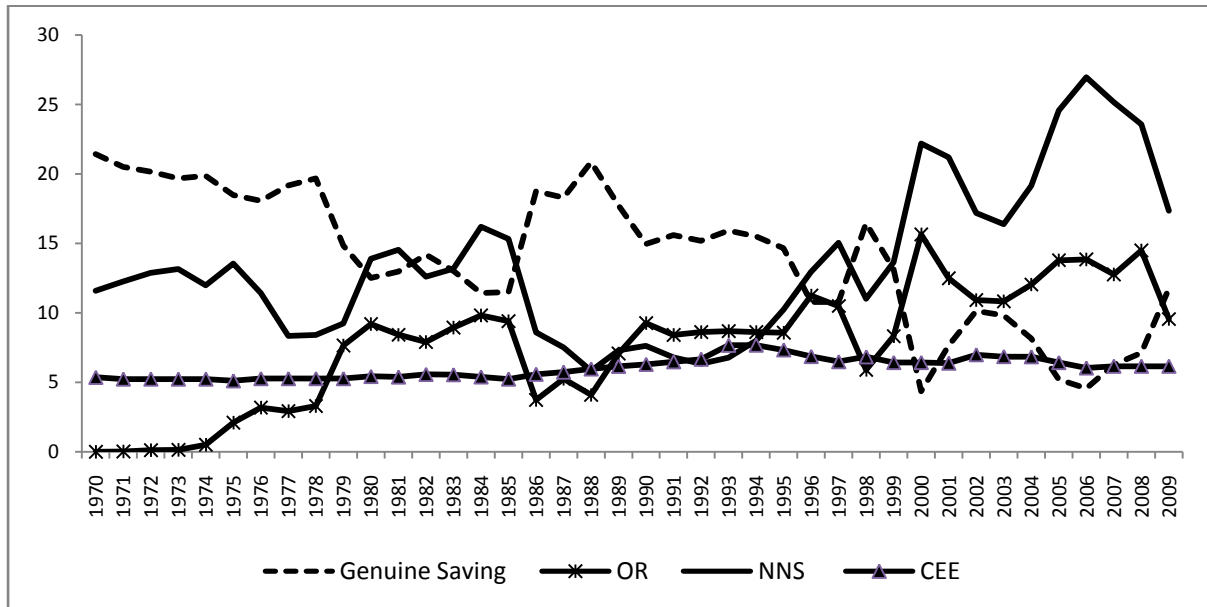
Source: *World Bank, http://web.worldbank.org/ & Authors' calculations*

To place Scotland's experience in a wider international context, genuine saving estimates were calculated for all the oil-producing countries, using the same definition applied to Scotland, RUK and Norway, over the 1970-2009 period. For reasons of space we do not reproduce the time series profiles of genuine saving in these countries here. Instead we plot the average genuine saving rates against the average share of oil rents in GNI in Figure 8. Around one fifth of the oil-producing countries had negative average genuine saving. Scotland is in this group. Angola and the Congo Republic are outliers, with negative genuine savings rates in excess of 30% of GNI. The next lowest average genuine saving rates, in the range from -20% to -10% are to be found in Scotland, Azerbaijan, Oman and Kazakhstan. The majority of oil-producing countries had positive average genuine saving rates.

Figure 8. Average Genuine Saving against Average Share of Oil Rents in GNI, 1970-2009
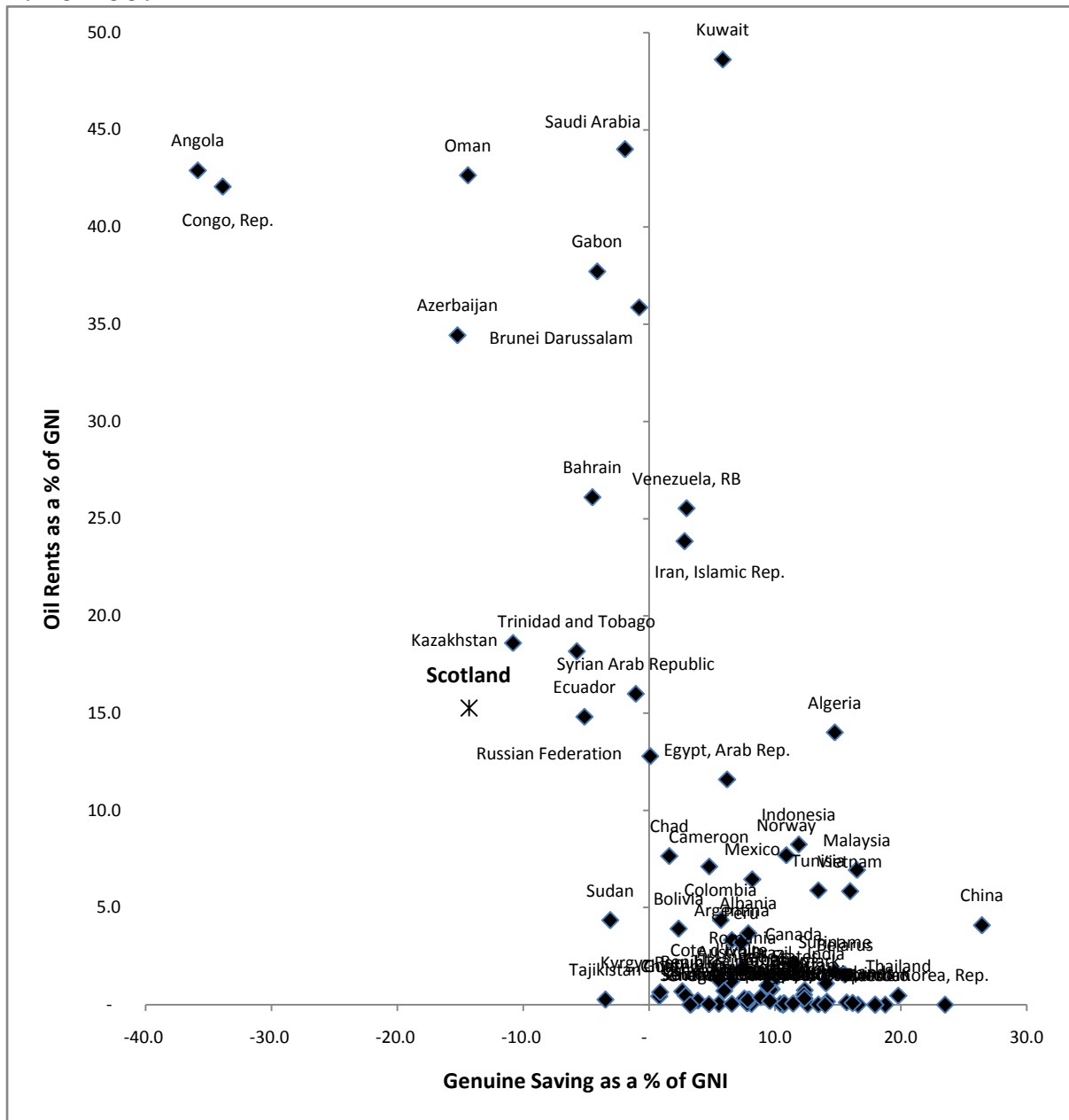
Source: *World Bank, http://web.worldbank.org/ & Authors' calculations*

4. CONCLUDING REMARKS

At the announcement of British Petroleum's plans to exploit substantial oil reserves in the Clair Ridge field, west of the Shetland Isles, which involved BP planning to maintain current oil production levels until 2030, and maybe 2050, the UK Prime Minister Mr. Cameron recalled being told in the early 1980s that "...by the turn of the century, certainly by 2010, the North Sea will be all over – all the oil will be gone" (Scotsman, 14th October 2011, p.4). The Prime Minister went on to say

that "... the whole of the UK has invested in the North Sea and the whole of the UK should benefit from the North Sea". The status quo is that all North Sea oil revenues are channelled into the UK exchequer as central government revenue; there is not a UK oil fund tasked with converting at least some of the rents from the exploitation of non-renewable North Sea oil resources into renewable assets that would yield sustainable returns; and the Scotland Bill under present consideration does not propose any devolution of North Sea oil tax levying powers or revenues to the Scottish Government. As the genuine saving estimates provided in Section 3 of this paper indicate, this arrangement has been consistent with the UK being able to sustain a more than constant consumption level since the advent of North Sea oil, as indicated by the positive genuine saving rate.

As pointed out in Section 2 of this paper, the present UK fiscal arrangements for North Sea oil fly in the face of the 'derivation' principle that tends to be applied to layers of government in other countries in relation to revenues arising from oil extraction. The SNP Government in Scotland has argued that this 'derivation' principle should be respected by devolving powers to tax North Sea oil, or a 'Scottish' share of tax revenues, to an independent or fiscally autonomous Scotland. In relation to the sustainability principles discussed in Section 1 of this paper, the Scottish Government would plan to establish a Scottish oil fund to "enable sustainable financial resource management, allowing returns from non-renewable oil and gas revenues to be converted into a pool of renewable assets. These assets can then be used to generate wealth long after a country's oil and gas reserves have been exhausted" (Scottish Government 2009, p.7). The hypothetical genuine saving estimates for Scotland presented in Section 3 of this paper tend to support the SNP Government's grounds for concern in this respect, 'Scottish' wealth having been in decline in the wake of the exploitation of North Sea oil resources.

The aim of this paper has been to contribute to this debate by producing time series estimates of genuine saving in a hypothetical Scotland, defined on the basis of a 'derivation' principle applied to North Sea oil. There are many problems with the measures of sustainability reviewed in Section 1 of this paper. Despite this, we would argue that our genuine saving estimates shed some new evidential light on the issues raised for Scotland and the UK by the exploitation of North Sea oil.

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Data Appendix.

Data for Figures 1,2,7 and 8 come from the World Bank, Washington DC, available at
http://web.worldbank.org/

Data for Figure 4 for the years 1975-2003 is contained in Kemp & Stephen (1999), Chart 6. Data for 2004-2009 comes from Table 5.4, GERS, June 2011. Data for 1970-1974 assume that the 1975 figure applies.

Data pertaining to the Scottish economy used in Figures 5 and 6 comes from two sources. For the period 1970-1995 the Caledonian Blue Book is used. For 1998-2009 an experimental data set constructed by the Scottish government is used and is available at
http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/SNAP/expstats/SNAP2011Q1

For the years 1996 and 1997, estimates were used.

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