

HOW USEFUL IS THE GENUINE SAVINGS RATE AS A MACROECONOMIC SUSTAINABILITY INDICATOR FOR COUNTRIES AND REGIONS?: AUSTRALIA AND QUEENSLAND COMPARED

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Abstract:

This paper demonstrates how macroeconomic indicators of sustainable development can be applied to the Queensland economy. We derive a Genuine Savings Rate (GSR) for Queensland for the period 1989 to 1999, which is then compared with the World Bank estimate of Australia's GSR for the same period. Specifically, we examine how well a single "headline" indicator based on the World Bank's GSR performs as a measure of overall sustainability. In doing so, we review criticisms of the GSR and compare its potential policy directives with those emerging from the use of net state savings and then the GSR as part of a suite of indicators.

Key Words: Genuine Savings Rate (GSR), sustainability indicator, green accounting, natural capital, human capital, natural resource depletion, Queensland

JEL Classification: E21

I. INTRODUCTION

Recently, the social and environmental implications of economic growth have been a major topic of international policy debate. This has occurred as a result of widespread community agreement around the goal of “sustainable development”, defined by the Brundtland Commission as: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987: 43).

In turn, there has been much discussion of the conceptualization and measurement of sustainability in advanced and developing economies. A number of different approaches to measurement have been developed and these can be classified into three groups. These groups of indicators vary in terms of theoretical consistency, data requirements and level of aggregation.

First, there are indicators such as Green Net National Product (GNNP) and the Genuine Savings Rate (GSR), which attempt to specify “optimal” adjustments to national income accounts. These adjustments are optimised according to a range of criteria including the costs of environmental degradation / pollution (GNNP) and changes in the natural resource base, environmental quality and human capital (the GSR). Second, there is an emerging technical literature on the incorporation of environmental factors into national and regional income accounts, as described in Bartelmus (1992). An interesting feature of this group of indicators is their interaction with concepts and techniques from environmental science. Finally, there are hybrid socio-political indicators of general social welfare or progress. The most well-known indicators in this group include Daly and Cobb’s (1989) Index of Sustainable Economic Welfare (ISEW) and Cobb et al’s (1995) Genuine Progress Indicator (GPI). While this group of indicators aims to measure social welfare, they are not explicitly derived from neo-classical welfare economics or growth theory.

This latter group of socio-political indicators has received the most attention in the Australian context. A GPI for Australia has been calculated in two studies (Hamilton and Saddler 1997, Hamilton and Dennis 2000). These studies found that the divergence between GPI and GDP increased between 1996 and 2000. Hence these studies strongly argue that GDP is best

viewed as a measure of market activity rather than as an indicator of social welfare¹. In contrast the ABS' *Measuring Australia's Progress* (MAP) project outlines a "suite of indicators" approach to the measurement of progress. The focal points for this suite of indicators approach are social wellbeing, economic structure / growth, and the quality of the environment. Practically, these focal points are examined in terms of a growth accounting framework that includes physical, human, natural and social capital. Arguably the MAP project can best be described as a disaggregated GPI, that is, one that does not offer a composite headline indicator as part of its analysis.

Further afield, there has been other work in Australia that can be classified as part of the second group of technically oriented indicators mentioned above. These include the ABS' expanding set of environmental indicators on topics such as salinity, environmental protection expenditures, natural resource accounts and even social attitudes concerning the environment. The CSIRO's *Future Dilemmas* report (Foran and Poldy 2002) provides detailed projections of the sustainability of different population growth scenarios up to the year 2050². Besides Australia's inclusion in the World Bank's (2003) cross-national calculations of GSR, there have been, to the best of our knowledge, no studies within Australia that fit into the first category of sustainability indicators based on "optimizing" adjustments to national income.

In this paper we partially fill this gap with an analysis of the Queensland economy's savings rate between 1989-2000. Specifically, we examine how well a single "headline" indicator based on the Genuine Savings Rate (GSR) performs as a measure of overall sustainability by comparing the potential policy recommendations that could be made for Queensland given the use of three different indicators: first, net state saving; second, the GSR; and third, the GSR alongside supplementary information, called the GSR "plus". In turn, we conclude that sustainability indicators based on hybrid GSR "plus" style indicators have the potential to give substantial insights into the pattern and direction of economic growth.

¹ Indeed, Hamilton and Dennis (2000:5) invoke the seminal work of Kuznets in making these criticisms. They note Kuznets' statement that "*The welfare of a nation can scarcely be inferred from a measurement of national income as defined (by GDP)...Goals for "more growth" should specify of what and for what*".

² This report generated major controversy on its release and was famously the subject of a "4-Corners" documentary where it was criticised by a number of economists for its unrealistic assumptions concerning technological change and factor reallocation.

The World Bank (2003) calculated the GSR for most countries including Australia for the period 1970-2000. However, there are strong reasons to believe that a separate analysis of the Queensland economy's macroeconomic sustainability can offer extra insights for the use of sustainability indicators in Australia. First, the Queensland economy is uniquely rich in natural capital that embodies the two main types of value as described by the "Total Economic Value" concept. Following Pearce and Turner (1990), these can be identified as: (a) "actual use plus option" value (where value is obtained from the direct consumption of natural resources through activities such as mining, logging and tourism, and the option for such); and, (b) "existence" value (where economic value is assigned via the indirect utilization of natural resources as providers of essential ecosystem services and various forms of amenity).³ This unique capital structure – illustrated, for example, by the existence of significant mining operations, National Heritage areas, wet tropics and the Great Barrier Reef – raises some important measurement issues and policy implications.

Second, there can be important variations in national and regional experiences of macroeconomic sustainability. For example, Hanley et al (1999) show that Scotland's heavily resource-based economy is unsustainable across a number of indicators. In contrast, studies of the UK as a whole indicate that sustainability conditions are being met. Clearly then, the way that the income flows generated by natural resource use are distributed within the national economy is important for the analysis of overall sustainability and the development of growth and resource policy at the state and federal levels. If growth in natural resource-intensive economies such as Queensland and Western Australia is unsustainable then this will have implications for Australia as a whole.

The paper proceeds in four sections: first, the structure of the GSR is outlined, together with a review of international trends. Second, the results of the GSR for Queensland are presented and evaluated. Third, the limitations of the GSR as an indicator of sustainability are discussed, and finally, a comparison of the potential policy recommendations arising from the use of three comparable indicators is made.

³ The concept of total economic value has been further refined over the years and a taxonomy of value will now include direct use, indirect use, option, existence and bequest values. See X for an example.

II. THE GSR: CONCEPT AND INTERNATIONAL ESTIMATES

The notion of Genuine Savings was first devised by Pearce and Atkinson (1993) as an empirical extension of the Hartwick (1977) rule. Briefly, Hartwick's (1977) model outlined sustainability conditions for economies dependent on the use of non-renewable resources. "Sustainability" in this framework is the maintenance of a constant stream of consumption into the infinite future. This is achieved via a savings and investment rule that ensures that the aggregate stock of physical and natural capital remains constant over time. In effect, the Hotelling rents from natural capital depletion are re-invested in physical capital so that consumption can be held constant. Therefore an important property of this model is that it assumes that natural and physical capital are substitutable with an elasticity equal to one.

Pearce and Atkinson's (1993) innovation was to specify an empirical application of the Hartwick rule based on the standard savings rate adjusted for the depreciation on physical and natural capital. Following Hanley (2000), this application can be stated most simply as⁴:

$$GS = (S/Y) - (\delta_m / Y) - (\delta_n / Y) \quad (1)$$

where GS = Genuine Savings ; S = Savings , Y = Income, δ_m = Depreciation of physical or manufactured capital, and δ_n = Depreciation of natural capital. The intuition behind (1) is best understood by expressing the variables on the right-hand side as aggregate amounts representing the depletion of the natural and physical capital stocks. Therefore, the GSR's optimizing adjustment to conventional saving hinges on the maintenance of a constant aggregate capital stock comprised of physical and natural components. Simply put, natural resource depletion must be matched by capital accumulation elsewhere if a given level of consumption is to be sustained. As Hamilton and Clemens (1999) state, "(t)he depletion of a natural resource is, in effect, the liquidation of an asset and therefore should not appear as a positive contribution to net income or net savings" (Hamilton and Clemens 1999:334).

Analytically, this approach to the aggregate capital stock makes the GSR a measure of "weak sustainability". Weak and strong conditions for sustainability are distinguished in terms of

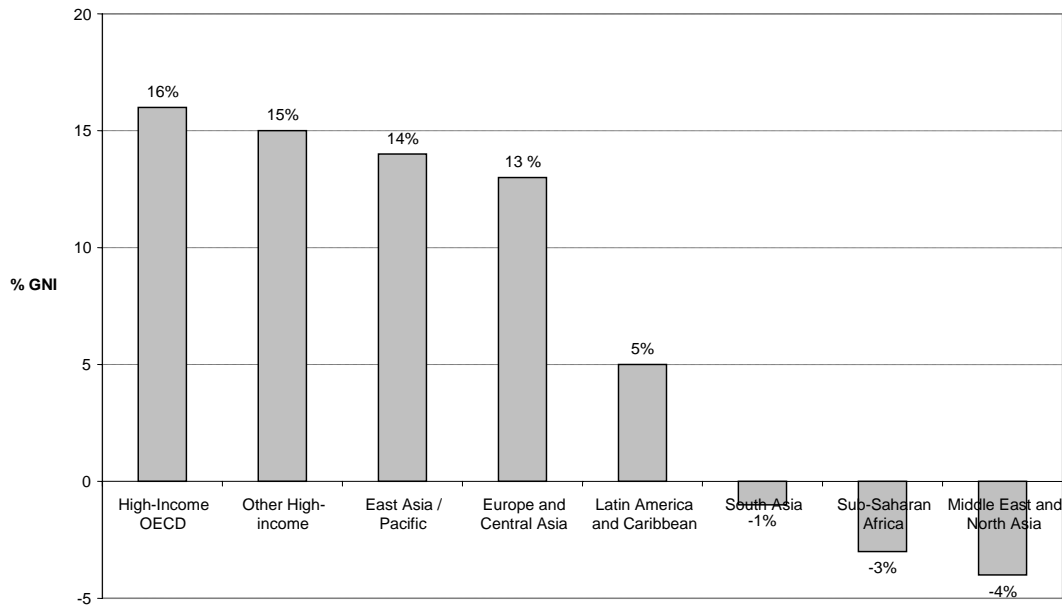
⁴ See Hamilton and Clemens (1999) for a full formal model of genuine savings. More recently the World Bank (2002) has revised its definition and methodology for calculating the GSR and has renamed it the Adjusted Net Savings Rate (NAS). In this paper we adhere to the more widely recognized term GSR but use the data and methodology for the NAS.

their treatment of the capital stock. Weak sustainability assigns no special conditions to the maintenance of a constant aggregate capital stock. In particular, it assumes physical and natural capital are perfectly substitutable in their capacity to generate welfare. In contrast, strong conditions for sustainability have been elaborated by economists associated with the “London School” (Pearce and Turner 1990). These strong conditions revolve around the maintenance of critical levels of natural capital, especially those related to ecosystem services. We discuss these conditions for strong sustainability in more detail in our final section.

The World Bank has taken a leading role in implementing the GSR as a measure of extended savings and investment performance across countries. It reports the GSR as part of its annual *World Development Indicators* and a number of its staff have played a prominent role in elaborating the GSR methodology⁵. International variations in data availability have led the World Bank to focus its valuation efforts on three areas of natural capital depletion. These are: the valuation of resource rents with respect to nonrenewable resources, the depletion of forests beyond replacement levels, and the marginal costs of carbon dioxide emissions.

These cross-country estimates of the GSR indicate that genuine savings is persistently negative for some important subsets of countries. This finding is moderated somewhat when human capital investment is included as a component of genuine savings but it does not fully reverse the effects of natural capital depletion. Figure 1 reports the GSRs of various regional groups of countries in 2000, without adjusting for human capital investment. Sub-Saharan Africa has suffered persistently negative genuine savings since the late 1970s. The Middle East and North Africa region also experienced a negative GSR over this period, although Hamilton and Clemens (1999) note that the heavy resource dependence of these economies imparts a negative bias to the estimates. Conversely, Hamilton and Clemens (1999) attribute the strong performance of the high-income OECD group to their limited economic dependence on natural resource depletion and diversified exports of value-added goods and services. Not only does this explain the high positive GSRs exhibited by the OECD group but it also explains the smoothness of the GSR over time, as these countries have not been disproportionately affected by volatile shifts in resource revenues over time.

⁵ See, for example, Hamilton and Clemens (1999).

Figure 1. International Variations in GSR, by Regional Grouping

Australia's genuine saving performance is poor by OECD standards. It is ranked last in terms of its average GSR between 1970 and 2000, at 6.3% per annum, just behind the UK and US, with 7.6% and 8.0% respectively. Australia's average GSR fell by 4.2% during the 1980s and by a further 0.2% in the 1990s. By 2000 Australia's GSR had fallen to 4.3%; the lowest in the whole OECD and one of the few countries for which the GSR in 2000 was lower than the average GSR for the period 1970 to 2000.

The relationship between gross investment, net savings and genuine savings in Australia is shown in Figure 2(a). The natural resource depletion and human capital investment components of the GSR are then given in Figure 2(b). This figure indicates that the sharp slide of the GSR in the 1980s was arrested in the 1990s mainly because of a reduction in the rate of energy depletion from over 4% in the early 1980s to less than 1% in the late 1980s, and, in the rate of mineral depletion from around 2.5% in the 1970s to 1.5% in the 1990s. Human capital investment (measured as public educational expenditure) has been stable at approximately 5%.

Figure 2 (a) GSR for Australia: 1970-2000

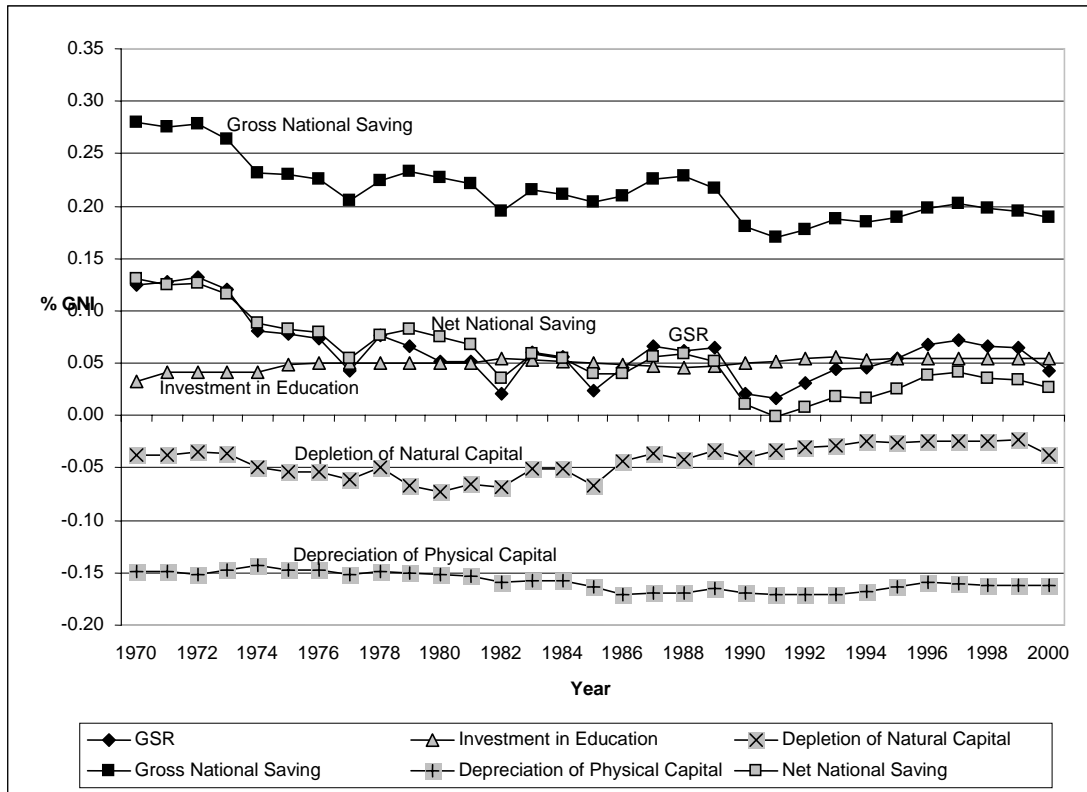
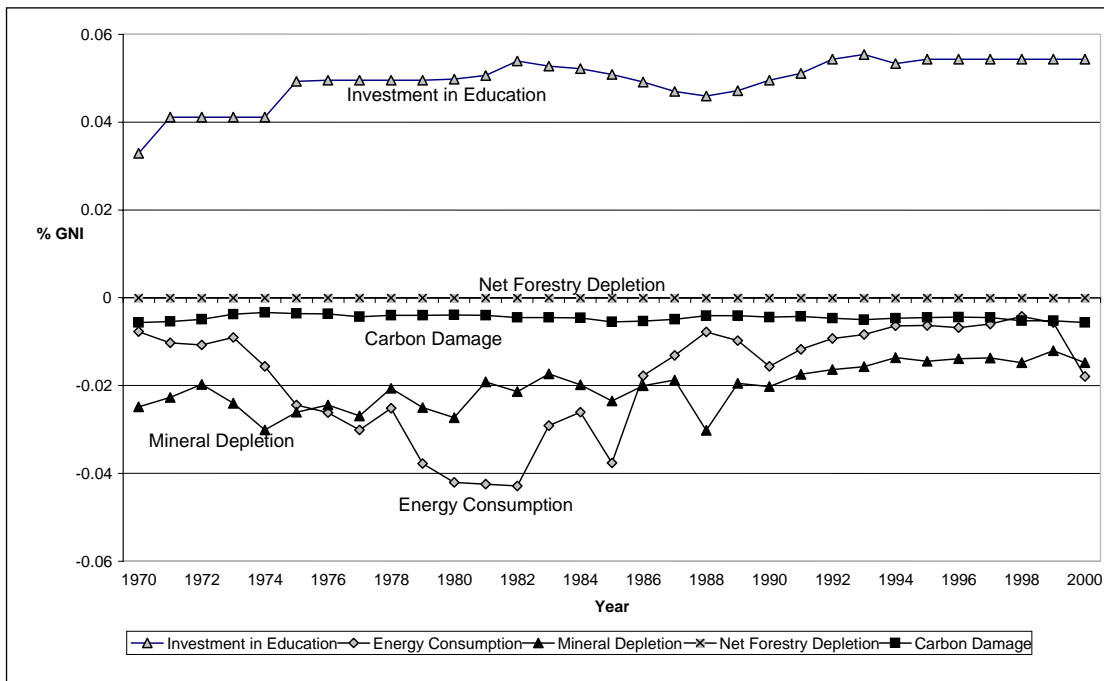


Figure 2 (b) Components of Australia's GSR, 1970-2000



Tables 1 and 2 contrast the GSR and its individual components, respectively, for all OECD economies (except Luxemburg) over the period 1970 to 2000. Australia's low GSR (Table 1) relative to all other OECD countries can be explained in terms of it having the lowest rate of net national savings, the highest rate of mineral depletion, and among the highest rates of energy depletion (Table 2). Educational expenditure for Australia is roughly in line with levels in the US and the UK.

Table 1: Genuine Savings Rates for OECD Economies: Annual Averages 1970-2000 (as % GNI)

	<i>1970-79</i>	<i>1980-89</i>	<i>1990-2000</i>	<i>1970-2000</i>
Australia	9.2	5.0	4.8	6.3
Austria	18.2	14.4	13.2	15.0
Belgium	16.0	10.8	13.1	12.8
Canada	11.9	7.8	8.5	9.3
Denmark	13.2	9.0	13.7	11.6
Finland	15.0	13.5	9.7	12.2
France	16.3	12.0	12.8	13.2
Germany	na	na	10.8	10.8
Greece	21.8	15.8	13.9	16.0
Ireland	18.0	13.0	20.2	17.0
Italy	16.0	12.5	10.8	13.0
Japan	23.7	21.6	19.8	21.0
Korea, Rep.	na	na	23.8	23.8
Netherlands	19.1	13.3	16.2	16.0
New Zealand	18.0	14.1	11.9	14.4
Norway	13.3	8.9	15.4	12.5
Portugal	11.5	15.7	12.5	13.5
Spain	14.9	10.9	13.5	12.8
Sweden	16.3	11.4	11.1	12.9
Switzerland	15.8	17.2	17.0	16.9
Turkey	11.2	14.1	19.3	15.6
UK	10.7	5.5	7.4	7.6
United States	9.6	6.1	8.3	8.0

Note: Luxembourg not available

Source: Compiled from World Bank, *Environmental Economics and Indicators* (2003)

A tentative consensus has emerged on the main implications of international variations in the GSR. Various studies of the GSR across countries (Pearce and Atkinson 1993, Hamilton and Clemens 1999) have argued that the negative genuine savings rates exhibited by less developed countries are a major signal of unsustainable economic growth. A persistent, negative GSR indicates “that the wealth inherent in the resource stocks of these countries is being liquidated and dissipated” (Hamilton and Clemens 1999:144) without a concomitant

Table 2: Components of Genuine Savings OECD Economies: Annual Averages 1970-2000 (as % GNI)

	(1) <i>Net National Savings</i>	(2) <i>CO2</i>	(3) <i>Mineral Depletion</i>	(4) <i>Energy Depletion</i>	(5) <i>Education Expenditure</i>	(6) <i>Genuine Savings</i>
Australia	5.7	0.5	2.0	1.8	4.9	6.3
Austria	10.7	0.3	0.0	0.3	4.8	15.0
Belgium	8.2	0.4	0.0	0.1	5.0	12.8
Canada	8.3	0.5	0.8	4.3	6.6	9.3
Denmark	5.1	0.3	0.0	0.2	7.0	11.6
Finland	6.7	0.3	0.1	0.0	5.8	12.2
France	8.3	0.2	0.0	0.1	5.0	13.2
Germany	9.3	0.2	0.0	0.2	4.3	10.8
Greece	14.9	0.4	0.2	0.3	2.0	16.0
Ireland	12.3	0.4	0.3	0.2	5.4	17.0
Italy	9.2	0.3	0.0	0.1	4.2	13.0
Japan	16.8	0.3	0.0	0.0	4.2	21.0
Korea, Rep.	20.5	0.7	0.0	0.0	3.9	23.8
Netherlands	11.5	0.3	0.0	1.2	6.0	16.0
New Zealand	10.3	0.3	0.2	1.0	5.6	14.4
Norway	11.8	0.3	0.1	4.2	5.9	12.5
Portugal	9.8	0.3	0.0	0.0	3.8	13.5
Spain	9.9	0.3	0.1	0.2	3.2	12.8
Sweden	6.4	0.2	0.3	0.0	7.0	12.9
Switzerland	12.6	0.1	0.0	0.0	4.3	16.9
Turkey	14.7	0.5	0.1	0.6	2.1	15.6
UK	4.7	0.4	0.0	1.7	5.0	7.6
United States	6.6	0.5	0.1	2.6	4.6	8.0

Notes: Luxemburg not available.

For all OECD economies it is assumed that forestry is managed on a sustainable basis implying a zero rate of forest depletion.

Source: Compiled from World Bank, *Environmental Economics and Indicators* (2003)

build-up of other types of assets. Furthermore, it is likely that if a country persistently displays a negative GSR – thereby violating the conditions for weak sustainability to be upheld – then it will also fail to meet the strong conditions embodied in a constant stock of critical natural assets or capital over time.

Arguably, the conceptual and empirical challenge for the GSR methodology when applied to advanced economies therefore lies in its capacity to inform analysts about this relationship between strong and weak conditions for sustainability. In particular, to what extent do variations in the headline GSR and its components shed light on macroeconomic sustainability in countries with positive genuine savings? And, can the GSR framework be

modified to analyse issues such as the drivers of savings and investment performance and the changing “portfolio” of natural assets over time? We use the case of Australia and Queensland to investigate these questions.

III. CALCULATING THE GSR FOR QUEENSLAND

In practice, calculating the GSR for a region such as Queensland involves two steps. First, there is the calculation of the state’s savings rate adjusted for borrowings and transfers at the sub-national level. Second, there is the calculation of physical and natural capital depletion, the natural capital in terms of different resources, and the calculation of human capital investment.

In this paper we follow the World Bank’s methodology to compute the GSR for Queensland by adding net national saving, the savings embodied in additions to human capital, and, the loss of savings (capital) from the depletion of natural resources (Bolt *et al*, 2002)⁶. The GSR for Queensland is estimated for the period 1989/90 to 1999/2000, at constant (1999/2000) prices, and is reported in the next section. Appendix A contains a list of all sources of data. We modify the GSR to reflect the State-level equivalent of each component in the World Bank’s original cross-national study, where:

$$GSR = \text{net state saving} + \text{human capital investment} - \text{depletion of natural resources} - \text{pollution damage}$$

The definitions adopted here for Gross and Net State Saving are consistent with the World Bank’s method where:

$$\text{Net State Saving} = \text{Gross State Saving} - \text{Consumption of Fixed Capital}$$

and;

$$\text{Gross State Saving} = \text{Gross Domestic Investment} - \text{Net Foreign Borrowing}$$

⁶ It should be noted that in this paper we have used the revised methodology of the World Bank (Bolt *et al* 2002) to be consistent with the GSRs reported in previous sections for Australia and other countries. These estimates therefore differ from those produced for the original Queensland EPA study which were based on the World Bank’s earlier definition and methodology for calculating the GSR.

This is measured using the State level equivalent of national income, Gross State Income (GSI). At the level of a State within a country, this implies adjusting Gross State Product (GSP) for net factor income inflows from both international and interstate transactions. Another method would be to subtract private and public sector consumption from GSI to derive the state equivalent of national savings. See Appendix B for a more detailed account.

“Human capital investment” equals government expenditure on education. Effectively, this is a re-classification of government expenditure, as education expenditure is usually treated as an element of government consumption. It ignores other components of human capital such as health, and it measures the value of human capital in terms of the cost of education measured by public expenditure on the education sector.

As per the World Bank approach, “pollution damage” is restricted to include carbon dioxide only. Other major air pollutants in Queensland such as SO_x, NO_x, particulates, ozone and CFCs are omitted. Water pollution damage is not included. The World Bank estimates carbon costs at US\$20 per ton. This study uses the same unit value for each year (converted to AUD). Estimated carbon emissions are based on annual data for the whole of Australia and Queensland data for two years, 1989/90 and 1998/99. The intermediate years’ values were estimated by interpolation using Queensland’s share of total Australian emissions in the two end years.

Following the World Bank methodology, sources of “natural capital depletion” are restricted to forest and mineral resources. These two components represent the depletion of the economy’s renewable and non-renewable resources respectively. This makes no provision for the depletion of other land-based capital due to factors such as soil erosion, salinity and water pollution. Furthermore, freshwater and marine-based resources are also excluded. There is also no commonly agreed method of calculating resource rents. The World Bank adopts a ‘constant revenue stream’ approach. However, others have suggested that since non-renewable resources are irreversibly lost in the process of use, the rental income accruing

from resource extraction is not sustainable and should either be fully or partly deducted.⁷

The results of these component calculations are presented in the next section alongside those for Extended Saving, being net State saving plus human capital investment.

IV. RESULTS

Queensland's GSR

Table 3 and Figure 3 track the changes for the GSR and each of its components for the period 1989/90 to 1999/2000. Since 1989, Queensland's GSR has fallen from 7.9% to 2.3%, implying that although, following the World Bank interpretation of the GSR, we are possibly on a sustainable growth path, the decline should be of concern to policy makers.

It is noteworthy that the trend level of genuine saving for Queensland follows the trend for the value of net State saving very closely. The saving embodied in investment in human capital (government spending on education) constitutes a significant component of the total value of extended State investment, and, since 1990/91 has been consistently greater than net State saving. By offsetting the impact of natural resource depletion within the GSR framework, human capital investment plays an important role in the calculation of Queensland's overall GSR. Measured in terms of state government expenditure on education, human capital investment increased in line with natural capital depletion between 1989/90 and 1999/2000.

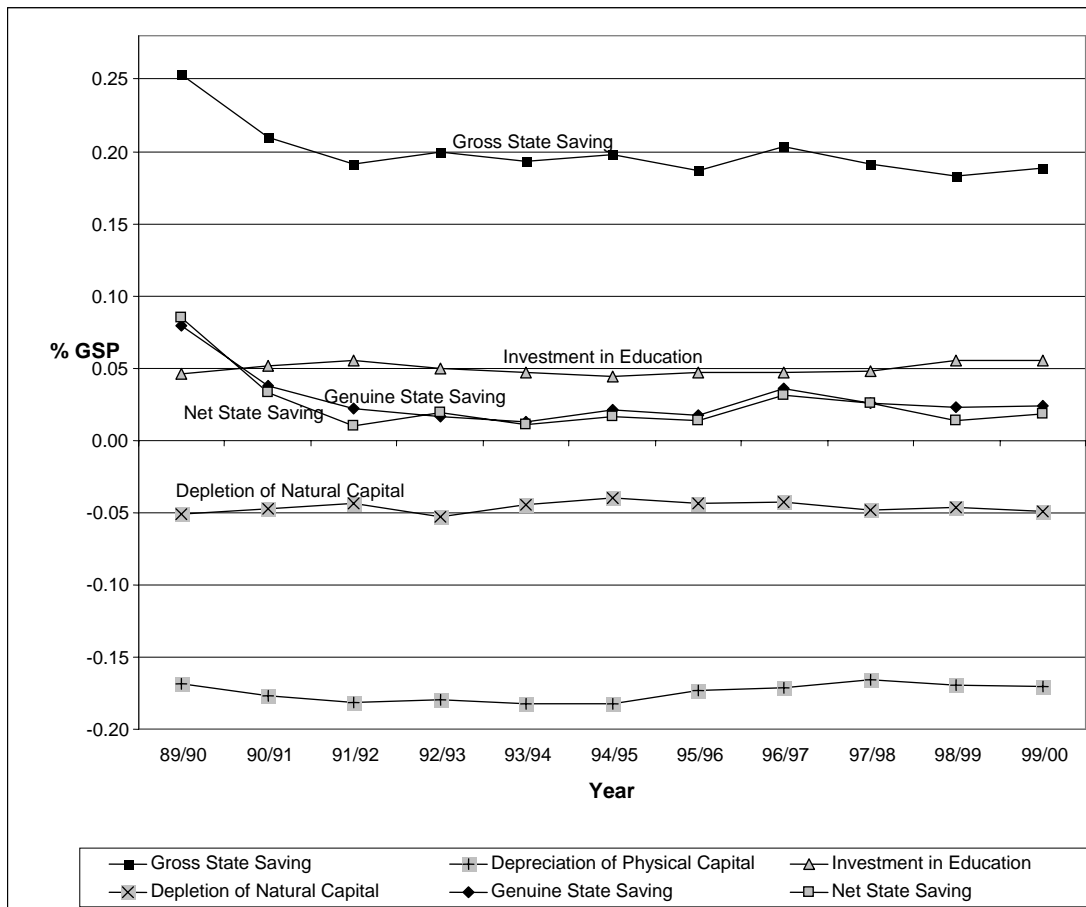
Specifically, human capital investment increased, in real terms, at a rate of approximately 8% per annum from \$3.13 billion in 1989/90 to \$5.59 billion in 1999/2000. In comparison, total natural resource depletion increased at a rate of approximately 5% per annum from \$3.4 billion to \$5.0 billion over the same period. It should also be noted that total resource

⁷ To estimate the resource rent component of the value of mineral production, we first calculated gross surplus by adding royalties and company taxes to gross operating surplus. We then estimated 'normal profit' as 10% of total costs (including depreciation), which we subtracted from gross operating surplus to arrive at the estimates resource rents for mining and forestry. The figure of 10% is based on input-output tables for Queensland (Queensland Treasury, Office of Economic and Social Research (OESR)). The results of these calculations are reported in the next section.

Table 3: Queensland's Genuine Saving, 1989/90-1999/2000. (1999/00 prices and as a % of GSP in brackets)

	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00
(1)Gross State Saving	17,370 (25.3)	14,247 (21.0)	13,426 (19.2)	15,046 (20.0)	15,155 (19.3)	16,396 (19.8)	15,895 (18.7)	18,001 (20.3)	17,829 (19.2)	18,068 (18.3)	19,151 (18.8)
(2)Depreciation	11,547 (16.8)	11,999 (17.7)	12,705 (18.1)	13,575 (18.0)	14,310 (18.2)	15,071 (18.2)	14,729 (17.3)	15,225 (17.2)	15,414 (16.6)	16,732 (16.9)	17,326 (17.0)
(3=1-2)Net State Saving	5,823 (8.5)	2,248 (3.3)	721 (1.0)	1,470 (1.9)	846 (1.1)	1,325 (1.6)	1,165 (1.4)	2,776 (3.1)	2,415 (2.6)	1,336 (1.4)	1,824 (1.8)
(4) Human Capital Investment	3,135 (4.6)	3,495 (5.2)	3,867 (5.5)	3,762 (5.0)	3,664 (4.7)	3,688 (4.5)	3,993 (4.7)	4,188 (4.7)	4,486 (4.8)	5,458 (5.5)	5,586 (5.5)
(5=3+4) Extended Saving	8,958 (13.0)	5,743 (8.5)	4,588 (6.5)	5,232 (6.9)	4,510 (5.8)	5,013 (6.1)	5,158 (6.1)	6,964 (7.8)	6,901 (7.4)	6,794 (6.9)	7,410 (7.3)
(6) Carbon Damage	-512 (-0.9)	-524 (-0.9)	-541 (-0.9)	-607 (-0.9)	-623 (-0.9)	-621 (-0.8)	-614 (-0.8)	-621 (-0.7)	-757 (-0.8)	-808 (-0.8)	-910 (-0.9)
(7) Mineral Depletion	-2,858 (-4.2)	-2,544 (-3.8)	-2,400 (-3.4)	-3,268 (-4.3)	-2,754 (-3.5)	-2,584 (-3.1)	-3,035 (-3.6)	-3,109 (-3.5)	-3,715 (-4.0)	-3,689 (-3.7)	-4,065 (-4.0)
(8) Forestry Depletion	-59 (-0.1)	-48 (-0.1)	-43 (-0.1)	-48 (-0.1)	-55 (-0.1)	-43 (-0.1)	-40 (-0.0)	-37 (-0.00)	-39 (-0.0)	-48 (-0.0)	-51 (-0.0)
(9=7+8) Total Resource Depletion	-3,429 (-5.1)	-3,116 (-4.7)	-2,984 (-4.4)	-3,923 (-5.3)	-3,431 (-4.5)	-3,248 (-4.0)	-3,688 (-4.4)	-3,767 (-4.3)	-4,511 (-4.9)	-4,545 (-4.6)	-5,025 (-4.9)
(10=5+6+9) Genuine State Saving	5,530 (7.9)	2,628 (3.8)	1,605 (2.2)	1,310 (1.7)	1,079 (1.3)	1,765 (2.1)	1,470 (1.7)	3,197 (3.6)	2,390 (2.6)	2,249 (2.3)	2,385 (2.3)

Sources: Authors' Estimates. (See Appendix A.)

Figure 3: Queensland's Genuine Saving Rate, 1989/90-1999/2000 (as % GSP)

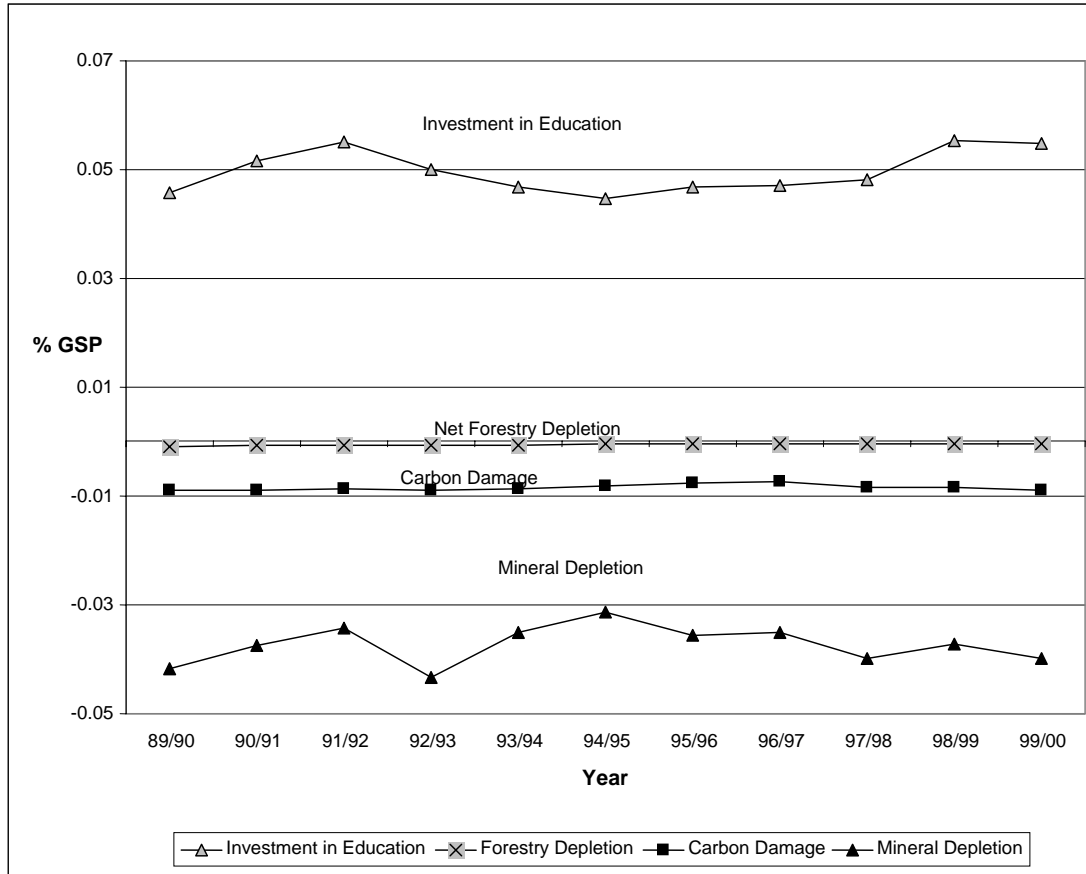
depletion is dominated by the absolute value of mineral resource depletion, accounting for 80% of total resource depletion, which is much greater than the other two components together, namely the value of forest resource depletion and pollution damage. This is shown more clearly in Figure 4 which plots the movements in the individual components of natural capital against investment in human capital.

The net value of Genuine Saving and any variation in its value relative to net State saving is therefore influenced largely by changes in human capital accumulation and mineral resource depletion. As the value of natural capital depletion (including pollution damage) is very close to the value of human capital accumulation, the (positive) human and (negative) natural capital components of Genuine Saving effectively offset one another. In turn, this explains why the values and trends of Genuine Saving and Net State Saving in Figure 3 are similar.

These trends also indicate that despite the significant value of natural capital depletion, the rate of net state saving has fallen over the decade. This could be interpreted as suggesting that the proceeds from the exploitation of natural resources are not being channeled towards

physical investments that enhance the saving capacity of the Queensland economy. Instead, it could be argued that Queensland remains highly dependent on natural capital depletion as a means of consumption support.

Figure 4: Components of Queensland's GSR, 1989/90 to 1999/2000 (as %GSP)



Caution needs to be exercised in drawing such conclusions without a proper analysis of the interrelationships between income generated from mineral exploitation, on the one hand, and saving and investment in other sectors of the economy, including human capital on the other. The discussion section will bring to light the benefits of presenting the GSR alongside other relevant information in order to better inform policy about these sorts of linkages.

Comparison with Australia's GSR

The World Bank's estimates of Australia's GSR over the period 1990 to 2000 are given in Table 4. It is noticeable that while the average GSR over the period is much higher for the whole of Australia (4.8% per annum) in comparison with Queensland's average GSR of 2.8% per annum. It is also noticeable that Queensland's GSR fell from almost 8% in 1989/90 to

below 2% in 1992/3 and 1993/4, recovering slightly to 2.3% in 1999/2000. For Australia as a whole, the GSR rose from 2% in 1990 to over 7% in 1997, before dropping back to 4.3% in 2000. These divergent trends can be explained mainly by two components: net domestic/State saving and resource depletion. While Queensland's net State savings rate has fallen from 8.5% in 1989/90 to less than 2% by 1999/2000, Australia's net national savings rate has risen (from 1.1% in 1990 to 2.7% in 2000. And, while Queensland's rate of natural resource depletion has continued at approximately the same rate throughout the period (approximately 5% per annum), Australia's resource depletion rate fell from 4% to just over 2% per annum in the late 1990s, although it crept up to 3.8% in 2000.

These trends indicate that diversification of the rest of the Australian economy in terms of increasing roles for the manufacturing and services sectors, away from natural resource exploitation, has been more evident for Australia as a whole than for the Queensland state economy in particular. This reinforces the point raised at the outset of this paper that any macro-indicator of sustainability for an economy as a whole could mask what is actually occurring in relation to the depletion of natural capital at the level of an individual state or region within the macroeconomy. For instance, while total natural resource depletion for the Australian economy as a whole remained relatively stable over this period, for Queensland it increased at a rate of approximately 4.6% per annum from \$3.4 billion to \$5 billion.

Issues for Queensland

Although the trend for Queensland's GSR is negative, no decisive conclusion on the sustainability of the state's growth can be made. However, the analysis of the GSR, as estimated above, does provide some important insights into Queensland's overall growth path and the policy challenges the state faces in the next decade. The issues of mineral resource depletion, forest depletion, and human capital are crucial in making an evaluation of Queensland's prospects.

In the estimation of Queensland's Genuine Savings, the depletion of mineral resources accounts for most of the exploitation of natural capital. However, this does not necessarily imply that the rate of resource depletion is higher for minerals than other components of natural capital. Indeed, the extremely large stocks of coal reserves in Queensland - estimated

commercially extractable reserves of more than 600 years at current rates of extraction⁸ - would indicate that the current rate of depletion would be sustainable on an almost indefinite basis, unless, of course, we were to assume that policy makers are concerned about what will happen after 600 years! However, what needs to be considered are the possible implications for Queensland if the demand for coal falls, in the shorter term, due to the development of cleaner energy sources.

By comparison, the current rate of forest depletion as measured by the value of resource rent, although very small relative to mineral rent, could be significantly less sustainable than the rate of mineral depletion. Current management of public forests is meant to be sustainable whereas there are presently no standards for harvesting of forest on private lands. What the measures used in this report do not consider is the degradation of land associated with the clearing of non-forest areas. Thus, the potential long term impacts of recent land clearing could be severe.

The inclusion of human capital as a component of the GSR allows Queensland to meet the conditions for “weak sustainability”. That is, the accumulation of human capital offsets the depletion of mineral resources leading to a parallel relationship between genuine saving and net state saving. It should be noted, however, that weak sustainability is based on the assumption that different types of capital are substitutable. Furthermore, we cannot be sure about the content and quality of human capital investment as presented in the World Bank model. As indicated earlier, pollution damage and/or resource depletion other than that measured here could far exceed these estimates and threshold levels could be exceeded, despite the aggregate genuine saving rate being positive.

The data shows that Queensland has a higher rate of natural resource depletion and a lower rate of Genuine Saving than the whole of Australia. This may be a product of structural and demographic factors, including interstate migration, a lower level of per capita GSP and the prominent role of extractive industries in Queensland relative to the rest of Australia. The determinants of this differential, and whether it should be of concern to policy makers, are important subjects for further research.

Moreover, it needs to be emphasized that these estimates are based on the World Bank’s somewhat narrow definition of natural resource depletion and pollution damage. It is worth

⁸ Personal communication with Queensland EPA, 2002.

noting here however that if a broader definition of resource depletion and pollution damage were to be adopted, the level of genuine saving would almost certainly fall *below* the level of net state saving; that is, resource depletion and pollution damage would more than offset the additional saving embodied in investment in human capital.

In relation to investment in human capital, it should also be noted that no attempt is made to estimate this on a *net* basis which would entail some allowance for ‘depreciation’ of existing human capital stocks, due to, for example, skills obsolescence or ageing of the population. On the other hand, this measure does not include private expenditure on education.

These and other implications of relying on the GSR as a comprehensive sustainability indicator are addressed in the following sections.

V. DISCUSSION

The true test of any indicator is its ability to inform successful policy decisions. By successful, we mean decisions that encourage an economy, or subset of an economy, to make the best use of any changes it faces while maintaining its ability and capacity to perform its essential functions. There have been many criticisms of the GSR as an indicator of sustainability, most focused around the fact that it is based on the notion of weak sustainability. Here, we summarise the conceptual limitations (earlier sections of this paper have already discussed many of the technical and measurement issues that arise), and emphasise that it is important for the purposes of understanding macroeconomic sustainability to know how efficiently an economy’s savings are being used over time in terms of output: generating further capital, generating the potential for future capital, and cleaning up accumulated pollutants. We then move forward to compare and contrast some of the potential policy recommendations that could be made for Queensland given the use of three different indicators: first, net state saving; second, the GSR; and third, the GSR alongside supplementary information, called the GSR “plus”.

Conceptual limitations and recommendations

The GSR has been variously criticised; in the first instance, because it is based on the notion of weak sustainability; and in the second, more fundamental instance, because weak sustainability is itself underpinned by a certain set of theories and assumptions. This theoretical foundation describes, at essence, a theory of value, and leads to the use of certain methodologies for placing economic values on the various components of capital as discussed in this paper. Many of these methodologies themselves also invite criticism, along with the need for economic valuation in the first place to allow aggregation of what are obviously incommensurate forms of assets. The criticisms raised during application of the GSR have been mentioned in previous sections.

Pearce *et al.* (1996) clearly state that the characterisation of sustainability as “weak” immediately establishes a theoretical foundation in which the standard economic assumptions can be made, most importantly for this discussion the assumption of substitutability between the three forms of capital. In contrast, they connect the strong sustainability criterion with ecological imperatives such as resilience, carrying capacity and ‘distance to goal’ approaches. The continued investigation of these concepts and how they can be developed into tractable models and workable indicators is essential to the sustainable development research agenda. It is also crucial, however, that attempts be made to integrate some of these concepts into the notion of weak sustainability via an extension of standard economic theory.

Despite these criticisms, and accepting the irrefutable need for indicators of sustainability, there exist several ways in which the use of the GSR as a policy tool could be strengthened. Both refer to the way in which the GSR is reported and recommend the inclusion of complementary information.

First, it cannot be assumed that savings as indicated by a positive GSR will translate into additional capital – savings do not necessarily cause investment, and, even if savings are channeled into investment and the size of the capital stock increases, this does not mean that the growth rate of output will necessarily be sustained. This will depend on: (a) the quality of the investment in capital and how efficient it is; and (b) the extent to which different forms of capital can be substituted for one another in production. These points illustrate that while the GSR as an indicator of an economy’s potential sustainability is useful, it is important to know

how efficiently (genuine) savings are being used: for example, in terms of generating further capital, generating the potential for future capital, and cleaning up accumulated pollutants.

Ideally, a refined GSR would need to allow for changes in the productivity of capital, not simply the value of expenditure on the particular component. For instance, the analysis of human capital investment is subject to problems of definition and interpretation. On the one hand, the World Bank's approach to measuring human capital conflates financial inputs with educational outputs. Conventionally, "human capital" is measured in terms of the labour income accruing to different levels of education⁹. Therefore financial inputs are at best an *indirect* indicator of human capital formation. As Hanushek (1996) argues, educational expenditure is driven by factors such as enrolment rates, demography and cost inflation. The link between expenditure and human capital formation leading to increased income is therefore subject to complex lags and cost variations¹⁰. On the other hand, while labour-income indexes are generally accepted as adequate measures of the human capital *stock* it is harder to define an analogous, income-based measure of *flows* emanating from the human capital stock. Strictly speaking, the flow produced by the human capital stock is defined as the private and social returns to education. However, this type of human capital indicator is not a feature of existing macroeconomic sustainability indicator systems.

Conceptually, the interpretation of the overall GSR is affected by these caveats regarding measurement. In particular, it could be argued that this measurement difficulty amplifies the problem of substitutability between different types of capital. How can we know if human capital investment is successfully offsetting natural capital depletion if we are uncertain that our investment measure accurately reflects human capital formation? A possible response would be to develop complementary indicators related to the returns to education and the productivity of educational expenditure¹¹. Overall, this is an important issue for further indicator development because in the current analysis human capital investment is crucial for ensuring that the conditions of weak sustainability are met for Queensland.

⁹ See Jorgenson and Fraumeni (1996) and the OECD (1998) for a discussion of the measurement of human capital. Following the labour income approach, Wei (2002) has recently constructed experimental estimates of the human capital stock for Australia.

¹⁰ Expenditure-based measures are also subject to arbitrary definitions of scope. For example, the measure in this paper only considers state government expenditure on education in Queensland. Other types of expenditure (private sector expenditures on school fees, Commonwealth expenditure on higher education) could also be added and subsequently boost the GSR.

¹¹ See the Productivity Commission (2003) *Report on Government Services* for an analysis of inter-state variations in unit-costs for educational expenditure.

Second, the GSR, by definition, does not take into account additions to domestic capital stock funded from external sources such as foreign borrowing or direct foreign investment. On the other hand, when there is a positive current account balance, the corresponding export of national savings as net foreign lending and/or investment *is* included in the measurement of the GSR. This assumption is purely arbitrary, and, to our knowledge, nowhere in the GSR literature has there been any attempt to justify it; why does externally-funded capital accumulation not contribute to a country's macroeconomic sustainability, while domestically-funded capital export does? It is recommended that a refined measure of GSR should at least address, more explicitly, the roles of domestic versus national capital accumulation in the conceptualization and measurement of a country's macroeconomic sustainability.

Third, the GSR is based on the use of resources by a country for production. In the open economy context this measure does not necessarily reflect the resource implications of a country's consumption. Proops (1999) calculates an 'open measure' of the GSR which also takes account of international trade in natural resources. This shows that while natural resource poor countries like Japan may appear to be on a sustainable growth path, recording a relatively high GSR, it shows up as being much less sustainable due to its import of natural capital-intensive products from other countries. Conversely, resource rich countries like Australia and Canada and many developing economies (especially oil-exporting countries) show up as being more sustainable (less unsustainable) than they do using the World Bank's 'closed measure' of the GSR.

Broadly speaking, the reporting of a single dollar value of sustainability like the GSR could also be made more relevant and useful for policy if presented alongside a range of indicators such as those developed by the United Nations Environment Program (UNEP) for their System-Wide Earthwatch. The current framework for progress includes a list of some 130 indicators, including a comprehensive range of social, environmental, economic and institutional indicators; and a range of methodologies for estimating these indicators, which is being tested in over 20 countries on a pilot basis. The important point to note here is that this approach relies on a wide range of indicators all measured in their own terms, a method the Australian Bureau of Statistics has used for its project, *Measuring Australia's Progress*, and has named the 'suite-of-indicators' approach.

Comparative policy implications of different indicators

Net state saving

Net saving, being total gross saving less the value of depreciation of produced assets, was the natural extension to the use of gross saving in the World Bank's *World Development Indicators*. While net saving still focuses only on produced assets, it can be considered one step closer to a sustainability indicator in the sense that it allows for the possibility that depreciation of the existing capital stock is greater than gross investment, resulting in a declining, unsustainable stock of (manufactured) capital. However, as noted above, this measure ignores the possibility that domestic savings could be supplemented by indefinitely sustainable levels of external savings in the form of foreign investment, foreign borrowing, or, unrequited transfers such as foreign aid. Conversely, an apparently sustainable rate of net saving, if exported as foreign lending, investment or aid, could be associated with a negative (unsustainable) rate of net domestic investment.

These limitations apart, economic policy based exclusively on observed changes in the net saving (and investment) rate could well overlook contrary changes in human and/or natural capital stocks affecting, negatively, the longer term sustainability of the economic growth rate.

GSR

The GSR, by taking account of changes in human and natural capital, does to some extent, overcome the limitations noted above in relation to net state saving, such that if human and/or natural capital levels were declining sufficiently to result in a declining (or even negative) overall GSR, attention would be drawn to the reasons for this. On the other hand, a single indicator, reported only on an aggregate basis, could conceal significant changes in one of its components that could potentially undermine the economy's overall sustainability. For this reason, we argue, the GSR should always be reported on a disaggregated basis, allowing the policy maker to take account of changes in any one of its components.

Even when reported on a disaggregated basis, one major problem with the GSR's definition of natural capital depletion is that it fails to take account of the significance of current depletion rates, relative to remaining stocks of natural capital. What appears as a relatively insignificant rate of depletion of a particular asset, could well be highly significant if the remaining stock is close to its critical level, and vice versa.

Moreover, in relation to human capital, focusing only on the dollar value of total expenditure on human capital could mask a decline in the quality of education.

GSR “plus”

Between the current state of sustainability indicator calculation in practice, and the progressively evolving System of Integrated Environmental and Economic Accounting (SEEA), sits our notion of the GSR “plus”. In essence, this suite-of-indicators approach attempts to alleviate the limitations of the GSR as a lone indicator of sustainability.

The hypothetical GSR “plus” approach involves the calculation of the GSR and reporting of such as both an aggregate and disaggregated indicator alongside a range of other, more detailed qualitative information. This other information would be tailored to suit the specific policy needs of the economy. As such, this approach invites its own research agenda, allowing the most useful indicators to emerge as required and leading practitioners towards them in a systematic way. The extent of data collection depends on each particular situation and its time and budgetary constraints. Finally, while this approach may seem similar to that of, say, the Genuine Progress Indicator, being anchored by the GSR means that it is still linked to national accounting standards.

The approach of the London School mentioned earlier involves the structuring of physical environmental data in a way similar to that used for the flows of goods and services in the System of National Accounts (SNA). This is essentially a supply and use or input-output framework, whereby parallels can be drawn between the physical and monetary flows to compare the relative importance of different economic activities’ impacts on the environment with the corresponding importance of the activities in economic terms. Such an account being a desirable goal, the GSR “plus” could be seen as an interim step, aiding in further clarification of exactly what sustainability and sustainable development mean for individual economies and overall, and providing comparative measures for the revised SEEA, when operational.

The GSR calculated for Queensland on its own raises the following questions, for example: (1) is Queensland’s higher rate of natural resource depletion and lower rate of Genuine Savings due to the prominent role of extractive industries in Queensland’s economy or some production or extraction inefficiency? (2) what is the quality of Queensland’s labour

emerging from the levels of investment in human capital and how is this associated with future productivity gains? (3) what are the levels of degradation associated with the clearing of non-forest areas and does this clearing impact on future productive potential and ecological health? (4) do any of Queensland's resource extraction activities impose in a significant way on some keystone ecological process? and (5) which of Queensland's resources are non-substitutable, how do they enter the GSR equation; and how does this then affect the GSR for Queensland and future policy directions? Each of these questions could then be broken down into several sub-questions and appropriate indicators chosen or designed¹². The richness of such an approach is obvious, and one would hope that this is most likely the process followed in most rigorous policy research endeavours. As attention has only recently come to sustainable development and its indicators, and as there seems to be a curious preference for single, "big picture" numbers within government bodies, it seems important make this point explicitly.

The GSR "plus" echoes some of the ideas raised by the natural capital stock approaches to macroeconomic measures of sustainability summarised by Hanley (2000: 21-4). The finding of a sustainable development rule, however, raises issues of incommensurability, aggregation and scale, while the GSR "plus" may not face such problems by avoiding attempts to rely on a single indicator.

VI. CONCLUDING COMMENTS

If we are looking for an indicator of an economy's sustainability, then we must answer several questions before we can even begin to attempt its calculation. First, is sustainable development in the sense of the Bruntland Commission definition feasible and desirable? Do we want "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987: 43)? If so, how do we know what the needs of future generations will be? Perhaps the best thing that we can do is to engage in development that leaves future generations a world with as much potential for development, creation and regeneration as possible. This would suggest that what is

¹² Examples of ABS data and other government programs currently available that may provide assistance in answering these questions include: for question (1), a state disaggregation of ABS 4608.0 Mineral Account, Australia – supply and use tables; for question (2) a state disaggregation of ABS 4224.0 Education and Training in Australia alongside a state disaggregation of ABS 8112.0 Research and Experimental Development, All Sector Summary, Australia and the background material for the government's "Smart State" initiative; for question (3), ABS 4615.0 Salinity on Australian Farms; and for questions (4) and (5), a state disaggregation of ABS 4613.0 Australia's Environment: Issues and Trends. The ABS program, "Measuring Australia's Progress" goes a long way towards building a foundation for the answering of such questions.

important is not only the rate of saving, adjusted for changes in the natural resource base, environmental quality and human capital, as indicated by the GSR, but the rate and quality of future investment potential.

As such we make the following conclusions for sustainability indicator reporting for Australia.

First, the compilation and reporting of a GSR for Australia and each of its States should be undertaken on a regular basis with a view to informing policy makers and the general public about the sustainability of the country's pattern of economic growth.

Second, reporting of the GSR should always be undertaken on a disaggregated basis allowing for identification and separate analysis of changes in its key individual components.

Third, the GSR should always be treated as an indicator of what is necessary for sustainable growth, but not as an indicator of what is sufficient; i.e. the GSR should not be negative, but having a positive value does not necessarily imply sustainability.

Fourth, policy makers should not rely on the GSR alone as an indicator of an economy's sustainability. It should be used only in conjunction with other indicators.

Fifth, other complementary indicators should aim to provide information specifically about rates of depletion of non-substitutable and critical components of natural capital. To this end, the Federal and State-level EPAs (or other departments) should compile a set of complementary indicators to gauge the extent to which current rates of natural capital depletion for specific components of natural capital fall within some 'safe minimum standard' necessary for sustainability. These could include individual, critical and other non-critical, non-substitutable components of natural capital, and, in some cases aggregated components, such as whole ecosystems that cannot be disaggregated due to the complex and non-linear interrelationships between their component parts.

To conclude, the concept of sustainability is subject to ongoing debate. Hence, the calculation and use of sustainability indicators requires careful interpretation. However, there is clear scope for sustainability indicators to play an integral role in the prudent and efficient management of natural resources. This management is necessary for our own wellbeing and

economic stability, for that of future generations and for the ability of our ecosystems to maintain themselves and their productive capacity into the future.

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Appendix A: Data Sources

Table 1: Data Sources for Queensland GSR by Component, 1989/90-1999/2000.

<i>Component</i>	<i>Sub-components</i>	<i>Data Sources</i>
Net State Saving	Queensland GSP	Queensland Treasury, Office of Economic and Social Research (OESR)
	Investment	
	International trade balance	
	Total final consumption	
	Gross fixed capital consumption	
	Depreciation	
Natural Resource Depletion	Carbon Damage	Australian Greenhouse Inventory, EPA
	Mineral Depletion	ABS, Australian National Accounts, Cat. No. 5220.0; <i>Queensland Minerals and Energy Review</i>
	Forestry Depletion	ABS, Australian National Accounts, Cat. No. 5220.0
Human Capital Investment	State Government Expenditure on Education	ABS, Australian National Accounts, Cat. No. 5220.0

Appendix B: Calculation of net state saving

Net State Saving

Net saving is traditionally calculated as a residual. Using the usual national income accounting identities, net state saving equals $S = GSI - C - G - D$, where GSI is the state level equivalent of GNI, derived by adding to GSP net factor payments from both international and interstate transactions. It needs to be noted that this is in effect an estimate of net *private sector* saving, as all of government spending (G) is treated as if it was consumed. In our estimates we subtract only government consumption spending:

$$S = GSI - C - G_c - D \quad (1)$$

Net Saving can also be estimated from the expenditure side where

$$S = I + (X-M) - D \quad (2)$$

In the context of a State within a country, the term (X-M) represents net international *and* inter-state current account balances. By adding these balances one is effectively *subtracting* from State investment net external (international and inter-state) borrowing. The World Bank's methodology follows this approach. As we have reasonable data for both

Queensland government consumption spending (G_c) and net international and inter-state trade, both approaches were used and the results averaged.

To obtain a more precise estimate of saving we should also add to GSP the other components of disposable income not included in GSI, such as unrequited transfers, including grants or transfers from federal government, to arrive at *State Disposable Income*. In other words, net state saving (from disposable income) can be written as:

$$S' = I + (X-M) - D + NT \quad (3)$$

where NT are *net* unrequited transfers from abroad and inter-state. To be consistent with the World Bank's calculations we have not used this broader definition of state saving.

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The School of Economics has developed specialisations in several fields of applied economics including project evaluation and cost benefit analysis, transport economics, public finance, regional and urban studies, applied econometric analysis and economic model building. Other areas of interest to the School include development economics, natural resource utilisation, environmental economics, science and technology policies, information economics research, macroeconomics and monetary economics.

CONSULTING SERVICES:

- * economic impact analysis at state and regional level
- * regional and urban economic planning and policy issues
- * local government economic planning
- * general microeconomic analysis
- * industry studies
- * health services research
- * economic evaluation studies
- * cost benefit analysis
- * economic modelling and testing
- * macroeconomic forecasting
- * statistical package instruction
- * economic analysis of Queensland economy and Queensland economic policy
- * natural resource and environmental economics including marine resource economics and aquaculture
- * labour economics
- * science technology and information policy
- * information economics and economics of technological change
- * input-output impact studies
- * managerial economics
- * economics of tourism
- * development economics in the Third World - Asian Pacific Economics

Research units within the School include:

Regional and Urban Economics Research Unit (*Director: Professor Rod Jensen*)

This unit was formed to co-ordinate activities appropriate to research and the dissemination of ideas on regional and urban economics. The Unit has particular strengths in regional and urban modelling, policy and planning.

Resources Environment and Development Research Unit (*Director: Associate Professor George Docwra*)

This unit was formed to carry out research into all aspects of economic and environmental policy formation with particular, but not exclusive, focus on Queensland and Australia, centring on issues which involve natural resources.

Queensland Economic Policy Research Group (*Director: Dr. Tom Riha*)

The program is concerned with research into any aspect of Queensland economy - but especially with critiques of government policy, restructuring of the economy in the light of changing world trade circumstances, public finance, and aspects of federalism.