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**CAPITAL AND DEVELOPMENT:
A CONCEPTUAL AND PRACTICAL FRAMEWORK FOR MEASUREMENT AND POLICIES**

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FOREWORD

This is not a detailed and technical survey of a vast literature, going back to the classical economists more than 200 years ago, on development and its longer term sustainability.

Rather, the paper attempts to highlight in non-technical terms:

- Capital as a key driver of development,
- How stocks of capital have to at least remain at critical levels in order to ensure longer term sustainable development,
- How to measure capital,
- And how to use this basic framework to arrive at a small set of sustainable development indicators (SDIs), mostly measured in physical terms.

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Thorvald Moe

INTRODUCTION

1. The notion of capital as a framework for, or cause of, development goes back to the seminal work of Adam Smith: "An Inquiry into the Nature and Causes of the Wealth of Nations" (1776). According to John Hicks, the first primitive growth models were constructed by the fathers of classical economics Adam Smith and David Ricardo. See "Capital and Growth" (1965), chapter 4.
2. The starting point for establishing a conceptual framework for sustainable development statistics is logically to look for theories or analytical frameworks that explain development. In chapter II below I briefly set forth a well known and long since established framework in non-technical terms.
3. The term "sustainable" means "enduring" and "lasting". So, sustainable development (SD) is development that lasts. "Utility" or "well-being" (per capita) is the appropriate focus for analysing development and the extent to which it may last over the longer term. For an analysis of the link between wealth and social welfare, and useful insights into why we need to care about wealth measures, see Samuelson "The Evaluation of Social Income, Capital Formation and Wealth" (1961). Concern regarding SD depends on several factors:
 - Firstly, the seriousness of tradeoffs between longer term sustainability and other (short term) social goals, cf. for example how this is elaborated in the Stern Report: The Economics of Climate Change;
 - Secondly, the seriousness of major risks to longer term sustainability.
4. The challenge of SD is basically a global one. Can economic development as we know it be sustained over the longer term, inter alia to enhance material welfare per capita in a number of developing countries, while at the same time maintain capital stocks at sustainable levels and preserve the global environmental commons? The above mentioned Stern Report argues that the total stock of greenhouse Gases, GHGs, (CO₂ eq) should be stabilised at 500-550 ppm in 2050 to achieve sustainability. If correct, this is then a global, physical sustainability indicator (SDI) for the global climate threat, but to achieve sustainability we have to reduce emissions of GHGs by 80 per cent compared to BAU. The costs according to Stern will be that the level of world GDP in 2050 will be one percentage point lower than if we do not do anything (BAU). The benefits will be large, so that the present value – when we discount costs and benefits by a social discount rate – will be positive. So, policy makers are faced with the question of buying insurance now and in coming years in order to reduce future risks. A question we face in our daily life, i.e. whether we should apply the precautionary principle. But there is no free luncheon. If we buy insurance today, there is something else we have to give up.
5. Some (imperfect) global conventions are in place in order to achieve global sustainability, e.g. The Kyoto Protocol under The United Nations framework Convention on Climate Change which establishes physical targets for emissions in 2008-2012 for those countries that have ratified The Protocol. But many of the policies and policy instruments needed are still the responsibility of sovereign nation states.
6. Thus national SD measurements and policies can be useful in order to contribute to reducing a global problem:
 - About two-thirds of GDP and GHGs are presently produced by developed countries;
 - Most policies to promote SD are still national or the responsibility of nation states;
 - A number of European countries have now established national SD strategies which may indicate increasing political support for contributing to global SD through national policies.
7. In any case, the mandate of The Working Group on SD Statistics, WGSDS, is mainly directed at national statistics in OECD/CES countries. At the CES Bureau meeting in October 2006 the decided mandate was: "The WGSDS is encouraged to thoroughly explore the approach on four types of capital - economic, natural, human and social capital, as the basis for the measurement of sustainability. However in each of the four capital areas the WGSDS is encouraged to go only as far as it can in a conceptually sound manner".

FORCES DRIVING DEVELOPMENT

8. Saving and investments are keys to development. It is fundamental that one has to save in order to have a surplus in which to invest in maintaining or enhancing the capital stock. As far as I know, the first systematic and rigorous treatment of this topic is found in F. Ramsey: "A Mathematical Theory of Saving" (1928). *Economic Journal*, 38:543-59.
9. Economic Nobel Prize winner Robert Solow revived interest in classical growth theory in the 1950s, and he sums up his work on neoclassical growth theory in his book: "Growth Theory: An Exposition" (1988) formalising production functions or growth equations explaining the forces driving development.
10. The notion of human capital was introduced in the literature by T.W. Schultze and Gary Becker in the 1960s. In Romer's models of endogenous growth of the 1980s, human capital was seen as an important element in understanding development, as was (endogenous) technological change. The OECD Growth Study (2003) documents empirically (inter alia through regression analyses) the importance of education and human capital for (economic) development. Greker will elaborate on human capital in a separate paper.
11. The role of natural resources or natural capital, NC, has perhaps been intuitively understood for a long time. Land figured prominently as a factor of production in Ricardo's works. Some 30 years ago John Hartwick published the article: "Intergenerational Equity and the Investing of Rents from Exhaustible Resources" (1977). *American Economic Review*, 67:972-4. For a fairly recent survey of this literature, see Atkinson, Dubourg, Hamilton, Munasinghe, Pearce and Young: "Measuring Sustainable Development. Macroeconomics and the Environment" (1997).
12. Pearce and Atkinson introduced the concept of weak sustainability (WSD) in their article: "Capital Theory and the Measurement of Sustainable Development: An Indicator of Weak Sustainability" (1993). *Ecological Economics*, 8:103-8. WSD is a rule specifying that the overall capital stock per capita, or national wealth (NW) per capita, does not decline over time. Substitution between the various stocks of capital is possible. This links to neoclassical growth theory which assumes that the elasticity of substitution is positive (unity in Cobb-Douglas production functions).
13. Strong sustainability, SSD, assumes that substitution is limited, and that there is at least a minimum requirement for maintenance of (critical levels) the natural capital stock, NC.

MEASUREMENT OF CAPITAL

14. Thus a long established and well known general theory or framework for development is based on capital. I.e. the forces driving development are financial, real or produced capital PC, human capital HC, natural capital NC, social capital SC, population developments and technological change. Growth theory as it has been developed over a long time period, as briefly sketched above, is a special case of more general development theory. Growth theory, at least until recently, assumed (implicitly) that NC can be substituted by other types of capital over time, and/or that technological improvements (new technologies) are such that we need not worry about critical levels of NC. In other words, weak sustainable development, WSD. Recent research and empirical evidence indicate in my view that prudent long term risk management should not ignore such longer term risks as climate change, destruction of ecosystems, etc. Thus we need to assess the real developments of each main capital category, notably critical levels of NC. To make sustainability assessments (strong SD-SSD), one needs to assess the present value of the future services of capital stocks, and one may attempt to maximize this present value per capita -social welfare- subject to the constraint that critical or irreversible levels of NC are not eroded.

15. Financial and real capital are measured according to SNA conventions. Alfsen, Bye and Lorentsen published in 1987 methods for how to measure natural capital. Recently, Smith, Simard and Sharpe published work on measurement of natural capital in Canada, see: "A Proposed Approach to Environment and Sustainable Development Indicators Based on Capital" (2001).

How National Wealth, including natural capital, is measured presently in Norway, see section IV below.

16. Human capital is estimated indirectly in estimation of NW. This is what The World Bank calls The Intangible Capital Residual: The Role of Human capital and Institutions. See: "Where is the Wealth of Nations? Measuring Capital for the 21st Century" (2005). This residual seems to include more than human capital, HC, it also may include institutions (governance) - perhaps a key factor in explaining the differences in pace and levels of development between developed and developing nations. The World Bank Publication, edited by Dasgupta and Stiglitz, "Social Capital. A Multifaceted Perspective" (2000) gives various interpretations both from economic and sociological perspectives. While not discussing SC at length, d'Ercole and Salvini suggest in their paper. "Towards Sustainable development: The Role of Social Protection" (OECD 2003) how key longer term social developments matter for SD, and how it can be measured through indicators. The role of social institutions and social protection systems and how well they work as elaborated upon in this paper could be interpreted as forms of social capital important for development.

MEASUREMENT OF NATIONAL WEALTH

17. The following will give a brief description, based on Greaker op. cit., how Statistics Norway presently estimates NW and its main components. One should distinguish between the concept of National Wealth which includes a nations total capital and resource base (financial, real, natural, human and social capital), and its measurement in numbers. This is illustrated below. The value of each category of capital is defined as the present value of the income or services that these can be expected to yield in the future. Briefly, the following three steps are followed:

- Step 1: Natural resources are particular goods because they are not produced by inputs of labour and produced capital. Exploitation of NC will therefore provide added value to the extent they are managed efficiently. This added value, or resource rent RR, is the income from NC left after the expenditures of extraction and sale are deducted. RR for each category of NC is thus computed based on the national accounts (SNA). For the period 1985 to 2004 this was done for the following categories in Norway: fisheries, forests, agriculture, hydro power, oil and gas and mining.
- Step 2: Net National Income (NNI) is decomposed each year based on the national accounts and the definition of GDP as follows: $NNI =$
 - i) RR for renewable NC (fish, forests, agriculture, hydro power);
 - plus ii) RR for non-renewable resources (oil, gas and mining);
 - plus iii) The return on the stock of produced capital, PC;
 - plus iv) Net income from wealth and wages to abroad;
 - plus v) The return on human capital, HC.iv) comes directly from SNA, and HC is arrived at as a residual.
- Step 3: Computation of NW =
 - i) Present value of RR of renewable NC;
 - plus ii) Present value of RR of non-renewable NC;
 - plus iii) Present value of the rate of return of HC;
 - plus iv) The stock of produced capital, PC;
 - plus v) The stock of net claims on foreigners.

18. Estimated NW in Norway grew in real terms from some 2000 billion NOK in 1985 to some 3000 billion NOK in 2004. Shares in 2004 were: NC 12 pst, PC 12 pst and HC 76 pst (NW of agriculture was found to be negative). The World Bank uses the same conceptual framework based on capital in their wealth estimates. See "Where is the Wealth of Nations? Measuring Capital for the 21st Century" (2005). This book describes

estimates of wealth and its components for nearly 120 countries. Genuine Savings (GS) is the difference between real stocks of wealth estimated at different periods. The World Bank definition of GS is given in Figure 3.1, page 37 of the above mentioned book.

19. See also Geir B. Asheim: "Indicators of Welfare Improvements and Sustainability" Appendix 3 in The Norwegian Commission on Sustainable Development Indicators: "Simple Signals in a Complex World, Proposals for a National Set of Indicators for Sustainable Development". Norwegian Official Report, NOU 2005:5

FROM MEASURING CAPITAL TO PRACTICAL SUSTAINABLE DEVELOPMENT INDICATORS, SDIS

20. As further elaborated upon in my paper: "The Norwegian Model of Sustainable Development: A Conceptual and Practical Framework for Measurement and Policies" (2007), estimates of NW (like GDP) have their limitations. Only natural capital components directly or indirectly exchanged in markets are counted. Thus additional SDIs for natural capital components not exchanged in markets and measured in physical terms are needed and thus included in the Norwegian core SDI set. Presently, human capital is estimated as a residual. In this residual one could also imagine that some key institutional and social components important for long term development more included. As elaborated upon in my paper, op. cit, The Norwegian Sustainable Development Indicator Commission therefore included SDIs in physical terms of human capital and social conditions. This is now official policy. See Statistics Norway: "Natural Resources and the Environment" (2006). Mads Greger will, as mentioned, in a separate paper elaborate on ways to arrive more direct estimates of human capital.

21. Key requirements to use the capital framework to construct SDIs based on this framework should be:

- A single index should not be used for the reasons given above. In addition it easily leads to too much focus on technical and methodological issues (as with "green" GDP);
- One must avoid a large set of indicators which at best is impractical, and easily hides essential messages and key threats to SD;
- Policy relevance;
- SDIs must be based on a theoretically sound framework (the key task of WGSDS), and not ad hoc or short term political issues based on measurement without theory.

22. Short term policies are made on the basis of SNA (growing out of the Keynesian theoretical framework after World War II). Longer term development policies need to look how the overall resources base, NW, develops over time, on how one manages each component of the portfolio of main assets, and how one transforms one form of asset into another most efficiently. These are key elements of all good longer term development policies, and necessary to assess sustainability of development if that is the key policy question at hand.

23. To reiterate, the capital approach does not rely only on one capital stock indicator (NW per capita in real terms and its development over time) measured in monetary terms. Let me briefly illustrate by alluding to present practices in Norway:

- Step 1: Compute NW in real terms per capita and compare with the same measure made last time (historical numbers).
- Step 2: Use the core SDI set, largely in physical terms, that have been arrived from the capital approach and are indicators for each capital category (and relates to each of the main policy areas in a national SD strategy), to assess sustainability risks or challenges in key areas.
- Step 3: One looks, e.g., at the GHG indicator of CO₂ emissions to see how it develops. If we see that this indicator shows steadily increasing emissions, we make a further assessment by simulating with the aid

of our economic model - with submodels of energy and emissions - developments into the longer term (2010 and 2020) based on present policies (BAU). If these simulations indicate unsustainability by breaching the Kyoto target and up to 2020, policy measures such as green taxes and emission trading schemes are implemented.

- Step 4: Similar examination and possible in depth analyses of the other 17 core Norwegian SDIs.

24. Another advantage of the capital approach for assessment of sustainability and policy use is that it gives a consistent and fairly rigorous framework for using the right indicators and asking the relevant questions for assessing longer term sustainability. One example is real GDP (per capita), presently used in a number of SDI sets. According to present SNA conventions, (increased) extraction and sale of natural resources, e.g. the non-renewable resource petroleum in the Norwegian case, will boost GDP. No subtraction is made for the corresponding reduction in the stock of a (non-renewable) natural resource which reduces the production and income possibilities for future generations. Thus GDP is not an SDI! Using it as such could even be misleading and actually contribute to non-sustainable policies¹. Instead one should assess the evolution of the real stock of NC over time (or how these stocks evolve, i.e. real genuine savings, and in addition aided by physical SDI indicators, look at critical values, and as far as possible apply the Hartwick rule of managing NC. This as part of a total valuation of developments also in PC, HC and SC - and the sustainable development indicators that flow naturally from the capital framework.

25. The capital framework is also, according to our experience in Norway, a simple and practical framework for the construction and follow up of SDIs. It is based on well known theory and statistical procedures, based in our case on one national accounts, resource accounts and available statistics, and most of the work is coordinated by one national statistical agency: Statistics Norway.

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¹ GDP measures material living standards but not the over all well-being (social welfare) of its citizens. See Boarini, Johansson and D'Ercole: "Alternative Measures of Well-being" OECD (2006).

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