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MEASURING SUSTAINABLE DEVELOPMENT: WEALTH AND ADJUSTED NET SAVINGS

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I. INTRODUCTION

1. A large body of theoretical work has shown that wealth, encompassing produced, natural and human capital, is the proper measure of economic well being and that maintaining wealth is essential for sustainable development (see Fisher (1906) for the earliest effort, followed by Samuelson (1961), with a large amount of work since then summarized in Dasgupta (2009)). In parallel, applied work to improve the System of National Accounts by extending it to cover missing capital and investment items and reclassify as intermediate costs items that are currently treated as final demand (e.g., defensive expenditures by government on defense and pollution abatement) (Nordhaus and Tobin, 1973; Eisner, 1988). Considerable progress has been made in the area of natural capital with the development of a handbook for environmental accounting (UN et al., 2003).

2. In this paper we report on the current state of the World Bank's work on the capital approach to sustainable development, priorities for future work and comments on the JTF report on Measuring Sustainable Development. Section 2 briefly describes the World Bank's approach to measuring wealth and Genuine Savings. Section 3 presents some of the recent wealth accounts for 2005 and describes work to test Genuine Savings as an indicator of sustainable development. Section 4 identifies the work planned by the World Bank to improve the wealth accounts and Section 5 concludes with comments on the report by the JTF.

II. MEASURING THE WEALTH OF NATIONS

3. Estimates of wealth and saving for 120 countries are derived from internationally available data, employing the methods outlined below.

4. To measure total wealth along the lines suggested by Fisher (1906), Hamilton and Hartwick (2005) show that the current value of wealth – measured by summing up produced, human and natural capital – is equal to the present value of future consumption if (i) asset prices are efficient (exhaustible prices follow the Hotelling rule, for example), and (ii) the economy exhibits constant returns to scale. Assuming a constant rate of growth of consumption and a specified rate of time preference, it is possible to calculate total wealth using a measure of current consumption.

5. Broadly speaking, total wealth is composed of produced, natural and intangible capital, where the latter is an aggregate including human, social and institutional capital. The estimation proceeds by first calculating total wealth as the present value of consumption. We then construct estimates of produced and natural capital. Finally we calculate intangible capital as the difference between total wealth and the sum of produced and natural capital – Table 1 outlines the basic approach.

Table 1: Estimating wealth in four steps

	(1) *Total capital*	*(2)* *Produced capital*	*(3)* *Natural capital*	*(4) = (1)-(2)-(3)* *Intangible capital*
Method used	Present Value of consumption	Perpetual Inventory Method	Present Value of rents Opportunity cost	Difference
Assets included	By definition, all assets that contribute to national consumption	Machinery, equipment and infrastructure Urban land	Sub-soil assets Forest resources (timber and non-timber) Crop and pasture land Protected areas	Human capital Governance Institutional effectiveness All other assets not measured in column (2) and (3)

A. Produced capital

6. There are a number of estimation methods available for the calculation of produced capital stocks. The Perpetual Inventory Method (PIM) is the method used here. Urban land was valued as a fixed proportion of the value of physical capital. This is a fall back for the more palatable and data intensive option of using country-specific proportions. A constant proportion equal to 24% is then assumed[1].

B. Natural capital

7. Natural capital is the sum of non-renewable resources (including energy resources such as oil, natural gas and coal, and mineral resources), cropland, pasture land, and forested areas (including areas used for timber extraction and non-timber forest products). These resources are valued by computing the present value of natural resource rents over the life span of the resource (which will be finite for exhaustible resources or renewable resources that are being exploited unsustainably). When data on rents (or benefits) are not available, the opportunity cost method is used instead – this is how protected areas are valued as part of natural capital.

8. Sub-soil assets. Estimating future rents for sub-soil assets is subject to high level of uncertainty. Here the simplifying assumption that rents grow at a constant rate is used. Moreover, an average life of a mine is assumed to be 20 years (this may vary from country to country though and from one resource to the other)

[1] The estimation of the value of urban land is based on Canada's detailed national balance sheet information. Urban land is estimated to be a 33% of the value of structures, that in turn is estimated to be a 72% of the total value of physical capital.

9. Timber resources. The predominant economic use of forests has been as a source of timber. Timber wealth is calculated as the net present value of rents from roundwood production. The estimation then requires data on roundwood production, unit rents and the time to exhaustion of the forest (if unsustainably managed). Notice that the use of rents to value capital implicitly assumes that the timber value of forest is given by the currently exploitable timber, rather than the volume of the resource itself.

10. In the case of non-timber forest products, average world values are applied to a share of the country's forest.

11. Cropland. Given the lack of data on price of land, land values are computed on the basis of the present value of land rents, assuming that the products of the land are sold at world prices. The return to land is computed as the difference between market value of output crops and crop-specific production costs. Nine representative crops are taken mainly based on their production significance in terms of sowing area, production volume, and revenue. The nine representative crops considered are: maize, rice, wheat, banana, grapes, apples, oranges, soybean, and coffee. A country's overall land rent is calculated as a weighted average (weighted by sowing areas) of rents from the crop categories. A projected growth in production (land areas are assumed to stay constant) is assumed.

12. Pasture land. The returns to pasture land are assumed to be a fixed proportion of the value of output. On average, costs of production are 55 percent of revenues, and therefore returns to pasture land are assumed to be 45 percent of output value. Value of output is based on the production of beef, lamb, milk and wool valued at international prices. As with croplands, this rental share of output values is applied to country-specific outputs of pastureland valued at world prices. A projected growth in production is assumed also in this case.

13. Protected areas values are obtained using as a proxy the lowest between the unit value of cropland and pasture land, an imperfect – because conservative – measure of the opportunity cost of protecting land areas. Precise estimations are very difficult to undertake and country specific data are sparse.

C. Intangible capital

14. By construction, intangible capital includes all assets that are not measured explicitly in the produced and natural capital estimates. It includes assets such as the skills and know-how embodied in the labor force – human capital. It also encompasses social capital, the amount of trust among people in a society and their ability to work together for common purposes. It includes those elements of governance, such as quality of institutions, which boost the productivity of the economy. It includes net financial assets, but not explicitly – net receipts or payments of interest have the effect of raising or lowering consumption levels, and these flows are capitalized in the intangible capital residual. Finally, it includes any natural capital that has not been captured. At this time groundwater, fisheries and coastal resources have not been included in wealth accounts

D. Genuine Saving

15. Turning to changes in wealth, the following summarizes how the saving estimates are constructed:

Genuine saving	=	Gross national saving
	+	Education expenditure
	-	Consumption of fixed capital
	-	Depletion of energy resources
	-	Depletion of minerals
	-	Net depletion of forests
	-	CO_2 damages
	-	Particulate pollution damages

16. Here gross national saving and consumption of fixed capital are precisely as defined in the SNA. Education expenditures are added to saving in order to estimate investment in human capital. This is a particularly crude assumption since it represents gross rather than net investment, and it assumes that each dollar of educational expenditure is in fact creating a dollar of human capital.

17. For each type of resource and each country, depletion is measured using a revised, theoretically devised method described in (Hamilton and Ruta, 2009), in which total asset value is divided by the remaining lifespan.

18. A positive net depletion figure for forest resources implies that the harvest rate exceeds the rate of natural growth; this is not the same as deforestation, which represents a change in land use. In principle, there should be an addition to savings in countries where growth exceeds harvest, but empirical estimates suggest that most of this net growth is in forested areas that cannot be exploited economically at present. Because the depletion estimates reflect only timber values, they ignore all the external and non-timber benefits associated with standing forests.

19. Pollution damage from emissions of carbon dioxide is calculated as the marginal social cost per unit multiplied by the increase in the stock of carbon dioxide. The unit damage figure represents the present value of global damage to economic assets and to human wellbeing over the time the unit of pollution remains in the atmosphere – roughly 100 years in the case of CO_2.

20. Pollution damage from particulate emissions is estimated by valuing the human health effects from exposure to particulate matter pollution in urban areas. The estimates are calculated as willingness to pay to avoid the mortality and morbidity from cardiopulmonary disease and lung cancer in adults and acute respiratory infections in children.

III. WEALTH AND SAVING ESTIMATES: MAIN FINDINGS

21. Country-specific estimates of total capital and saving rates were presented for 2000 and 1995 in *Where is the Wealth of Nations?* (World Bank 2006). A new report is under preparation, *The Changing Wealth of Nations*, that updates the wealth accounts for 2005 and analyzes changes over the past decade. Table 2 summarizes the most recent wealth estimation results by region, income group and for the world as a whole. High energy and mineral exporters are treated as a separate group (denoted ‘oil exporters’) because of their unique characteristics.

Table 2. Estimates of total wealth and its components by region and income group in 2005 (US$ per capita and %)

Group	*Dollars per capita*				Percent share of total wealth		
	Total Wealth	**Natural Capital**	**Prod. Capital**	**Intang. Capital**	**Natural Capital**	**Prod. Capital**	**Intang. Capital**
Lat. Am. and Carib.	75,280	15,003	12,259	48,017	20%	16%	64%
Sub-Saharan Africa	13,294	5,468	1,956	5,870	41%	15%	44%
South Asia	10,156	2,933	1,828	5,395	29%	18%	53%
East Asia and Pacif.	19,412	5,358	5,687	8,367	28%	29%	43%
Mid. East and N.Africa	29,405	14,083	7,107	8,215	48%	24%	28%
Eur. and Central Asia	69,485	16,934	14,228	38,323	24%	20%	55%
Low Income	9,007	3,588	1,571	3,849	40%	17%	43%
Lower Middle Income	22,082	6,754	5,885	9,444	31%	27%	43%
Upper Middle Income	87,640	17,741	15,802	54,097	20%	18%	62%
High Income OECD	563,907	20,227	97,043	446,637	4%	17%	79%
World	***113,325***	***9,197***	***20,348***	***83,780***	***8%***	***18%***	***74%***
World excl. oil	119,834	7,123	21,223	91,488	6%	18%	76%
Oil exporters	45,413	30,833	11,217	3,363	68%	25%	7%

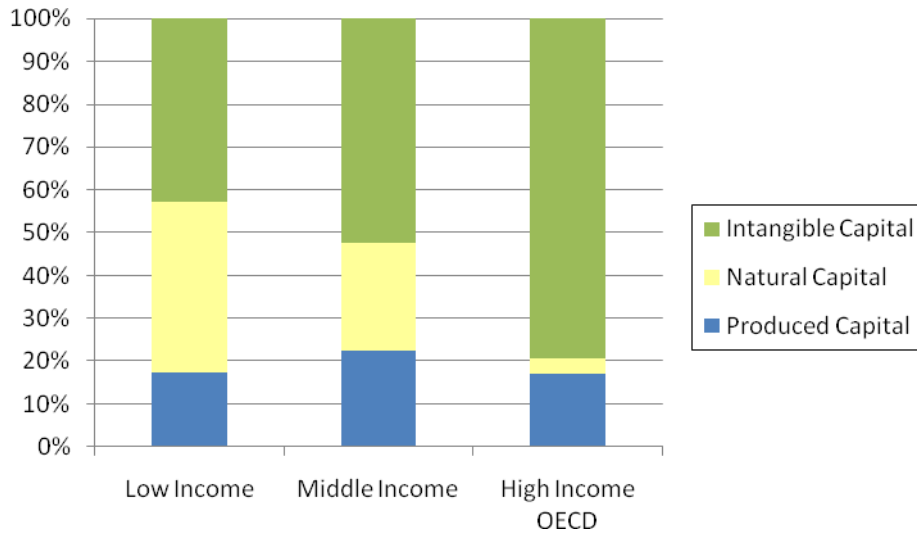
Source: World Bank, forthcoming 2010

22. As Table 2 and Figure 1 show, intangible capital is the preponderant form of wealth and, the share of intangible capital rises across income classes, as expected. The world's poorest countries depend heavily on natural resources (column 6 in Table 2). For low income countries overall, natural resources constitute 40% of total wealth, a share that is larger than produced capital. The natural resource share falls to 4% of total wealth in high income countries, but this is a fall in relative terms – the total value of natural capital per person actually rises with income.

23. The oil exporters stand out as a special case with only 7% of total wealth composed of intangible capital. As argued in *Where is the Wealth of Nations?* this almost certainly reflects the low returns on all assets that characterize these economies – resource rents of more than 20% of GNI (in some cases much more) are highly distortionary. The 'resource curse' literature explores these issues more fully.

24. Although it is estimated as a residual, intangible wealth is not entirely a black box. Preliminary analysis in *Where is the Wealth of Nations?* suggests that over 90% of the variation in intangible wealth across countries can be explained by human capital and institutional quality, with roughly equal shares of intangible wealth for each. A society investing in skilled workers, trusted institutions and efficient government is building the very basis of welfare creation.

Figure 1: Wealth Composition by Income Group



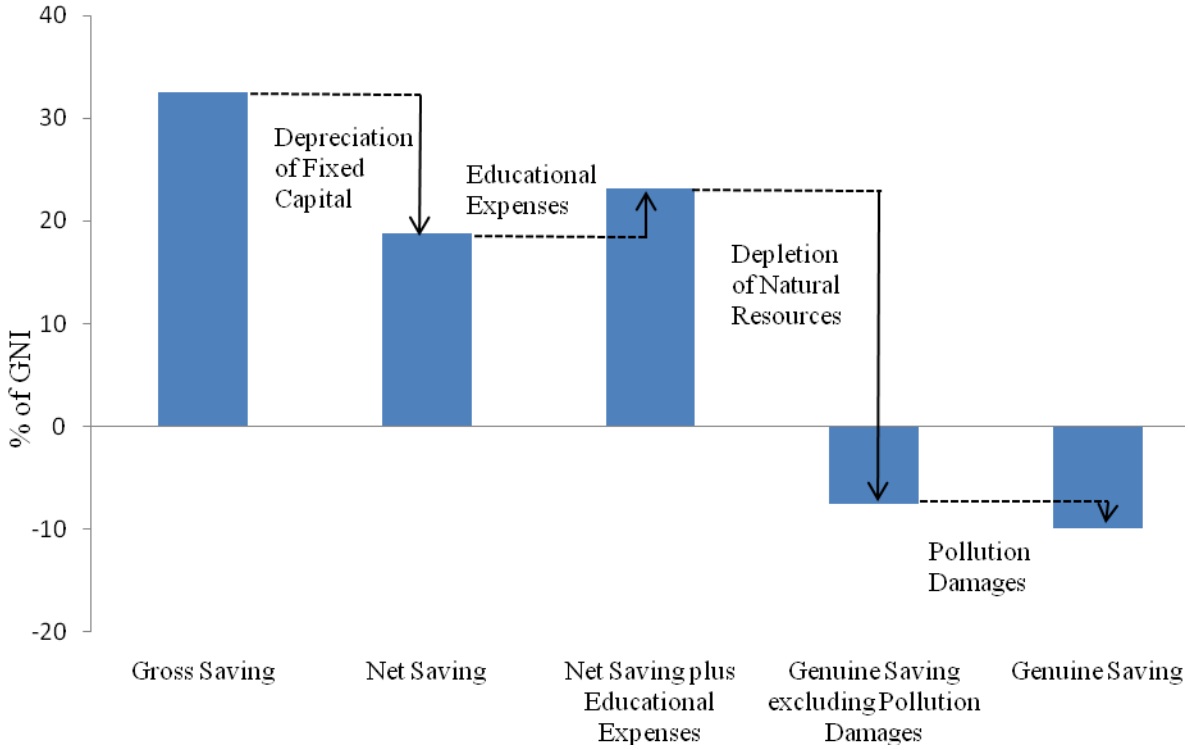
Source: Table 2.

25. Figure 2 shows the steps in calculating genuine saving for Kazakhstan, which is endowed with a wealth of natural resources. The first column in Figure 2 shows the traditional measure of gross national saving in Kazakhstan, 33 percent of gross national income (GNI) in 2007.

26. Deducting the depreciation of produced capital reveals a lower net saving rate, less than 19 percent. Investments in education are estimated to be around 4 percent of GNI, bringing the saving rate up to 23 percent as shown by the third column. Following this, an adjustment is made for depletion of natural resources: oil, gas, gold, silver, lead, zinc, and tin, which amounts to almost 31 percent of GNI. As a result of these deductions for resource depletion, Kazakhstan's genuine saving rate is negative. There are no significant forest resources in Kazakhstan. Finally, the deduction for pollution damages (about 90% of this adjustment is for carbon emissions) leads to a bottom-line estimate of Kazakhstan's genuine saving rate of almost minus 10 percent of GNI. Kazakhstan is currently on an unsustainable development path.

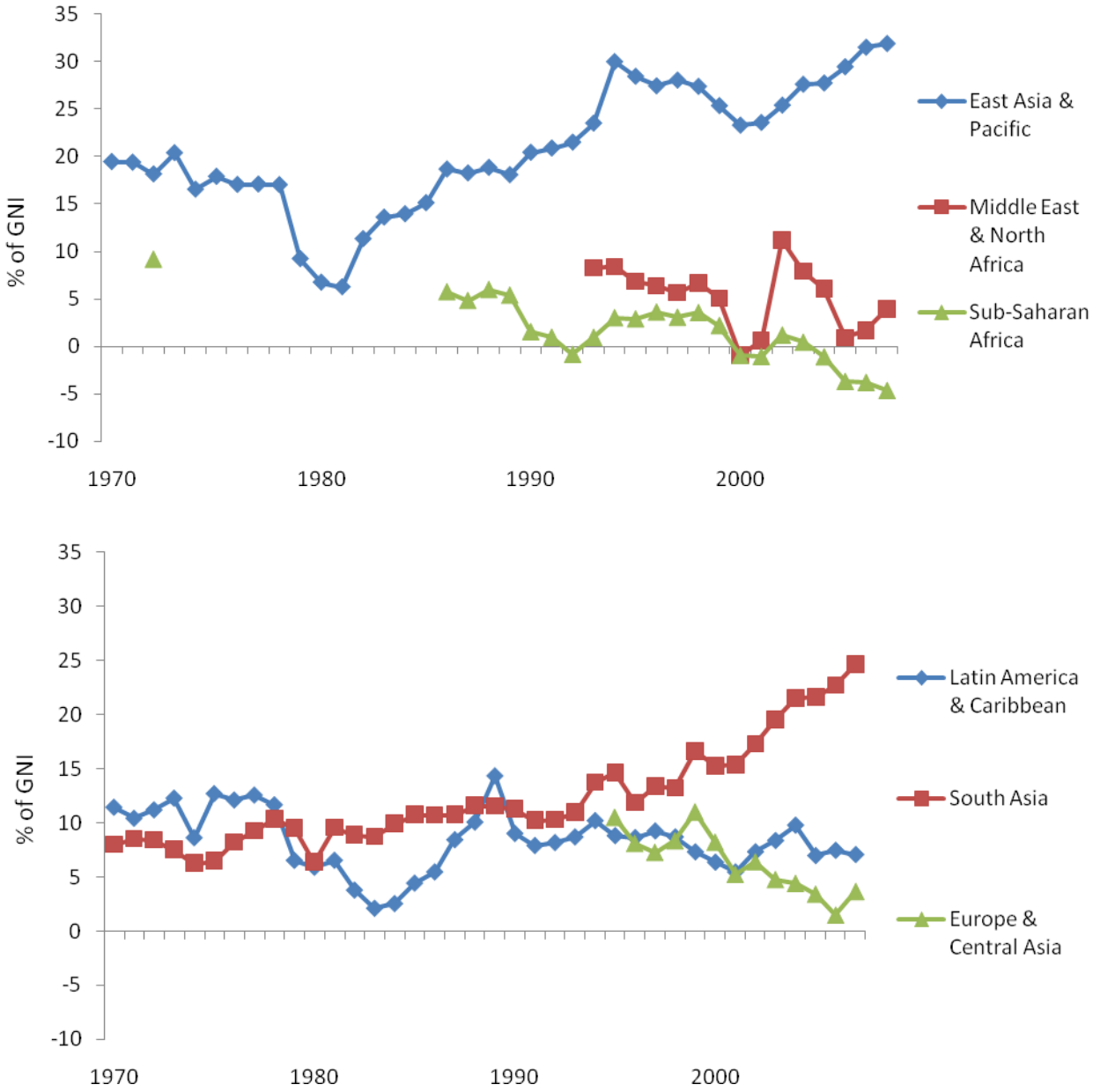
27. As Figure 3 shows, aggregate savings as a percent of GNI for the developing regions of the world display distinctive levels and trends. East Asia & Pacific and South Asia stand in stark contrast with the other regions, with recent aggregate genuine saving figures over 25 percent. The boom in economic performance from the second half of the 1980s until the Asian financial crisis in 1997 is reflected in the genuine saving numbers, largely driven by increases in gross national saving.

Figure 2. From Gross Saving to Genuine Savings in Kazakhstan, 2007



Source: World Bank unpublished database, 2009

Figure 3. Trends in Genuine Saving by Region, 1970 to 2007



Source: World Bank unpublished database, 2009

28. Genuine saving rates have been declining in Sub-Saharan Africa and are currently negative. Positive saving in countries such as Kenya is offset by strongly negative genuine saving rates in resource-dependent countries such as Angola which had a genuine saving rate of minus 36 percent in 2007.

29. Latin American genuine savings rate have remained fairly constant throughout the 1990s. The large economies in the region, Mexico and Brazil, have positive genuine saving rates in excess of 5 percent.

30. This is the broad picture that emerges from the cross-country analysis of wealth and savings: intangible wealth, including human and institutional capital, is the most important

share of wealth, and this share increases with income. In low income countries natural resources are the next most important share of wealth. Genuine saving rates are negative in many of the most resource-dependent economies, and have been effectively zero in Sub-Saharan Africa over the past decade.

31. The important story for development in the wealth and saving figures is not the 'league table' listing who is richest, who poorest, but the composition of wealth and the sign and magnitude of the change in wealth.

32. The composition of wealth tells policy makers which assets are crucial for welfare. As noted above, in low income countries natural resources represent a much larger share of wealth than produced assets, so natural resource management will have a significant impact on social welfare in these countries. The saving figures tell policy makers whether social welfare is rising or falling and, in the latter case, whether the economy is on an unsustainable path. An admonition to policy makers to 'maintain positive genuine saving' is not very operational, however. The key to sustainability policy is to decompose saving into its components, which will reveal the key set of policy questions.

A. Testing Genuine Saving as an indicator of sustainable development

33. The usefulness of an indicator of sustainable development lies in its predictive power, how well it can predict the present discounted value of future consumption. Ferreira and Vincent (2005) and Hamilton, Ferreira and Vincent (2008) tested Genuine Savings econometrically—to our knowledge the only indicator that has been subjected to such testing.

34. Using World Bank historical data on consumption and genuine saving, they found that when conventional Gross Savings was used, the relationship between savings and the present discounted value of future consumption was negative. But when Gross savings was adjusted for natural capital there was a strong positive correlation as theory predicts, especially for non-OECD countries. The relationship did not hold when savings were adjusted for education expenditure, however, which probably indicates the weakness of this indicator of changes in human capital.

IV. PLANS FOR NEW WORK ON WEALTH ACCOUNTS

35. Ultimately, our goal is to convince countries to implement wealth accounting and use their own data for the accounts, as each country compiles its own national accounts. The wealth accounts compiled by the World Bank demonstrate that it is possible to make reasonable estimates of wealth and changes in wealth that are comparable across a large number of countries. Even using rather crude data, the results are useful for indicating broad trends.

36. National statistical offices in a number of countries have begun to implement wealth accounting, notably for subsoil assets, but for the foreseeable future, the majority of countries will not do so and the World Bank will continue to estimate wealth and genuine saving. However, major improvements in the World Bank estimates are needed both in the conceptual understanding of wealth and empirical methods.

37. The World Bank is planning a new report on wealth for 2010, called *The Changing Wealth of Nations*. With this update we will have wealth accounts for 3 years, 1995, 2000, and

2005 which will allow us to analyze the dynamics of changes in wealth and well being over time.

38. The new report will address several conceptual issues including

(a) Estimation of intangible capital based on more theoretically grounded and extensive analysis of the residual;

(b) Alternatives to market exchange rates for international comparisons. We will be exploring the use of PPP or some parts of PPP.

39. Empirical issues that will be reviewed include:

(a) Treatment of some natural capital that is currently omitted: certain minerals, fisheries, groundwater;

(b) Assumptions and data underlying current calculations for mineral and forest asset values, e.g., unit rents, lifespan, value of non-timber forest products;

(c) How to incorporate asset values compiled by national statistical offices.

V. WORLD BANK WEALTH ACCOUNTS AND THE JTF PROPOSED SD INDICATORS

40. The Joint UN ECE/Eurostat/OECD Task Force recently issued a report, *Measuring Sustainable Development* (UN ECE, 2009), that has proposed a small set of indicators for international comparisons of sustainable development, including those based on the capital-approach.

41. The proposed set of indicators includes the individual components of wealth and savings but not total economic wealth and adjusted net savings. We would like to point out that although the individual components are useful in identifying policy responses, the indicator relevant to monitoring sustainability is total economic wealth, the sum of the individual components. We would strongly recommend that this indicator be included.

42. The JTF raised several issues regarding use of economic wealth as an indicator of sustainable development. One of them, understanding of the residual, is a priority in the World Bank's current work. The other two issues regarding assumptions about the future path of income and the use of existing relative prices are also critical issues and we would welcome cooperation to address these issues.

VI. REFERENCES

Dasgupta, P. 2009. The welfare economic theory of green national accounts. *Environmental and Resource Economics,* 42:3-38.

Eisner, R., 1999. Extended Accounts for National Income and Product, *Journal of Economic Literature*, vol XXVI, 1611-84.

Ferreira, S. and J. Vincent. 2005. Genuine savings: leading indicator of sustainable development? *Economic Development and Cultural Change* 53(3): 737-54.

Fisher, I. 1906. The *Nature of Capital and Income,* New York: Macmillan.

Hamilton, K. and M. Clemens. 1999. Genuine Savings Rates in Developing Countries. *The World Bank Economic Review* 13(2): 333-56.

Hamilton, K., S. Ferreira and J. Vincent. 2008. Comprehensive wealth and future consumption: accounting for population growth. *World Bank Economic Review*.

Hamilton, K., and J.M. Hartwick. 2005. Investing Exhaustible Resource Rents and the Path of Consumption. *Canadian Journal of Economics* 38(2): 615–21.

Hamilton, K. and G. Ruta. 2009. Wealth Accounting, Exhaustible Resources and Social Welfare. *Environmental and Resource Economics*, 42:53–64

Nordhaus, W., and J. Tobin. 1973. Is Growth Obsolete? In Moss (ed), *The Measurement of Economic and Social Performance*. Conference on research studies on income and wealth Vol. 38. Columbia University Press for NBER.

Pearce, D.W., K. Hamilton and G. Atkinson 1996. Measuring Sustainable Development: Progress on Indicators. *Environment and Development Economics* 1 (1996), pp. 85-101.

Samuelson P. 1961. The Evaluation of "Social Income"," Capital Formation and Wealth, in F. A. Lutz and D. C. Hague (eds.), *The Theory of Capital*, New York: St. Martin's Press.

UN, EC, IMF, WB, OECD. 2003. *Integrated Environmental and Economic Accounting 2003*. To be issued as Series F, No.61, Rev.1 (ST/ESA/STAT/SER.F/61/Rev.1). United Nations: New York

World Bank, 2005. *World Development Indicators.* Washington: The World Bank.

World Bank. 2006. *Where is the Wealth of Nations? Measuring Capital in the 21st Century.* Washington DC: The World Bank.

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