



Measuring National Income and Growth in Resource-Rich, Income-Poor Countries

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GDP, the leading economic measurement, is outdated and misleading. . . . It's like grading a corporation based on today's cash flow and forgetting to depreciate assets and other costs. –Joseph Stiglitz, “Good Numbers Gone Bad,” *Fortune*, October 2, 2006

In the decade leading to the recent commodity boom, which peaked in 2007-08, several resource-rich, low-income countries displayed high rates of GDP growth while social indicators did not improve significantly. It is well known that, in itself, the widely tracked GDP may not be the most relevant summary of aggregate economic performance in all places at all times. This note suggests that for countries with significant exhaustible natural resources and important foreign-investor presence, *adjusted net national income* (*aNNI*), can usefully complement GDP to assess economic progress.¹

As will be explained below, *aNNI* includes a charge to net national income for the depletion of natural resources. Given that “what gets measured gets managed,” there is a strong case for routinely monitoring *aNNI*—and its related measure of adjusted net savings—especially in low-income, resource-rich economies, like many countries in Sub-Saharan Africa.

It is useful to start with a preview of the different aggregates that will be discussed in this note:

Net national income (NNI)
= GDP + (Net foreign factor income) –
(Depreciation of fixed capital)

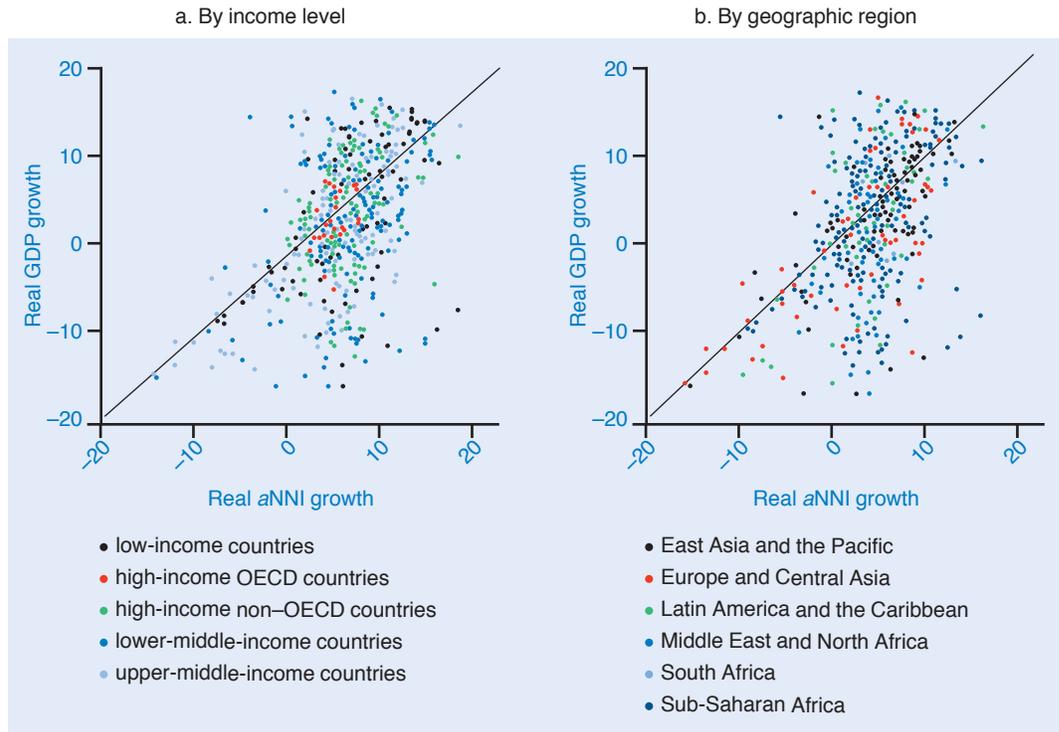
Adjusted net national income (*aNNI*)
= NNI – (Depreciation of natural
capital)

Adjusted net savings (ANS)
= *aNNI* – (Consumption) + (Foreign
transfers) + (Education expenditures)

Let's start by showing that the measures being contrasted—GDP and *aNNI*—behave quite differently empirically. Figure 1 presents a scatter plot of annual rates of real growth of GDP against *aNNI*. The figure shows that these rates of growth scatter very widely around the 45-degree line. They are unequal more often than not, and can diverge substantially for some countries in specific years.

This divergence in growth rates can also be seen over time. Figure 2, which displays average growth rates for Sub-Saharan Africa, shows that growth rates of real *aNNI* are not systematically lower than growth rates of real

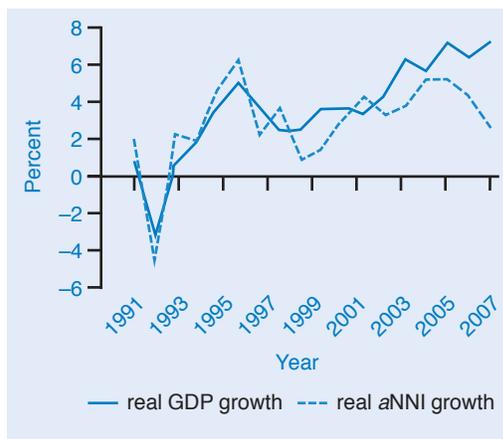
Figure 1. Rates of Growth of Real GDP versus Real aNNI, 1990–2008



Source: World Bank 2010.
 Note: OECD = Organisation for Economic Co-operation and Development.

GDP. If anything, there is a countercyclical tendency, with aNNI growing faster than GDP during a bust and slower during a boom—reflecting the underlying changes in the quantity of resource extracted and the unit resource rents.

Figure 2. Growth Rates of GDP and aNNI in Sub-Saharan Africa, 1991–2008



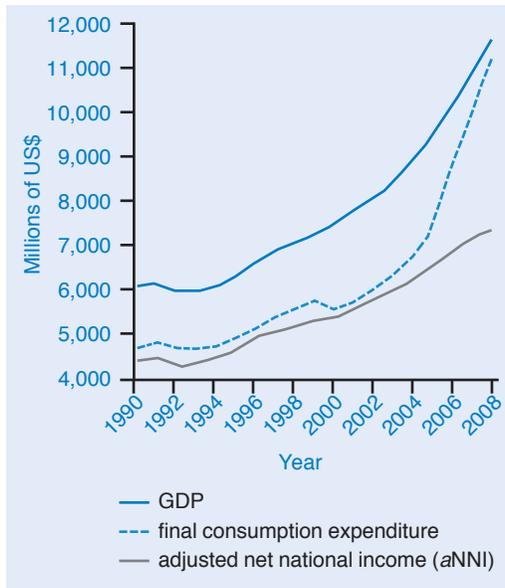
Source: World Bank 2010.

Turning to levels, data for Sub-Saharan Africa (figure 3) show that aNNI can give a strikingly different picture of economic performance when compared with GDP.² The figure shows that African countries have been consuming more than their incomes since 1990, and particularly so through much of the current resource boom. These facts suggest that overconfidence in the future of resource-rich economies may need to be revisited because it may be largely unjustified under current policies.

From GDP to National Wealth

The key to increasing future consumption and thus the standard of living lies in increasing national wealth, including not only the traditional measures of capital (such as produced and human capital), but also natural capital. Natural capital, in turn, comprises assets such as land, forests, and subsoil resources. All three types of capital—produced,

Figure 3. Consumption, GDP, and aNNI in Sub-Saharan Africa, 1990–2008
Constant 2000 US\$



Source: World Bank 2010.

human, and natural—are key inputs to sustaining economic growth.

However, as the Stiglitz quote on the first page of this note points out, GDP does not account for the depreciation of assets. Drawing down assets (of any kind) implies dis-saving. A recurring theme in this note is that national wealth shrinks if the proceeds from drawing down an asset are not invested.

Because increasing national wealth requires investment, national savings—possibly complemented by foreign savings transferred as aid—must be available to finance this investment.³ Here is where aNNI comes in, because it is the ultimate source for funding these investments. First, national income rather than domestic product is a more appropriate income measure in countries where largely foreign-operated extractive industries are substantial because payments to foreign-owned factors are often considerable.⁴ Second, in resource-rich countries, national income must be adjusted by offsetting a part of the credits for resource extraction with the

corresponding depletion costs—these costs are similar to capital depreciation.⁵

After adding net foreign factor income to GDP, and subtracting the consumption of fixed and natural capital, we obtain the country's aNNI. This is a better measure of the available income that can be consumed or invested to increase the nation's future consumption.⁶

Recognizing that resource depletion and environmental degradation are types of depreciation—whereas education expenditures increase a country's human capital—Hamilton and Clemens (1999) propose a measure of *genuine savings*. This concept is formalized in the measurement of adjusted net savings, which subtracts consumption from aNNI, adds foreign transfers, and reclassifies education expenditures from consumption to investment. See box 1 for illustrative calculations.

The policy implications of measuring adjusted net savings are quite direct: sustained negative savings lead to decreased national wealth and diminished social welfare.

Adjusted Net Savings in Sub-Saharan Africa versus East Asia: Divergence, Big Time

As figure 3 hints, a worrisome fact is that most resource-rich countries in the Sub-Saharan Africa region display small or negative adjusted net savings, even in the recent boom times. A decade ago, Hamilton and Clemens (1999) noted the following:

The comparison of adjusted savings rates [across developing regions] reveals a disappointing trend for the countries of Sub-Saharan Africa[...]. Equally important, negative adjusted savings rates have been accompanied by persistently low regional indicators of human welfare, including education, nutrition, and medical care [...]. *The savings analysis highlights the fact that the situation with regard to fu-*

Box 1. Illustrative Examples—Computing National Wealth and Adjusted Savings

National Wealth—Table B.1 shows estimates of national wealth for Peru, a middle-income, resource-rich country. Natural capital is a relatively important component of Peru’s wealth, constituting 13 percent of total wealth—almost as much as produced capital that accounts for 16 percent. Intangible capital (including human and social/institutional capital) accounts for 74 percent. This pattern is qualitatively similar to the pattern found in many resource-rich countries.

Adjusted Savings—Figure B.1 displays the calculation of adjusted savings in Uzbekistan in 2008. The starting point is gross national savings, which includes net factor foreign income and net current transfers (that is, remittances and aid). Consumption of fixed capital is subtracted to obtain net national savings. Then public current operating expenditures in education (including wages and salaries and excluding capital investments in buildings and equipment) are added as investments in human capital, before charges for the depletion of resources and pollution damages are applied to obtain adjusted savings.

In table B.2, we explain the calculation of adjusted savings in a mineral-rich economy. In the example we present, Zambia’s saving rate for 2007 declines by nearly 30 percentage points—from 26.2 percent to –3.0 percent of gross national income (GNI) when depreciation of produced capital, depletion of natural resources, and damage from global and local air pollutants are taken into account. Particularly noteworthy is the mineral depletion figure because copper rents play a key role in Zambia’s economy. Depletion of the mineral reserves, together with physical capital depreciation and damages from pollution, are not being completely offset by the economy’s saving effort—which includes full credit for education expenditure as a proxy for human capital investments. The scale of resource rents as a share of GNI in Uzbekistan is the most salient difference with respect to Zambia’s adjusted savings calculation. The size of resource rents tends to be more extreme in oil-rich countries than in mineral-rich countries.

The depletion figures for Zambia do not include soil depletion because information is not available. A large portion of Zambia’s economy, however, depends on agricultural land resources: agriculture accounts for more than 15 percent of GDP. Deforestation does not result in net forest

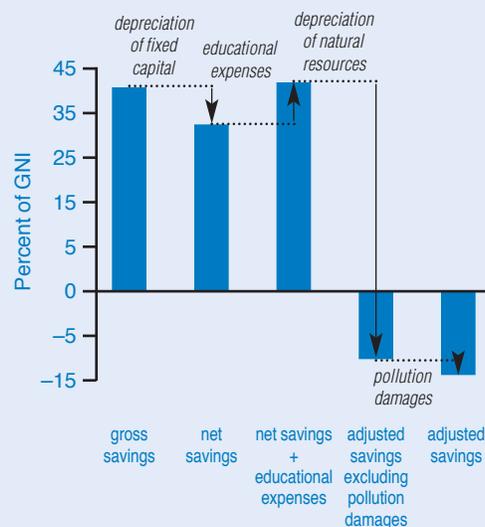
depletion as a result of the natural growth of a very large forested stock.

Table B.1. Wealth Estimates for Peru, 2005

	Per capita wealth (US\$)	Percent of total wealth
Total wealth	44,912	100
Natural capital	5,823	13
Subsoil assets	1,047	2
Cropland	1,993	4
Pasture	568	1
Forest	1,611	4
Protected areas	603	1
Produced capital	7,160	16
Intangible capital	33,165	74
Net foreign assets	–1,235	–3

Source: World Bank 2010.

Figure B.1. Calculating Adjusted Savings for Uzbekistan, 2008



Source: World Bank 2010.

Table B.2. Calculation of Adjusted Savings for Zambia, 2007

	Percent of GNI
Gross savings	26.2
– Consumption of fixed capital	10.7
= Net national savings	15.5
+ Education expenditure	2.1
– Energy depletion	0.1
– Mineral depletion	19.8
– Net forest depletion	0.0
– Carbon dioxide damage	0.2
– Particulate emission damage	0.6
= Adjusted net savings	–3.0

Source: World Bank 2009a.

ture well-being is worse than might otherwise be thought: not only has Sub-Saharan Africa performed badly by conventional measures, it is clear that the wealth inherent in the resource stocks of these countries is being liquidated and dissipated (p. 344; emphasis added).

Figure 4 updates Hamilton and Clemens (1999), showing a persistent downward trend in adjusted savings in Sub-Saharan Africa, with negative rates indicating wealth dissipation through much of the recent resource boom. Total net wealth creation in Sub-Saharan Africa was effectively zero from 1990 to 2007, a period when population grew by 60 percent.⁷

Figure 4 also suggests a substantial regional divergence in saving rates—one that may drive future regional divergence in income levels. East Asia is increasing national wealth substantially more rapidly than is Latin America, while Sub-Saharan Africa is becoming poorer.

Many resource-rich countries display very low (and often negative) rates of adjusted savings. In these cases, current macroeconomic trajectories are unsustainable because

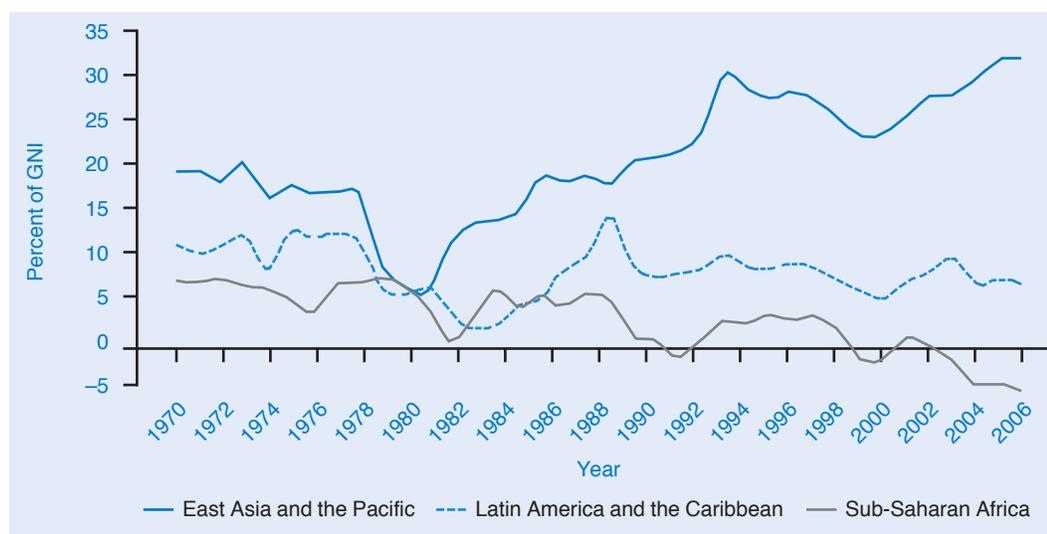
they imply shrinking national wealth. To reverse this trend, resource-rich countries need to (1) capture an efficient and fair share of the resource rents for the government, and (2) invest that share effectively to increase the nation's wealth (see box 2).⁸

Policy Implications

There is a long tradition of using GDP growth as a key performance indicator; and during the recent commodity boom, it has led to over-optimism in many low-income, resource-rich countries. In these countries, however, *a*NNI is a better indicator of performance because it accounts both for factor payments abroad and for depletion of natural resources. Moreover, the strongest policy messages for resource-rich countries are often linked to the question of net wealth creation, measured either narrowly as the difference between *a*NNI and consumption or more broadly as adjusted net savings.

The wealth analysis suggests that a range of policies is needed to ensure that mineral wealth is parlayed into sustainable growth. These policies include macroeconomic policies that encourage saving, fiscal policies that

Figure 4. Adjusted Net Savings as a Percentage of GNI for Selected Regions, 1970–2007



Source: World Bank 2009b.

capture resource rents, public investment programs that put resource revenues to their best use (including investment in human capital), and resource policies that lead to dynamically efficient rates of extraction. Failure to implement sound policies risks the “resource curse.” Atkinson and Hamilton

(2003) show that countries with high resource abundance and negative rates of adjusted savings have suffered severely negative growth consequences.

In practice, indicators of economic performance set the stage for the policies that are considered. In resource-rich countries,

Box 2. The Hartwick Rule

In the context of resource-rich countries, the Hartwick (1977) rule dictates that the rents from natural-resource extraction should be invested in reproducible capital to enjoy a constant stream of consumption. The Hartwick rule is a reminder of the old-fashioned obligation to “maintain capital intact.” When adjusted savings are negative, however, national capital is shrinking. Atkinson and Hamilton (2003) find that countries that escaped the resource curse used resource rents as a source of investment rather than a source of public current expenditure. These countries have been transforming natural capital into produced capital.

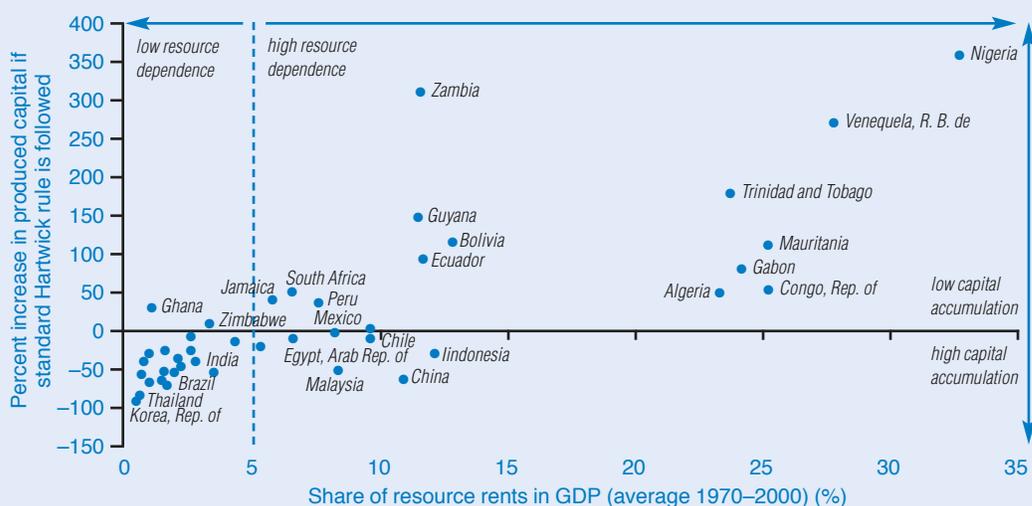
Relating to this transformation of natural capital into produced capital, World Bank (2006) poses the following question: How rich would countries be in the year 2000 had they followed the Hartwick rule since 1970? Figure B.2 plots resource dependence against the percentage difference between actual capital accumulation and counterfactual capital accumulation. Countries in the top-right quadrant of the figure are resource dependent, with a counter-

factual capital stock that is higher than the actual capital stock. These countries experienced declines in real per capita income from 1970 to 2000—a tendency that is borne out in recent research by Ferreira, Hamilton, and Vincent (2008). Using panel data on savings and consumption, they show that adjusted savings is robustly correlated with future changes in consumption.¹

Note

1. Ferreira and Vincent (2005) show, however, that the treatment of human capital in adjusted net savings is not robust (presumably because it measures gross rather than net investment and implicitly assumes that each dollar of government expenditure on education creates one dollar of human capital). They also show that the correlation between savings and future changes in consumption holds for developing countries, but not for high-income countries. This finding arguably reflects the larger roles of knowledge and technological change as sources of wealth in rich countries.

Figure B.2. Resource Abundance and Capital Accumulation (Standard Hartwick Rule)



Source: World Bank 2006, figure 4.1.

moving away from GDP-growth complacency and focusing on *a*NNI and adjusted savings measures can improve the focus of the policy discussion. When it is recognized that negative adjusted savings dissipates national wealth and translates into a poorer future, it becomes clear that sustainable growth must be grounded on preserving and increasing national wealth.

Botswana provides the example of the most successful mineral-based economy in Africa. As Lange and Wright (2004) report, the Ministry of Finance and Development Planning uses a “sustainable budget index” to ensure that resource revenues finance investments rather than consumption. But Botswana’s success is based on more than implementing the Hartwick rule. The government has paid close attention to absorptive capacity and is willing to hold financial assets in a resource fund when competitive domestic investments are not available. The resource fund also helps buffer Dutch disease effects and provides the basis for government to run counter-cyclical fiscal policies to smooth out booms and busts.

Finally, it is important to avoid the mechanical use of any indicator in policy formulation. Increasing savings implies belt tightening, and cutting some government programs may be especially harmful to poor people in the poorest countries. Reforms that boost returns on existing assets must be part of the policy prescription in these countries, generating a virtuous cycle of growth in income that can increase both consumption and saving in the future.

References

- Atkinson, G., and K. Hamilton. 2003. “Savings, Growth and the Resource Curse Hypothesis.” *World Development* 31 (11): 1793–807.
- Ferreira, S., K. Hamilton, and J. R. Vincent. 2008. “Comprehensive Wealth and Future Consumption: Accounting for Population Growth.” *World Bank Economic Review* 22 (2): 233–48.
- Ferreira, S., and J. R. Vincent. 2005. “Genuine Savings: Leading Indicator of Sustainable Development?” *Economic Development and Cultural Change* 53 (3): 737–54.
- Hamilton, K., and M. Clemens. 1999. “Genuine Savings Rates in Developing Countries.” *World Bank Economic Review* 13 (2): 333–56.
- Hartwick, J. M. 1977. “Intergenerational Equity and the Investing of Rents from Exhaustible Resources.” *American Economic Review* 67 (5): 972–74.
- Lange, G.-M., and M. Wright. 2004. “Sustainable Development in Mineral Economies: The Example of Botswana.” *Environment and Development Economics* 9 (4): 485–505.
- Nordhaus, W. D., and J. Tobin. 1972. “Is Growth Obsolete?” Discussion Paper 319. Cowles Foundation, Yale University, New Haven, CT.
- Stiglitz, J., A. Sen, and J.-P. Fitoussi. 2009. “Report by the Commission on Measuring Economic Performance and Social Progress.” Paris. <http://www.stiglitz-sen-fitoussi.fr/en/index.htm>.
- World Bank. 2006. *Where Is the Wealth of Nations: Measuring Capital for the 21st Century*. Washington, DC.
- . 2009a. *The Little Green Data Book 2009*. Washington, DC.
- . 2009b. *World Development Indicators 2009*. Washington, DC.
- . 2010. *World Development Indicators 2010*. Washington, DC.

Endnotes

1. The Stiglitz-Sen-Fitoussi report (2009) has strongly recommended developing alternatives to GDP, including more comprehensive measures of income and product, better measures of well-being, and measures of net wealth creation to reflect the sustainability of income and well-being.
2. Note that Nigeria is excluded from figure 3 because of data problems, and that not all countries in Sub-Saharan Africa are rich in resources.
3. In contrast, whereas foreign investment may increase *domestic* wealth, it cannot directly increase *national* wealth (although the indirect wealth effects of foreign investment may sometimes be substantial).
4. That is not to say that extractive activities cannot contribute to national wealth; indeed they

can, by adequately sharing rents with the government and employing national factors (mostly labor), and through economic spillovers. However, because direct employment is often of very little significance and of poor quality, the taxation of rents is key to transforming domestic production into national income.

5. These costs of depletion are now routinely reported in the World Bank's *World Development Indicators*. The "About the Data" endnote to table 3.16 World Bank (2010) provides a succinct summary of the methodology employed to estimate depletion of natural resources.

6. Moreover, income- or consumption-based measures are more relevant for welfare than are production-based indicators (Nordhaus and Tobin 1972).

7. Chapter 5 of World Bank (2006) presents per capita wealth accumulation figures in detail.

8. To a certain extent, a natural resource fund coupled with an effective public investment management system has the potential to address the three main problems associated with natural re-

source wealth: (1) the Dutch disease (because public investment increases the productivity of capital), (2) volatility (because the resource fund enables a countercyclical fiscal policy), and (3) political-economy issues (because a transparent, rules-based system prevents mismanagement of resources).

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Additional information concerning the World Bank's work on comprehensive wealth accounting may be found at <http://go.worldbank.org/VLJHBLZP71> and <http://go.worldbank.org/RRCQLBZMX0>.



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