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Abstract:

The purpose of the present paper is to demonstrate the usefulness of Green National Accounting by drawing out some interesting insights from the Integrated Environmental and Economic Accounts recently elaborated by the Institute for Advanced Development Studies for the case of Bolivia. The paper uses the Green National Accounts to show the importance of environmental inputs in 7 different productive sectors and compares the corresponding natural resource rents to the level of producer taxes in each sector. The paper also analyses the evolution of total productive capital, in order to judge whether Bolivia's current development model can be considered sustainable. The paper finished with recommendations about interesting extensions that can be made to the Green National Accounts.

JEL classification: Q56, Q01, Q32, Q51

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1. Introduction

Green National Accounting corrects one of the flaws in conventional national accounting, which is ignoring the important role of nature as a source of inputs into production processes. Despite the fact that there are well-established methods for incorporating the role of the environment into the national accounts (United Nations et al., 2003), few countries have fully implemented these satellite accounts and few are using them actively to guide public policy.

In Bolivia, the Institute for Advanced Development Studies has recently finished a first version of the Integrated Environmental and Economic Accounts for Bolivia (also called Green National Accounts) with financial support from Conservation International (see Jemio, 2010).

The purpose of the present short paper is to demonstrate the usefulness of Green National Accounts by drawing out some of the insights that such accounts can provide.

The remainder of the paper is organized as follows. Section 2 first shows the importance of environmental inputs in the seven productive sectors for which natural resources (non-renewable and renewable) constitute a major production factor, namely hydrocarbons, mining, modern agriculture, traditional agriculture, livestock, forestry and water. Section 3 compares the level of natural resource rents in each sector with the level of producer taxes in order to see if the Bolivian government manages to capture the rents from the state-owned natural resources. Section 4 analyses the evolution of the different types of productive capital to assess whether Bolivia's development model can be considered sustainable. Finally, section 5 provides some suggestions on how the Green National Accounts can be extended to provide further insights.

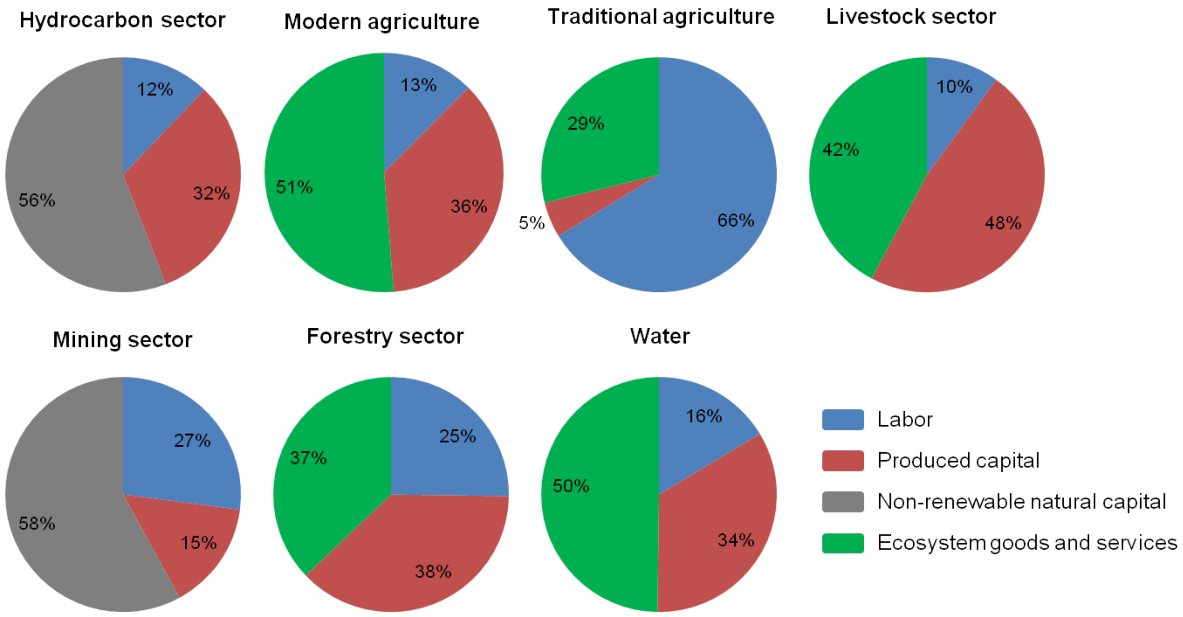
2. The contribution of nature in each productive sector

In some sectors environmental inputs are very important (e.g. forestry, farming and fishing), while in other sectors they play a minimal role (e.g. banking, commerce and education). In each sector they interact with the two other conventional production factors, labor and capital, to produce the total GDP for the sector, but the proportions are different for each sector (see Figure 1 for the sectors with a significant environmental component).

Hydrocarbons and minerals are of course essential for the output of the hydrocarbon and mining sectors, but still these natural resources account for less than 60% of the inputs. Labor and produced capital constitute necessary complementary inputs, without which the natural resources could not be extracted and sold to their respective markets.

The same holds in the other sectors. Fertile lands are necessary for agriculture, but these have to be complemented by labor and produced capital (seeds, equipment, transportation, etc.) in order to produce agricultural output for consumption.

Figure 1: The relative contribution of different factors of production to sector GDP, Bolivia 2008



Source: Authors' elaboration based on Jemio (2010).

While the three types of inputs are clearly complementary, they can also to a certain extent be substitutes. This can, for example, be seen by comparing the pies of modern and traditional agriculture in Figure 1. Modern agriculture uses a lot of environmental and capital inputs, but very little labor, while traditional agriculture uses mainly labor.

The chosen input mix depends above all on the relative scarcity of the different factors of production. In the highlands of Bolivia, where traditional agriculture is mainly practiced, producers have very little land and capital available, so their main input has to be labor. In the Bolivian lowlands, on the other hand, the modern agricultural industry takes advantage of easy access to new agricultural land and subsidized complementary inputs (diesel), while minimizing the use of relatively scarce labor inputs.

Relative scarcity can change over time and can be manipulated through public policy. For example, a policy that stimulates labor migration from the highlands to the lowlands would make labor relatively less abundant in the highlands and relatively less scarce in the lowlands, implying that the two pies would tend to grow more similar over time. Similarly, a policy to control illegal deforestation would make environmental inputs scarcer in the lowlands, thus encouraging more intensive farming methods, with less use of environmental inputs, and more inputs of labor and capital.

The sectors presented in Figure 1 are not all of the same size and there are sectors completely left out, which means that the contribution of environmental inputs to the total GDP of the country is considerably smaller than in any of these seven sectors. Figure 2 shows the

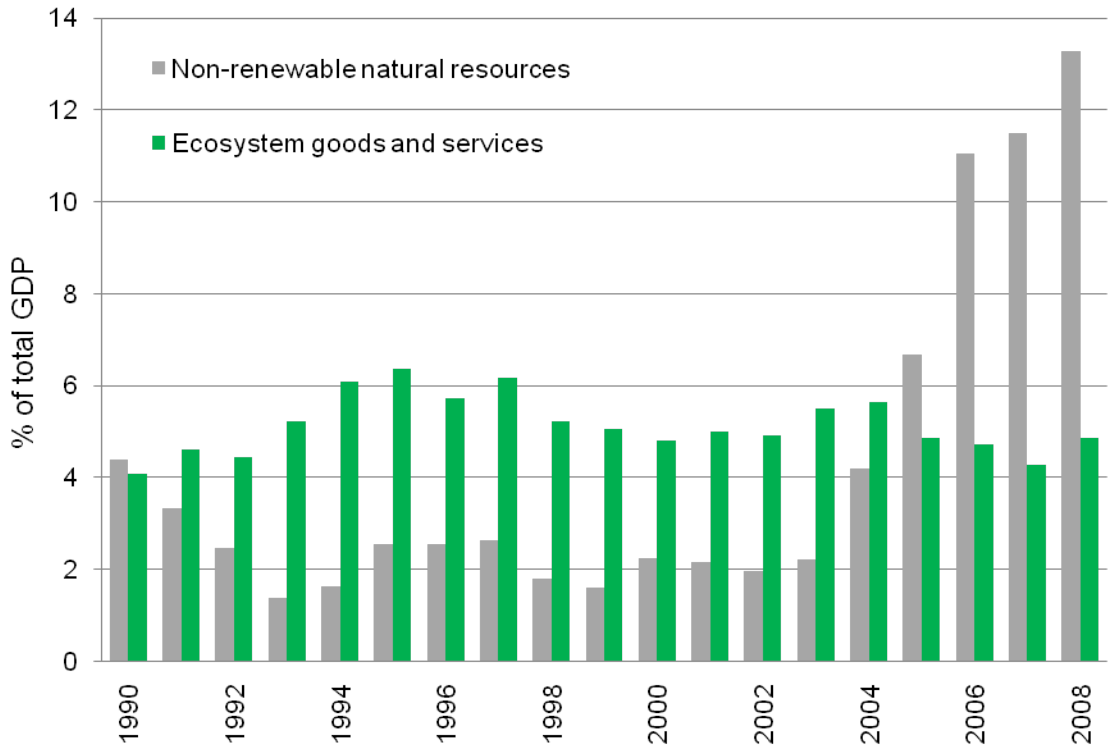
contribution of both non-renewable natural capital and ecosystem goods and services to total GDP from 1990 to 2008.

Until the year 2003, the contribution of both factors were quite stable, with non-renewable natural capital (hydrocarbons and minerals) contributing only about 2% of GDP and ecosystem goods and services contributing about 5%. The remaining 93% of GDP could be attributed to labor and capital.

But since 2004 the role of non-renewable natural capital has increased dramatically, reaching more than 13% of GDP in 2008. This is mostly due to the dramatic increase in the price of oil and minerals, but also due to an increase in production volumes.

This suggests a high dependency on non-renewable natural resources, the sustainability of which we will return to in a later section.

Figure 2: The contribution of non-renewable natural resources and ecosystem goods and services to total GDP, Bolivia 1990 - 2008



Source: Authors' elaboration based on Jemio (2010).

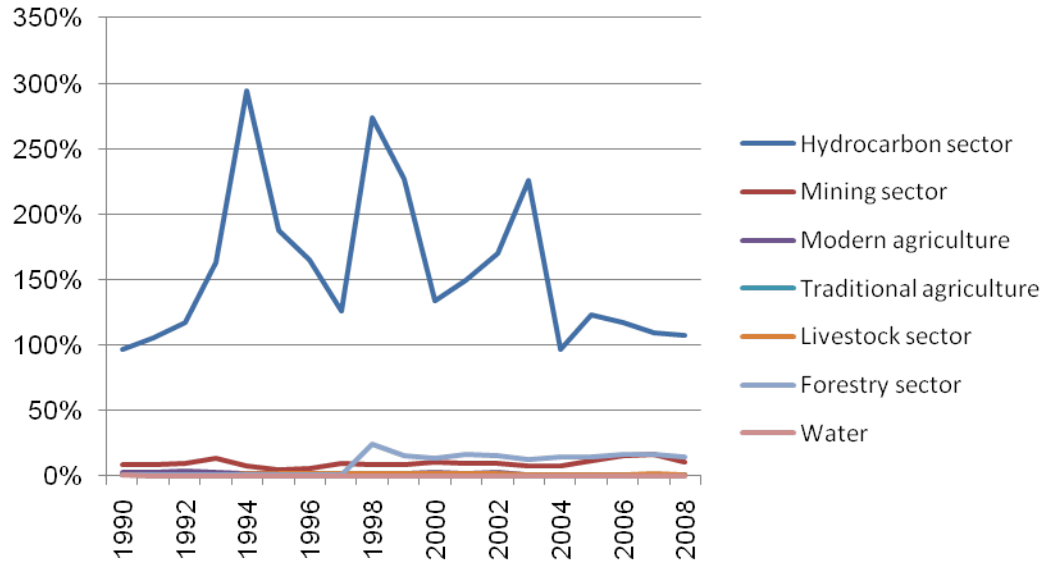
3. Natural resource rents and taxes

The contribution of non-renewable natural capital and ecosystem goods and services (the grey and green slices of Figure 1 or the grey and green bars of Figure 2) are called natural resource rents. The benefits from these rents should theoretically go to the owner of the corresponding productive asset, which according to the Bolivian Constitution would be the State. The State should try to recover these rents in the form of royalties or taxes, because otherwise producers would capture these rents in addition to the normal, fair payments for the labor and capital they have contributed.

The Green National Accounts allow us to judge whether the State manages to recover the resource rents in the form of royalties or taxes in each sector. Figure 3 shows the percentage of natural resource rents which is paid in producer taxes in each sector between 1990 and 2008. The aim should be to recover close to 100% of the natural resource rents in each sector, but the figure shows that this is only accomplished in the hydrocarbon sector. Indeed, in most years, the State has managed to capture considerably more than 100% of the natural resource rents in the hydrocarbon sector, suggesting that the production companies (state and private) are not getting fairly compensated for the labor and capital invested. This could affect long-term sustainability of the hydrocarbon sector, as the affected companies will be reluctant to make the necessary investments.

Since 2004, however, the recovery of resource rents in the hydrocarbon sector has been quite close to the target of 100% and the percentage has been relatively stable compared to previous periods with wild fluctuations.

Figure 3: Producer taxes as percent of natural resource rents in each sector, 1990 - 2008



Source: Authors' elaboration based on Jemio (2010).

In all the remaining sectors, the State is not good at recovering the natural resource rents. In the mining sector, for example, the State only manages to recover about 10% of natural resource rents, indicating that producers obtain exceptional profits in this sector. The forestry sector paid less than 1% of resource rents to the State until 1997, after which a new forestry law managed to increase this percentage to about 16%, which is still far from the target of 100%.

Agriculture and livestock sectors still only pay approximately 1% of the natural resource rents, suggesting that the State is subsidizing producers in these sectors, allowing them to get profits over and above what is warranted by the amount of labor and capital they are putting into the production. Such a subsidy would tend to encourage the expansion of the agricultural frontier at the expense of natural forests.

Green National Accounts are great for identifying rents that can be taxed without discouraging hard work and productive investment, and they are particularly useful for assessing the correct level of taxes/royalties. The Green National Accounts for Bolivia suggest that producers in the mining, agriculture, livestock and forestry sectors are benefitting unfairly from free access to natural resources that supposedly belong to all Bolivians. This implies that the Government of Bolivia would be entirely justified in increasing taxes on mining and modern agriculture and in cracking down severely on illegal logging and deforestation. The proceeds should then be used for public investments that benefit the whole population (like infrastructure, health and education).

4. Adjusted GDP, productive capital and sustainability

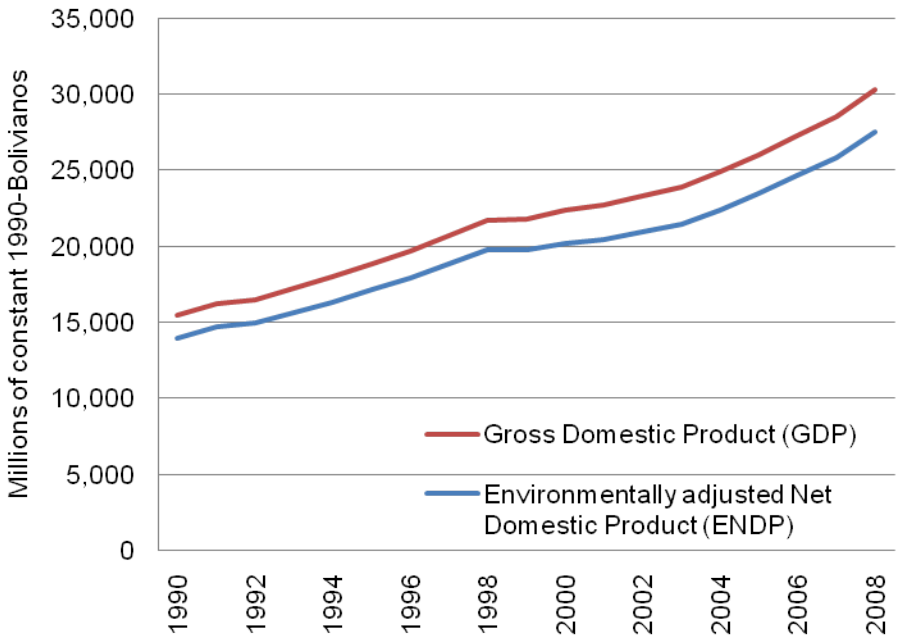
In accounting, it is very important to understand the difference between income and assets. If you have savings invested in a bank-account, in a department building, or in any other productive asset, these will provide you with regular interest/rent, which can be considered income. However, if you take out a chunk of your savings or sell your assets, this should not count as income, but rather as a transfer of assets. Although such withdrawals may temporarily increase your spending capacity, they will reduce your productive capital and your future income earning capacity. Thus, if you have to “spend your assets” your spending pattern is not sustainable. Sustainable living requires that you at least maintain your total amount of productive assets, although you may change between different types of assets.

The same principle applies at the level of countries. However, the conventional GDP measure does not distinguish between “real income” and “depredation of assets.” If we extract and sell our non-renewable natural resources and harvest and export all our timber, this will count directly towards an increase in GDP, while ignoring that our “savings” have been reduced.

Green National Accounting at least partially corrects this flaw, as it includes the calculation of an Environmentally-adjusted Net Domestic Production (ENDP), which is calculated by subtracting the depreciation of produced capital as well as the depredation and degradation of natural capital from the usual GDP. Figure 4 shows that in Bolivia ENDP is about 10% lower than GDP. Most of this difference is due to the depreciation of produced capital, while the depredation of

natural capital only amounts to a few percent of GDP. The depredation share, however, has been increasing lately, from 1.1% of GDP in 2002 to 3.2% of GDP in 2008, thus introducing a bigger and bigger wedge between GDP and ENDP.

Figure 4: GDP versus ENDP, Bolivia, 1990 - 2008



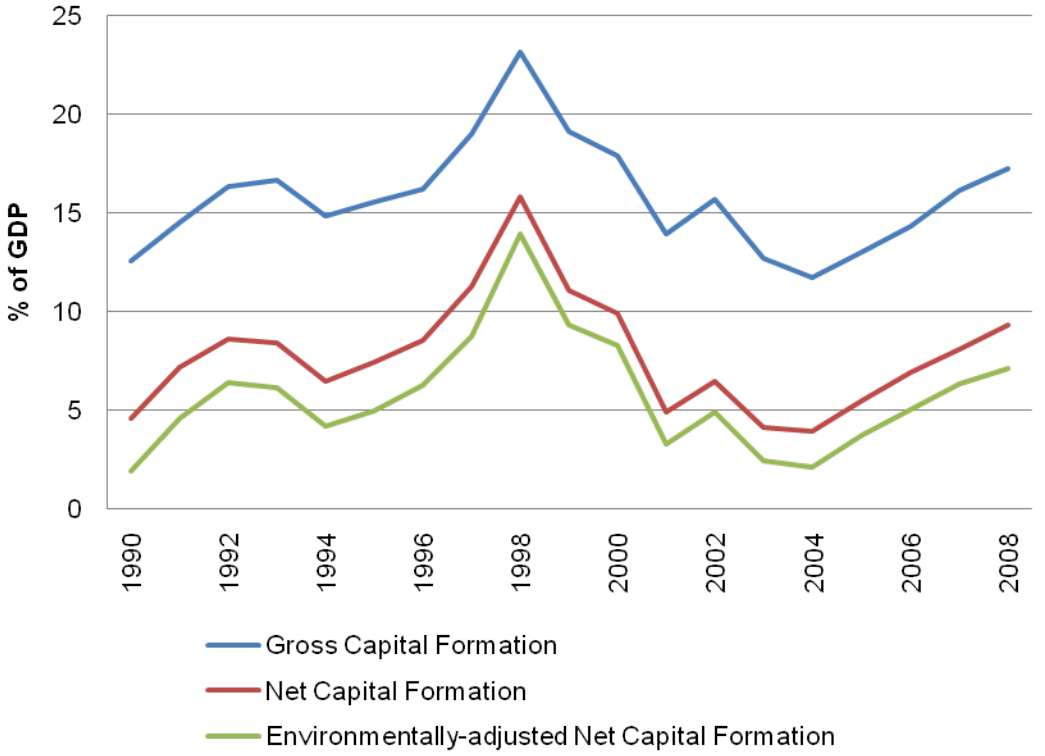
Source: Authors' elaboration based on Jemio (2010).

The depredation of natural capital is not necessarily a problem if these natural assets are converted into other types of capital, so that the total level of productive capital in the economy is not decreasing. The Green National Accounts allow us to assess whether this is the case.

If we depart from the standard national accounting variable, Gross Capital Formation, and again subtract both the depreciation of produced capital and the depredation of natural capital, we get the Environmentally-adjusted Net Capital Formation (ENCF), which is very interesting because it tells us if the economy has been able to generate new capital to compensate for depleted natural or produced capital. The maintenance of total productive capital is a minimum requirement for sustainability.

Figure 5 shows that ENCF has been positive, although small, during the whole period of analysis. This indicates that the total stock of productive capital in Bolivia is increasing slowly, despite the strong reliance on non-renewable natural resources and the depredation of renewable natural capital.

Figure 5: Gross Capital Formation, Net Capital Formation and Environmentally-adjusted Net Capital Formation (% of GDP), Bolivia, 1990-2008

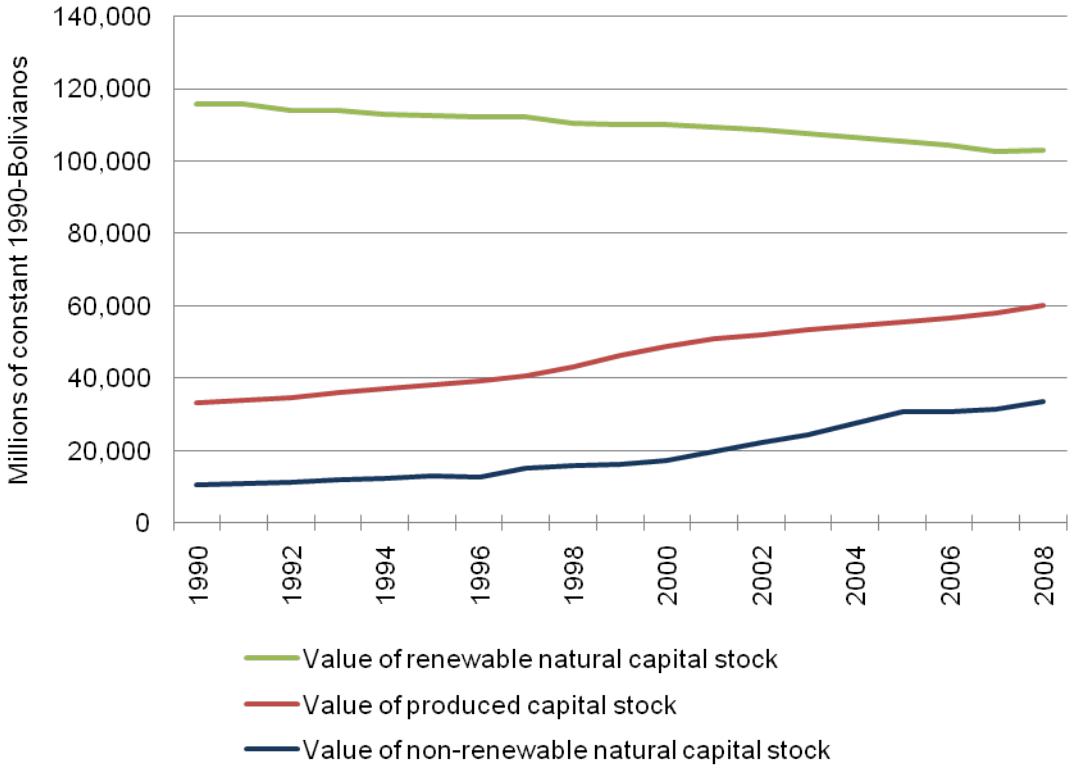


Source: Authors' elaboration based on Jemio (2010).

Figure 6 shows the changing composition of Bolivia's stock of productive capital, with renewable natural capital shrinking while produced capital and non-renewable natural capital is increasing.

It may seem counter-intuitive that the real value of the stock of non-renewable natural capital can increase, despite positive extraction, so it is worth explaining the technical details behind this phenomenon. One obvious part of the explanation is that there are regularly new discoveries of hydrocarbons and minerals, which add to the physical stocks. But in the graph below, this is not the most important effect, especially not in the period after 2002, which has seen very few new discoveries. Most of the increase since 2002 is rather due to the way the value of the capital stock is calculated, namely as the net present value (NPV) of future extractions, *assuming a constant rate of extraction until the resource runs out*. Since Bolivia's stocks of non-renewable natural resources are still very large, higher extraction rates substantially increase incomes early in the future while the date at which the resource runs out is still so far in the future, that the reduced output then counts little in the NPV, because the future is discounted (a discount rate of 6% per year is used in the Green National Accounts for Bolivia).

Figure 6: Evolution of the total stock of productive capital in Bolivia, 1990-2008



Source: Authors' elaboration based on Jemio (2010).

Within the renewable natural capital stock there have also been changes, especially from forest to agricultural land or pasture. In the Green National Accounts of Bolivia, the average value of forest is only about one third of the value of agricultural land, so every time a hectare of forest is converted to agricultural land the total value of natural capital increases. However, the average value of pasture land is less than a 10th of the value of forest, so when forest or agricultural land is converted to pasture, the total value of natural capital decreases. And finally, when the nutrients in any given plot are exhausted and the land is abandoned altogether, the value drops to zero.

One of the main reasons for the drop in the stock of renewable natural capital is the increasing amount of deforested, exhausted and abandoned land. According to the Green National Accounts of Bolivia, more than 1.5 million hectares of land was abandoned during the 1990-2008 period.

5. Conclusions and recommendations for future research

Green National Accounts give a more precise impression of the status and health of the Bolivian economy than the conventional national accounts because the important contribution of environmental inputs is taken into account.

The analysis shows that there are very large natural resource rents in many of the productive sectors in Bolivia, but that only in the hydrocarbon sector has the Government been able to capture these rents in the form of taxes and royalties. In the mining, agriculture, livestock and forestry sectors, these rents instead accrue as exceptional profits to producers.

The analysis also shows that Bolivia's development model, although heavily dependent on the mining of minerals, hydrocarbons and soil nutrients, can be considered sustainable in the weak sense, as total productive capital is maintained. Obviously it would be much better if investments were substantially higher and depredation lower, so that the total stock of productive capital would increase faster, thereby permitting an increase in incomes and a faster reduction in the still very high levels of poverty in Bolivia.

So far, these Green National Accounts are quite crude and entirely unofficial, serving only to encourage the National Statistical Institute to take up the challenge of formally developing a system of Green National Accounts.

There are many ways in which these accounts can and should be extended. First, the whole component related to contamination has so far been ignored. This could potentially be very important in the mining sector, which is a source of severe water contamination in Bolivia.

Second, given the tendency for regional autonomy in Bolivia, and the highly diverse development strategies of each region, it would be interesting to calculate Green National Accounts at the Department level. This would allow a comparison of the different development models and their sustainability, and could also provide arguments for regionally differentiated tax policies.

Finally, while the Green National Accounts include natural capital as part of total productive capital, human capital is still ominously missing. Given the enormous investments in education during the last few decades[1], this implies that total productive capital is very likely increasing faster than suggested by the Green National Accounts. An effort should be made to include human capital in national accounts, along the lines suggested by, for example, Bartelmus (2008) and Christian (2010).

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[1] According to the World Bank's World Development Indicators, public expenditure on education amounts to about 6.3% of GDP (2006), but in addition to that there would also be substantial private investments.

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