Aniyar, Sara

Working Paper

Estimating the Value of Oil Capital in a Small Open Economy: the Venezuela's Example

Nota di Lavoro, Fondazione Eni Enrico Mattei, No. 108.2003

Provided in Cooperation with:
Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Aniyar, Sara (2003) : Estimating the Value of Oil Capital in a Small Open Economy: the Venezuela's Example, Nota di Lavoro, Fondazione Eni Enrico Mattei, No. 108.2003, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:
http://hdl.handle.net/10419/118133

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes.
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.
If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.
Estimating the Value of Oil Capital in a Small Open Economy: the Venezuela’s Example
Sara Aniyar

NOTA DI LAVORO 108.2003

DECEMBER 2003
SIEV – Sustainability Indicators and Environmental Valuation

Sara Aniyar, University of Zulia, Venezuela and the Beijer International Institute of Ecological Economics, Sweden

This paper can be downloaded without charge at:
The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:
http://www.feem.it/web/activ/_wp.html

Social Science Research Network Electronic Paper Collection:
http://papers.ssrn.com/abstract_id=XXXXXX

The opinions expressed in this paper do not necessarily reflect the position of Fondazione Eni Enrico Mattei
Estimating the Value of Oil Capital in a Small Open Economy: the Venezuela’s Example

Summary

The paper focuses in the calculation of the oil capital value in a small open economy depending on oil rents. The Venezuelan case is used as an example. In valuing the oil capital, two issues are recalled and discussed: how should the exploration costs and the capital gains be treated? It is shown that the estimations vary significantly depending on which set of assumptions are made about the way to account for them and the assumptions made about how the economy functions. It is argued that during the studied period the value of the Venezuelan stock of oil capital has increased, and it has done so faster than the population.

Keywords: Venezuela, Oil Capital, Capital Gains, Exploration Costs, Property Rights

This paper has been presented at the "International Conference on Theoretical Topics in Ecological Economics", Trieste, Italy, February 10-12, 2003, a joint initiative of the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM.

I thank The Beijer Institute for giving me the possibilities of doing this research in a wonderful working environment. I thank Karl Göran Mäler, my research adviser, for guiding me in the understanding of the theoretical background, and his reviewing of the paper. I am also pleased to thank Geir Asheim and Bengt Kriström for their comments to a previous version of this work. This paper would have never existed without the help for obtaining data and other information that the following persons gave me: Belén Carrero, Ramón Espinasa, Judith Fuenmayor, Iraida Hernández, María Isabel Martínez, Carlos Mendoza, Bernard Mommer, Marisela Montenegro, Angel Urbina, and Felipa Urbina. All errors that remain despite this help are solely my responsibility.

Address for correspondence:

Sara Aniyar
The Beijer Institute
The International Institute of Ecological Economics
The Royal Swedish Academy of Sciences
Kungl. Vetenskapsakademien
Lilla Frecativagen 4
Stockholm
Sweden
Fax: +46 8 15 24 64
E-mail: sara@beijer.kva.se
I. Introduction and paper description

Introduction

This paper is an intermediate output of an empirical research aiming at the construction of an indicator of sustainability for Venezuela: oil based, open and small economy. Sustainability is defined as a non-negative and non-declining capital per capita where capital includes not only manufactured but also natural and human capital. (Dasgupta and Mäler, 2000 and Mäler 2001) The calculation of the index requires numerical information of the country’s total capital and its changes.

The Venezuela’s national accounting system records the annual formation of capital but the concept of capital is restricted to manufactured as is the current practice in most countries. Measures of total capital are not reported. Consequently, the task of estimating the sustainability index implies measurement of quantity and value of other kinds of capital: natural and human. Which new form of capital should one add first? Due to the primordial role that oil production has had in the Venezuelan economy (see table 1) it was obvious that one must start by adding the oil capital, as the key element of the natural capital the country possesses.

The first part of the paper (section II) includes the definition of oil capital as the oil proven reserves. It includes also the estimates of the oil capital volume, and an analysis of driving forces for the changes in the volume of proven reserves that occurred during the studied period (1960 – 2000). It is argued that changes in the property right regime of the oil industry played a decisive role in the changes of the
oil capital. The second part (section III) reports on the valuation issues. The value of
the stock of oil capital and its changes are defined. The way to calculate those values
depends on the assumptions made about the discovery function and the allocation
mechanisms. In the section are presented the results for calculations made under
different sets of assumptions. It is shown that the value of the oil capital may be very
different depending on the set of assumptions chosen. For the Venezuelan case it is
argued that the value of the oil capital has increased faster than the population, during
the studied period, which is the result obtained when accepting the following two
assumptions: a) Venezuela is a price taker in the oil market; and b) the exploration
costs do not measure the value of the additions but the oil contribution to human
capital. And section V is a concluding section where some of the limitations of the
study are presented and discussed.

Table 1
Indicators of the role of Oil in the Venezuelan economy

<table>
<thead>
<tr>
<th>Oil share of</th>
<th>GDP</th>
<th>X</th>
<th>FI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>27</td>
<td>91</td>
<td>65</td>
</tr>
<tr>
<td>1970</td>
<td>22</td>
<td>90</td>
<td>61</td>
</tr>
<tr>
<td>1975</td>
<td>30</td>
<td>91</td>
<td>77</td>
</tr>
<tr>
<td>1980</td>
<td>29</td>
<td>92</td>
<td>72</td>
</tr>
<tr>
<td>1990</td>
<td>28</td>
<td>75</td>
<td>77</td>
</tr>
<tr>
<td>1995</td>
<td>17</td>
<td>67</td>
<td>45</td>
</tr>
<tr>
<td>2000</td>
<td>23</td>
<td>78</td>
<td>50</td>
</tr>
</tbody>
</table>

GDP: Gross Domestic Product
X: Exports
FI: Fiscal Income

Source: MEM (Venezuela)

II. Oil capital, physical accounts and analysis of the changes

II.1 Definition of oil capital

Oil resources are classified according to the degree of geological certainty and
the technological and economic viability. Proven reserves are that part of the oil
resources that are known with considerable geological certainty and that can be recovered under the current economic and technological conditions (see Annexe 1, at the end of the paper). Oil capital is defined as the amount of proven reserves, because they are the amount of oil resources that have rental value. Although it is to acknowledge that other Venezuelan oil resources may have a positive market value (option value) but the magnitude of them are unknown. Better information on this matter would eventually increase the estimates presented here.

II.2 Proven Reserves Volume

The changes in the volume of proven reserves ($\Delta S_{ok}$) are the result of the combined effect of two forces: additions (see section II.4) and depletion.

$$\Delta S_{ok,t} = \Delta \text{Proven Reserves}_t = \text{Additions}_t - \text{Depletion}_t \quad (1)$$

**Figure 1**

**Venezuelan Proven Reserves**

**1960 - 2000**

**Million barrels**

Source: MEM. PODE. Selected years
II.3 The changes in the volume of the proven reserves

The Venezuelan proven reserves increased during the studied period at an annual average rate of 5%. Their increase did not happen evenly over that period (table 2). In the sixties the proven reserves went slightly down, and from 1972 they started to increase in a sustained path. However is in 1986 when the reserves jumped so as to double in size and thereafter they kept slowly increasing all the time with a moderate rate. Why?

Table 2
Proven reserves growth rate

<table>
<thead>
<tr>
<th>Period</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the 60’s</td>
<td>-1.31</td>
</tr>
<tr>
<td>In the 70’s</td>
<td>4.07</td>
</tr>
<tr>
<td>In the 80’s</td>
<td>15.64</td>
</tr>
<tr>
<td>In the 90’s</td>
<td>2.85</td>
</tr>
</tbody>
</table>

| Total 1960 – 2000 | 5.10 |

Source: MEM. PODE. Selected years

II.4 The analysis of the additions

1. Additions may occur for three reasons, namely: Discoveries, Extensions and Revisions.

\begin{equation}
\text{Additions} = \text{Discoveries} + \text{Extensions} + \text{Revisions}
\end{equation}

Discoveries are those proven reserves that exploratory drilling finds in new oil fields or in new reservoirs in oil fields. That is new oil resulting from successful exploration activities. Extensions are increases in proven reserves because of subsequent drilling showing that discovered reservoirs are larger than originally estimated. They are also new oil but resulting from increasing levels of certainty. Revisions are changes in proven reserves because oil firms acquire new information on markets conditions or new technologies.
Figure 2 shows the changes in the additions and one can see the source of the change. Most of the additions were revisions, that is, according to the definitions it must be the result of changes in market conditions.

II.5  Property rights modifications as a driving force of the changes in the proven reserves

The proven reserves of oil may increase when the prices do because some of the oil resources that were not included in the proven reserves acquire rental value.

Figure 2
Structure of the additions to proven reserves
Million barrels

Source: MEM. PODE. Selected years
In the Venezuelan case the reserves increased when the prices did but they also rose when the prices fell. Why?

Venezuela became the world biggest oil export country in 1928, when its exports started to be greater than those from Mexico. The legal status of oil has always been that it belongs to the state, as all subsoil resources do according to laws inherited from colonial times. However the oil industry was in the hands of foreign companies that had received concessions.

Main changes in the property right system occurred during the time period of this study. In 1958 the last dictatorial government came to an end and the Venezuela’s democratic period started then. Venezuela implemented at that time a new oil policy based on: a) no new concessions, b) the creation of a state oil company, c) the promotion of a producers union which led to the creation of OPEC, d) the introduction of changes in the royalties and the tax system in order to favour the nation’s recovery of the oil rents, and e) the creation of a state owned oil company. To that is to be added that the major concessions were to revert to the country in 1983-1984.

No new concessions, an increased participation of the state in the rents and in the business, and decreasing prices –together with the relatively short time remaining before the existing concessions will revert- were strong negative incentives for the foreign companies. The capital investments in the end of the sixties had decreased in about 20%, and the oil employment fell to its half (Espinasa, 1997). Meanwhile the production went up reaching its maximum in 1970 (see figure 3). After 1970 the oil production declined because of the exhaustion of the old fields. That is the oil
production started its fall much before OPEC decided to cut it back. The volume produced fell precisely when the price started to increase.

Figure 3

Venezuela’s Oil production
Million barrels

Source: MEM. PODE. Selected years

The new oil policy had increased the participation of the state in the oil revenues and simultaneously had created negative incentives for the oil companies; meanwhile the oil reserves from Arabic countries were rising. All these elements led to the fact that Venezuela kept its position as biggest exporter until 1970 when Saudi Arabia took over, while the relation reserves/production went down to 10.

In 1973, the international oil companies and the Venezuelan government agreed not to wait until the concession will revert to the state. The industry was nationalized in 1975. The new state oil company –PDV– started operations (1976) and a massive investment plan was carried out. In what affects the amount of reserves,
the new investment policy led first to stop the field’s decay and later to increases in reserves (Espinasa, 1998).

Simultaneously, resources were allocated also to technology development for the very heavy oil that had been found in the Orinoco belt. Orimulsión –the patented name - is a liquid combustible produced with this new technology, and it is used as an alternative input in electrical plants.

As a consequence, the proven reserves went up from 18 thousand million barrels 1976 (when the nationalization happened) to near 80 thousands million barrels today².

In the Figure 4 can be seen that when the oil prices jumped in the 70s, the reserves did not jump as much as they did in mid 80s. They increased in the 80s, with a big jump in 86, when the Orinoco belt resources started to be included in the proven reserves, and they continued to increase moderately even when the prices fell. The changes in reserves are more related to the changes in the property right system than to the changes in prices.

The property right regime had gone through major changes. That is not to say that changes in prices did not change the volume of reserves, they did; and the OPEC quota policy may also have given incentive to increases in the volume of the reserves – as quotas are related to the amount of reserves – but the main jump in reserves is more the consequence of changes in the property right system. Those changes created the incentives for exploration and technology development and for the search of markets to the extra heavy oil. These major changes in the property rights regime have also had other consequences that are not in focus here because they are not directly related to the reserves but to the fiscal revenues and in a more general way to the relations between the national oil industry and the rest of the economy.
II.6 The proven reserves increased but they changed in quality

The additions were mainly of heavy and extra heavy oil meanwhile the production was integrated mainly with light and medium oil (see figure 5 and 6). The corollary? The participation of heavy and extra heavy oil in the Venezuelan reserves of oil has increased.

Source: MEM. PODE. Selected years
Figure 5

Venezuelan Proven Reserve Structure by grades API in million cubic meter

0 2000 4000 6000 8000

Heavy and Extra Heavy
Light and Medium

Source: MEM. PODE. Selected years

Figure 6

Oil production in Venezuela classified by grades API

0 50 100 150 200

Light and Medium
Heavy and Extra heavy

Source: MEM. PODE. Selected years

(6)
III. Valuation of the oil capital

III.1 Definition

The value of oil capital in year $t$ ($W_{OK,t}$) is defined as the shadow price of oil ($p_t$) times the amount of proven reserves ($S_t$); and the shadow price is defined as the change in well-being $^3$ ($V_t$) derived from a unit change in the stock of oil ($S_t$) (see Dasgupta and Mäler 2000 and Mäler 2001)

$$W_{OK,t} = p_t \cdot S_{OK,t} \quad (3)$$

$$p_t = \frac{\partial V}{\partial S_{OK,t}} \quad (4)$$

However the shadow price, defined as above, is not available for the moment and its calculation is very difficult. Instead the international net average price of the Venezuelan oil exports is used in the paper. That introduces other bias in the calculations of the value, which will be discussed in section V. The value of the oil capital is calculated here as the international average market price for the Venezuelan oil, net of production costs, times the quantity of proven reserves.

$$P_t = \text{average oil world market price per barrel} - \text{average cost per barrel} \quad (5)$$

$$W_{OK,t} = P_t \cdot S_t$$

Two issues remain to be discussed in this section. 1) The changes in the stock of oil ($S$) are a function of production, discoveries and exploration costs. Explorations costs have been used as the value of discoveries (UN, 1983). How should we treat them when valuing oil capital? 2) The fluctuations in oil prices are notorious. Changes in prices lead to capital gain or losses. How should one account for capital gains (or losses)?
In other words, which assumptions may one make about the discovery function and the autonomy of the oil allocation mechanisms?

- The discovery function
  1. Are today’s discoveries the consequence of only today’s exploration costs? Or,
  2. Are they today’s discoveries the consequence of only the accumulated exploration costs?

- The resource mechanism allocations.
  a. Are the oil allocation mechanisms autonomous? Or,
  b. Are they non-autonomous?

The remaining part of this section focuses in these issues. It is shown that the value of the oil capital varies significantly depending on assumptions made.

III.2 Exploration costs

In current national accounting systems has been accepted that discoveries should not be treated as an expense but as an investment, and therefore they must be incorporated as part of the year capital formation of the country. The explanation has been that exploration costs are a measure of the potential discoveries of oil. The oil capital values are to be used for adjusting the current measures of capital in the search of a more inclusive definition of the country’s wealth. If when oil capital value is measured one includes the value of the oil discovered, then one can believe that there is double accounting. Is that true? Dasgupta, Kriström, Mäler (1997) developed a model with which they proved that if one assumes that oil resources discovered today depend only on the accumulated exploration costs then they should not be a measure of the discoveries value but instead a contribution of oil to the formation of human capital (knowledge). The value of the change in oil capital must be measured by the
result of the two forces that modified the stock, additions minus depletion. In other words, both the exploration costs and the value of the discoveries must be accounted for in the year capital formation.

In the other hand, if the discoveries of this year are the consequence of the exploration cost of the year, exploration cost can not be considered oil contribution to human capital and both addition and exploration costs can not be added but only one of them.

III.3 Allocation mechanism of oil resources

This section is done following Mäler (2001) in which the author develops a model for measuring wealth in discrete time, for the proof of what follows the reader may look at that reference.

If the economy’s allocation mechanisms are time autonomous, one can express in discrete time the change in social well-being as follows

\[ V_{t+1} - V_t = p_t (K_{t+1} - K_t) \] (7)

In equation 7, V stands for social well-being, p for shadow price (defined above as the change in well-being when the resource stock changes in one unit), K stands for the inclusive definition of capital, and t for the time period. That is, the change in well-being is equal to the value of the change in the capital stock. The value of the change in capital is different from the change in the value of the capital because it excludes capital gains.

The assumption of time autonomous mechanisms in the allocation of oil resources implies that the capital gains must be excluded.

However, resource mechanism allocations may be non-autonomous. They are non-autonomous when exogenous changes influence the economy and the way this
The economy’s resources are allocated also changes. For example, changes in the terms of trade.

When the allocation mechanisms are non-autonomous the change in well-being will be

\[ V_{t+1} - V_t = p_t \epsilon S_t - p_t R_t \]  \hspace{1cm} (8)

\( R \) is the production and \( \epsilon \) is the average annual relative change in the world market price. The world market price of the produced oil is in general different to the accounting price of the stock. In the calculations made here they are assumed to be the same and that introduces a bias in the calculations as it was mentioned in section III.1.

Mäler concludes that the capital gains generated by price changes in the world market should be included when assessing the change in well-being but no those being the consequence of changes in the accounting price

**III.4 Measuring the value of oil capital under different assumptions**

**III.4.1 Estimate 1**

Here is presented the value of oil capital when one accepts the following assumptions:

**Assumption 1.** The discoveries reported this year depends only on this year explorations costs and not in the previous years exploration cost.

**Assumption 2** The resource allocation mechanisms for oil resources are exogenous

In this case, the value of the oil capital

- Will not include the value of the discoveries
- The oil capital for the starting year is calculated as \( p_0 S_0 \), and,
- To this initial value of the stock one deducts every year the oil production.
\[ W_{OKt} = W_{OKt-1} - (p_t * D_t) \] \hspace{1cm} (9)

In figure 7 it is shown the value of the oil capital for the period 1960-2000 when it is measured following this set of assumptions. The average annual growth rate for this estimate is near to minus 7% (see table 3, in page 19).

**Figure 7**

**Value of the Venezuela’s oil capital**

This estimate may lead us to the conclusion that the country is depleting the oil resources without any compensation and may adjust down the estimations of total capital formation.

The United Nations recommendation how to account for mineral reserves included in the guidelines published in 1993, correspond to this case. According to those recommendations, capital gains are to be included and the discoveries are valued by the exploration costs. (United Nations 1993, in particular pages 219, 230).

The World Bank produces and publishes the genuine saving indicator, which is meant to cope with the absence of other capitals different to the real, within the
current accounting system. Genuine saving includes traditional savings less de value of resource depletion and environmental degradation plus de value of investments in human capital (Hamilton and Clemens, 1999)

That means that both United Nations and the World Bank are using this way for valuing an asset.

**III.4.2 Estimate 2**

Now both previous assumptions are changed and instead the following ones are accepted

**Assumption 1** The discoveries of proven reserves of oil that the country reports in year t depend only on the accumulated exploration costs

**Assumption 2** The resource mechanism allocation is autonomous

These assumptions together will imply the exclusion of capital gains and the inclusion of the discovery value when valuing oil capital.

That is the value of OK in year t is given by

\[
W_{OK_t} = W_{OK_0} + \sum_{\tau=0}^{t-1} p_{\tau} (OK_{\tau+1} - OK_{\tau})
\]

(10)

The oil capital in Venezuela has grown at an average annual rate of 10% with this set of assumptions, under the studied period (see table 3 in page 19).

Figure 8 shows now the results for estimates 1 and 2
III.4.3 Estimate 3

Here $W_{OK}$ is estimated under the following two assumptions:

**Assumption 1**: The discoveries of proven reserves of oil that the country reports in year $t$ depend only on the exploration costs the companies had in the previous years.

**Assumption 2**: The resource allocation mechanism in the economy is exogenous.

The stock of oil capital in period $t$ is given by

$$S_{OK, t} = S_{OK, t-1} + A_t - D_t$$  \hfill (11)
$S_{OK_t}$ stands for stock of oil proven reserves in year $t$, $A_t$ for the additions made to the proven reserves during the year, $D_t$ for the oil produced (depleted) during the year $t$, all of them expressed in physical units.

The value of the oil stock in period $t$, $W_{OK_t}$, is given by

$$W_{OK_t} = W_{OK_{t-1}} + P_t \cdot (A_t - D_t)$$  \hspace{1cm} (12)

In this estimate the value of oil capital includes the value of the net changes to proven reserves (Additions minus depletions) and the capital gains generated by changes in the world market prices.

The average annual growth of the oil capital, according with this set of assumptions is 8% (see table 3 in page 19). Notice that during the studied period, the changes in price gave in average losses instead of gains.

This third estimate of the oil value seems to me the one that is closest to the real conditions. The oil reserve additions do depend on the accumulated expenses in explorations. Venezuela is a price taker, even if the country has had some influence in the way OPEC may behave by itself neither Venezuela nor OPEC can fix the price of oil. The consequences of the changes in the world market prices are very much affecting the well-being of Venezuelan citizens.

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil capital estimates growth rate</td>
</tr>
<tr>
<td>1960 - 2000</td>
</tr>
<tr>
<td>Estimate 1</td>
</tr>
<tr>
<td>Estimate 2</td>
</tr>
<tr>
<td>Estimate 3</td>
</tr>
</tbody>
</table>
IV. Population and oil capital growth

The Venezuelan population grew at an annual average rate of 3% during the period 1960 – 2000. The growth rate of a series built with the value of oil capital (estimate #3) per capita is a bit larger than 3%. Oil capital has grown at a fastest path than population. And that is true also if we made the estimations with the volume of oil instead of the value of them.

V. A review of the biases in the estimations and concluding remarks

V.1 The biases

V.1.1 The concept of oil capital

Oil resources that are different from the proven reserves are not accounted for. By definition, oil capital is the amount of proven reserves a country has, and therefore it is the value of the Venezuelan proven reserves what I have estimated as the value of oil capital. Other resources, known with less geological certainty, are not included.
However those resources may have a positive market value, which should be also estimated and included, as Nordhaus and Kokkelenberg (1999) have already pointed out. How to measure the value of those other resources needs further work. In the case that other resources would have rental value, the measures given in this paper would have a bias downward.

**V.1.2 Valuing remaining reserves with the price of oil sold**

I am using the market price and average production costs of the oil sold to obtain the net price with which the oil capital is valued. However, in the Venezuelan case, the structure of the proven reserves is quite different from the structure of the oil being produced, in terms of the oil quality. The Venezuelan reserve composition has changed under the studied period (see figures 5 and 6 above). At the end of the period the proportion of the heavy and extra heavy oil has increased. These oils, heavy and extra heavy, have a smaller market price and a higher cost than the light and medium oils. Heavy oil and light oil are different goods and should be valued with different net prices. Given the composition of the remaining reserves in Venezuela, implies that the value estimated is biased upwards.

**V.1.3 Average costs**

According to the theory, one should use marginal costs in the estimation of the unit rent. Marginal costs are seldom available and I did not have access to them. Therefore the accounting price was estimated with average cost. The implication of this is a bias downward of the value of the oil capital, as the marginal cost would be higher than the average.

**V.1.4 Natural gas is not yet included**

The reported costs for oil are not separated from the cost of producing natural gas - a by-product.
V.2 Concluding remarks

Summarizing the findings

1. The changes in property right played an important role in the investments on exploration and in technology development leading later on to a substantial increase in the size of the oil capital.

2. The volume of proven reserves grew in average at an annual rate of 5%. While the population grew at 3% annual average rate (OCEI).

3. The oil capital structure has changed to have a much bigger proportion of heavy and extra heavy oil at the end of the period.

4. The estimate #1, which follows UN recommendations and the way the World Bank genuine savings indicator is calculated, gives a negative rate for the increase in capital. That happens because in this way of doing reserves are valued by the exploration costs.

5. The estimate #2, in which capital gains are excluded, shows that in the period the country had not gains but losses. The growth rate for this estimate was 10% average per year, while for the estimate #3—which includes the capital gains—was only 8%.

6. The three different estimates for the value of the oil capital showed in the paper correspond to different assumptions on
   a. The country allocates its resources autonomously or not.
   b. The additions to oil proven reserves were a function of the accumulated exploration costs or not.

I argue that the third estimate is the one that follows the theoretical principles best, because
   a. Venezuela is a price taker and
b. The additions made are mainly the consequences of the accumulated exploration costs

7. If one accepts estimate #3 as the best, the oil capital grew fastest than population, under the period

8. The estimates will improve if
   a. It is possible to use marginal costs
   b. It is possible to divide the oil reserves in at least two categories separating heavy and extra heavy oil, and if one can find prices and marginal costs for every year for these two groups of oils.
   c. Natural gas is incorporated

9. Last remark

One should not conclude anything about sustainability with the information gathered until now. It is good news that the oil capital has increased, and even faster than population but

- Other kinds of capital must be accounted for also
- The impact of oil capital in an foreseeable degradation of other capitals, for example due to pollution, is not measured and will not because there is not information

The main contribution of this empirical study is to show how big the differences of the estimates of oil capital value are, depending on the assumptions made on exploration costs and allocation mechanism. These issues have never been taken into consideration in previous capital valuations, as far as where our information goes. The paper also reveals how changes in the economic environment of the producer affect the country’s capital formation and gives and inside about the
causes of changes in oil proven reserves, which in general are suspected to be only capital gains.

**Acknowledgements**

I thank The Beijer Institute for giving me the possibilities of doing this research in a wonderful working environment. I thank Karl Göran Mäler, my research adviser, for guiding me in the understanding of the theoretical background, and his reviewing of the paper. I am also pleased to thank Geir Asheim and Bengt Kriström for their comments to a previous version of this work. This paper would have never existed without the help for obtaining data and other information that the following persons gave me: Belén Carrero, Ramón Espinasa, Judith Fuenmayor, Iraida Hernández, María Isabel Martínez, Carlos Mendoza, Bernard Mommer, Marisela Montenegro, Angel Urbina, and Felipa Urbina. All errors that remain despite this help are solely my responsibility.

**References**

**Banco Central de Venezuela** (1992) Series Estadísticas de Venezuela de los Últimos Cincuenta Años


**Mäler, Karl Göran.** (2001) “Wealth and well-being in a model with discrete time” Beijer discussion papers # 146

**Ministerio de Energía y Minas de Venezuela.** Petróleo y otros datos estadísticos PODE Selected years

Oficina Central de Información de Venezuela. OCEI. Informes de varios años


Annexe1

### INCREASING CERTAINTY

<table>
<thead>
<tr>
<th>Cumulative Production</th>
<th>IDENTIFIED RESOURCES</th>
<th>UNDISCOVERED RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demonstrated</td>
<td>Inferred</td>
</tr>
<tr>
<td></td>
<td>Measured</td>
<td>Indicated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Economic              | PROVEN RESERVES      | INFERRED RESERVES      |
|                       | Marginal Reserves    | Inferred               |
|                       |                       | Marginal.              |

| Marginally Economic   | Sub-economic         | Inferred               |
|                       | Resources            | sub economic          |
|                       |                       | resources             |

| Sub-economic          | Demonstrated         | Inferred               |
|                       | Sub economic         | sub economic          |
|                       | Resources            | resources              |

| Other                 | Includes non conventional and low-grade materials |

Notes

1 Manufactured, manmade, real or physical capital are here considered as synonyms
2 For a more detailed analysis of the changes in the relations between the oil
   companies and the state first as the collector of the rents and after as owner there is an
   huge literature. Further information on the subject can be found in Ramon Espinasa
   (1997), and Bernad Momer (2002)
3 The value function – $V_t$ - is defined as the net present value of future utilities.

$$V_t = \sum_{\tau=t}^{\infty} \frac{U(C(\tau))}{(1+\delta)^{\tau-t}}$$

4 A resource mechanism allocation is the mapping from the initial stock of capital into
   a feasible time paths of consumption. It is a predictor of the future of the economy.
5 A resource allocation mechanism $\alpha$ is time autonomous when it doesn't depende
   on absolute time but only in time differences

$$\alpha(\tau+s, t+s, K) = \alpha(\tau, t, K)$$
<table>
<thead>
<tr>
<th>Volume</th>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUST</td>
<td>1.2002</td>
<td>Using Conjoint Analysis to Estimate Farmers’ Preferences for Cattle Traits in West Africa</td>
<td>K. Tano, M.D. Faminow, M. Kamuanga and B. Swallow</td>
</tr>
<tr>
<td>ETA</td>
<td>2.2002</td>
<td>What Does Monetary Policy Reveal about Central Bank’s Preferences?</td>
<td>Efrem Castelnuovo and Paolo Surico</td>
</tr>
<tr>
<td>CLIM</td>
<td>4.2002</td>
<td>Technological Change in Economic Models of Environmental Policy: A Survey</td>
<td>Andreas Löschel</td>
</tr>
<tr>
<td>VOL</td>
<td>5.2002</td>
<td>Stable Coalitions</td>
<td>Carlo Carrasso and Carmen Marchiori</td>
</tr>
<tr>
<td>ETA</td>
<td>7.2002</td>
<td>Stable International Environmental Agreements: An Analytical Approach</td>
<td>Effrosyni Diamantoudi and Efthichos S. Sartzetakis</td>
</tr>
<tr>
<td>KNOW</td>
<td>8.2002</td>
<td>Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus</td>
<td>Alain Desdoigts</td>
</tr>
<tr>
<td>NRM</td>
<td>9.2002</td>
<td>Renewable Resources and Waste Recycling</td>
<td>Giuseppe Di Vita</td>
</tr>
<tr>
<td>KNOW</td>
<td>10.2002</td>
<td>Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries</td>
<td>Giorgio Brunello</td>
</tr>
<tr>
<td>ETA</td>
<td>11.2002</td>
<td>Endogenous Fluctuations and the Role of Monetary Policy</td>
<td>Mordecai Kurz, Hehai Jin and Maurizio Motolese</td>
</tr>
<tr>
<td>NRM</td>
<td>13.2002</td>
<td>The Use of Common Property Resources: A Dynamic Model</td>
<td>Michele Moretto and Paolo Rosato</td>
</tr>
<tr>
<td>CLIM</td>
<td>14.2002</td>
<td>Macroeconomic Effects of an Energy Saving Policy in the Public Sector</td>
<td>Philippe Quirion</td>
</tr>
<tr>
<td>ETA</td>
<td>16.2002</td>
<td>Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity</td>
<td>Francesco Ricci (I)</td>
</tr>
<tr>
<td>ETA</td>
<td>17.2002</td>
<td>Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy</td>
<td>Alberto Petrucci</td>
</tr>
<tr>
<td>Coalition Theory Network</td>
<td>18.2002</td>
<td>The Core in the Presence of Externalities</td>
<td>László Á. Kóczy (liv)</td>
</tr>
<tr>
<td>Coalition Theory Network</td>
<td>19.2002</td>
<td>Single-Peakedness and Disconnected Coalitions</td>
<td>Steven J. Brams, Michael A. Jones and D. Marc Kilgour (liv)</td>
</tr>
<tr>
<td>NRM</td>
<td>21.2002</td>
<td>Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems</td>
<td>Fausto Cavallaro and Luigi Ciraolo</td>
</tr>
<tr>
<td>CLIM</td>
<td>22.2002</td>
<td>Back to Kyoto? US Participation and the Linkage between R&amp;D and Climate Cooperation</td>
<td>Barbara Buchner, Carlo Carrasso, Igor Cersosimo and Carmen Marchiori</td>
</tr>
<tr>
<td>CLIM</td>
<td>23.2002</td>
<td>The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech</td>
<td>Andreas Löschel and Zhongxian Zhang</td>
</tr>
<tr>
<td>ETA</td>
<td>24.2002</td>
<td>Inventories, Employment and Hours</td>
<td>Marzio Galeotti, Louis J. Maccini and Fabio Schiantarelli</td>
</tr>
<tr>
<td>ETA</td>
<td>26.2002</td>
<td>Environmental Policy and Technological Change</td>
<td>Adam B. Jaffe, Richard G. Newell and Robert N. Stavins</td>
</tr>
<tr>
<td>SUST</td>
<td>27.2002</td>
<td>Farmer Premiums for the Voluntary Adoption of Conservation Plans</td>
<td>Joseph C. Cooper and Giovanni Signorello</td>
</tr>
<tr>
<td>SUST</td>
<td>28.2002</td>
<td>Towards An Analytical Strategic Environmental Assessment</td>
<td>The ANSEA Network</td>
</tr>
<tr>
<td>KNOW</td>
<td>29.2002</td>
<td>Geographic Concentration and Increasing Returns: a Survey of Evidence</td>
<td>Paolo Surico</td>
</tr>
<tr>
<td>ETA</td>
<td>30.2002</td>
<td>Lessons from the American Experiment with Market-Based Environmental Policies</td>
<td>Robert N. Stavins</td>
</tr>
</tbody>
</table>
NRM 31.2002 Carlo GIUPPONI and Paolo ROSATO: Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon

NRM 32.2002 Robert N. STAVINS: National Environmental Policy During the Clinton Years

KNOW 33.2002 A. SOUBEYRAN and H. STAHTH: Do Investments in Specialized Knowledge Lead to Composite Good Industries?

KNOW 34.2002 G. BRUNELLO, M.L. PARISSI and Daniela SONEDDA: Labor Taxes, Wage Setting and the Relative Wage Effect


CLIM 36.2002 T. TIETZENBERG (iv): The Tradable Permits Approach to Protecting the Commons: What Have We Learned?


NRM 40.2002 S. M. CAVANAGH, W. M. HANEMANN and R. N. STAVINS: Muffled Price Signals: Household Water Demand under Increasing-Block Prices


CLIM 42.2002 C. OHL (ivi): Inducing Environmental Co-operation by the Design of Emission Permits

CLIM 43.2002 J. EYCKMANS, D. VAN REGERMOTER and V. VAN STEENBERGHE (ivi): Is Kyoto Fatally Flawed? An Analysis with MacGEM

CLIM 44.2002 A. ANTOCI and S. BORGHESI (ivi): Working Too Much in a Polluted World: A North-South Evolutionary Model

ETA 45.2002 P. G. FREDRIKSSON, Johan A. LIST and Daniel MILLIMET (ivi): Chasing the Smokestack: Strategic Policymaking with Multiple Instruments

ETA 46.2002 Z. YU (ivi): A Theory of Strategic Vertical DFI and the Missing Pollution-Haven Effect

SUST 47.2002 Y. H. FARZIN: Can an Exhaustible Resource Economy Be Sustainable?

SUST 48.2002 Y. H. FARZIN: Sustainability and Hamiltonian Value

KNOW 49.2002 C. PIGA and M. VIVARELLI: Cooperation in R&D and Sample Selection

Coalition Theory Network 50.2002 M. SERTEL and A. SLINKO (ivi): Ranking Committees, Words or Multisets

Coalition Theory Network 51.2002 Sergio CURRARINI (ivi): Stable Organizations with Externalities

ETA 52.2002 Robert N. STAVINS: Experience with Market-Based Policy Instruments


CLIM 54.2002 Scott BARRETT (iii): Towards a Better Climate Treaty

ETA 55.2002 Richard G. NEWELL and Robert N. STAVINS: Cost Heterogeneity and the Potential Savings from Market-Based Policies

SUST 56.2002 Paolo ROSATO and Edi DEFRANCESCO: Individual Travel Cost Method and Flow Fixed Costs

SUST 57.2002 Vladimir KOTOV and Elena NIKITINA (ivii): Reorganisation of Environmental Policy in Russia: The Decade of Success and Failures in Implementation of Perspective Quests


VOL 60.2002 Giovanni DI BARTOLOMEO, Jacob ENGWERDA, Joseph PLASMANs and Bas VAN AARLE: Staying Together or Breaking Apart: Policy-Makers’ Endogenous Coalitions Formation in the European Economic and Monetary Union


PRIV 62.2002 Carlo CAPUANO: Demand Growth, Entry and Collusion Sustainability

PRIV 63.2002 Federico MUNARI and Raffaele ORIANI: Privatization and R&D Performance: An Empirical Analysis Based on Tobin’s Q

PRIV 64.2002 Federico MUNARI and Maurizio SOBRERO: The Effects of Privatization on R&D Investments and Patent Productivity

SUST 65.2002 Orley ASHENFELTER and Michael GREENSTONE: Using Mandated Speed Limits to Measure the Value of a Statistical Life


CLIM 68.2002 Barbara K. BUCHNER and Roberto ROSON: Conflicting Perspectives in Trade and Environmental Negotiations

CLIM 69.2002 Philippe QUIRION: Complying with the Kyoto Protocol under Uncertainty: Taxes or Tradable Permits?

SUST 70.2002 Anna ALBERINI, Patrizia RIGANTI and Alberto LONGO: Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents

SUST 71.2002 Marco PERCOCO: Discounting Environmental Effects in Project Appraisal
Sudeshna GHOSH BANERJEE and Michael C. MUNGER: Move to Markets? An Empirical Analysis of
Andreas LANGE: Privatization and Labor Force Restructuring Around the
Alberto CHONG and Florencio LÓPEZ-DE-SILANES: Does Ownership Affect Firms’ Efficiency? Panel Data Evidence from the Fixed-Line Telecommunications Sector in Developing Economies
Mohammed OMRAN: Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy
Nandini GUPTA: Privatization and Investment: Crowding-Out Effect vs Financial
Guillaume GIRMENS and Michel GUILLARD: Partial Privatization and Firm Performance
François DEGEORGE, Dirk JENTER, Alberto MOEL and Peter TUFANO: Selling Company Shares to Reluctant Employees: France Telecom’s Experience

Matthew HAAG and Roger LAGUNOFF: Globalisation and Migration - Multicultural Environment: Saint-Petersburg's Case

Lori SNYDER, Robert STAVINS and Alexander F. WAGNER: Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany

Bernardo BORTOLOTTI and Paolo PINOTTI: The Political Economy of Privatization

Halis Murat YILDIZ: Taxing Land Rent in an Open Economy

Giorgio BUSETTI and Matteo MANERA: Allocation Rules for Network Games

Ana MAULEON and Vincent VANNETELBOSCH: Free Trade Networks

Jens HORBACH: The Beginning of Organic Fish Farming in Italy

Sandra WALLMAN: ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research

Narjes BOURAKRI, Jean-Claude COSSET and Omrane GUEDHAMI: Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection

Matthieu GLACHANT: Voluntary Agreements under Endogenous Legislative Threats


Rolf GOLOMBEK and Michael HOEL: Climate Policy under Technology Spillovers

Slim BEN YOUSSEF: The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness

Carlo CARRARO and Carmen MARCHIORI: On Biology and Technology: The Economics of Managing Biotechnologies

Matthew O. JACKSON: Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany

Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO: The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing

Kazuma MATOBA: Allocation Rules for Network Games

Ana MAULEON and Vincent VANNETELBOSCH: Farsightedness and Cautionousness in Coalition Formation

Michael FINUS and Ekko van IERLAND and Robert DELLINK: Stability of Climate Coalitions in a Cartel Formation Game

Fernando VEGA-REDONDO (lx): Allocation Rules for Network Games

Matthew HAG and Roger LAGUNOFF (lx): On the Size and Structure of Group Cooperation

Taiji FURUSAWA and Hideo KONISHI (lx): Free Trade Networks

Katrin MILLOCK and Céline NAUGES: The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness

Bernardo BORTOLOTTI and Paolo PINOTTI (lx): The Political Economy of Privatization

Giorgio BUSERI and Matteo MANERA (lx): The Minimal Dominant Set is a Non-Empty Core-Extension


Michael FINUS and Bianca RUNDSHAGEN (lx): How the Rules of Coalition Formation Affect Stability of International Environmental Agreements

Michael FINUS and Bianca RUNDHAGEN: How the Rules of Coalition Formation Affect Stability of International Environmental Agreements


Halis Murat YILDIZ (lx): National Versus International Mergers and Trade Liberalization

Santiago RUBIO and Alistair ULPH: An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements


Carlo CARRARO and Carmen MARCHIORI: Global Climate Policy Architectures

CLIM 44.2003 Katrin MILLOCK and Céline NAUGES: The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness

CLIM 50.2003 László A. KOCZY and Luc LAUWERS (lx): The Minimal Dominant Set is a Non-Empty Core-Extension

PRIV 45.2003 Bernardo BORTOLOTTI and Paolo PINOTTI: The Political Economy of Privatization

SIEV 46.2003 Elbert DJUKGRAF and Herman R.J. VOLLEBERGH: Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods

SIEV 49.2003 Lori SNYDER, Nolan MILLER and Robert STAVINS: The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing

CLIM 48.2003 Lori SNYDER, Nolan MILLER and Robert STAVINS: The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing


CLIM 50.2003 Lori SNYDER, Nolan MILLER and Robert STAVINS (lx): The Minimal Dominant Set is a Non-Empty Core-Extension

CLIM 51.2003 Matthew O. JACKSON (lx): Allocation Rules for Network Games

CLIM 52.2003 Ana MAULEON and Vincent VANNETELBOSCH (lx): Farsightedness and Cautionousness in Coalition Formation


CLIM 54.2003 Matthew HAG and Roger LAGUNOFF (lx): On the Size and Structure of Group Cooperation

CLIM 55.2003 Taiji FURUSWA and Hideo KONISHI (lx): Free Trade Networks

CLIM 56.2003 Halis Murat YILDIZ (lx): National Versus International Mergers and Trade Liberalization

CLIM 57.2003 Santiago RUBIO and Alistair ULPH (lx): An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements

SIEV 63.2003 Alberto PETRUCCI: Taxing Land Rent in an Open Economy

SIEV 64.2003 Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS: Thirteen Plus One: A Comparison of Global Climate Policy Architectures

SIEV 65.2003 Edi DEFRANCESCO: The Beginning of Organic Fish Farming in Italy

SIEV 66.2003 Klaus CONRAD: Price Competition and Product Differentiation when Consumers Care for the Environment


CLIM 68.2003 ZhongXiang ZHANG: Open Trade with the U.S. Without Compromising Canada’s Ability to Comply with its Kyoto Target

CLIM 69.2003 David FRANTZ (lx): Lorenzo Market between Diversity and Mutation

CLIM 70.2003 Ercole SORI (lx): Mapping Diversity in Social History

CLIM 71.2003 Ljiljana DERU SIMIC (lx): What is Specific about Art/Cultural Projects?

CLIM 72.2003 Natalya V. TARANOVA (lx): The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg’s Case

CLIM 73.2003 Kristine CRANE (lx): The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration

CLIM 74.2003 Kazuma MATOBA (lx): Glocal Dialogue- Transformation through Transcultural Communication

CLIM 75.2003 Catarina REIS OLIVEIRA (lx): Immigrants’ Entrepreneurial Opportunities: The Case of the Chinese in Portugal

CLIM 76.2003 Sandra WALLMAN (lx): The Diversity of Diversity - towards a typology of urban systems
KNOW 77.2003 Richard PEARCE (lxii): A Biologist’s View of Individual Cultural Identity for the Study of Cities
KNOW 78.2003 Vincent MERK (lxii): Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas
KNOW 79.2003 Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P. OTTAVIANO: Child Labor and Resistance to Change
ETA 80.2003 Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA: Investment Size and Firm’s Value under Profit Sharing Regulation
IEM 81.2003 Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI: Oil and Product Dynamics in International Petroleum Markets
CLIM 82.2003 Y. Hossein FARZIN and Jinhua ZHAO: Pollution Abatement Investment When Firms Lobby Against Environmental Regulation
CLIM 83.2003 Giuseppe DI VITA: Is the Discount Rate Relevant in Explaining the Environmental Kuznets Curve?
CLIM 84.2003 Reyer GERALGH and Wietze LISE: Induced Technological Change Under Carbon Taxes
NRM 85.2003 Rinaldo BRAU, Alessandro LANZA and Francesco PIGLIARU: How Fast are the Tourism Countries Growing? The cross-country evidence
KNOW 86.2003 Elena BELLINI, Gianmarco I.P. OTTAVIANO and Dino PINELLI: The ICT Revolution: opportunities and risks for the Mezzogiorno
SIEV 87.2003 Lucas BRETSCHGER and Sjak SMULDERS: Sustainability and Substitution of Exhaustible Natural Resources. How resource prices affect long-term R&D investments
CLIM 89.2003 Marzio GALEOTTI: Economic Development and Environmental Protection
CLIM 90.2003 Marzio GALEOTTI: Environment and Economic Growth: Is Technical Change the Key to Decoupling?
CLIM 91.2003 Marzio GALEOTTI and Barbara BUCHNER: Climate Policy and Economic Growth in Developing Countries
ETA 93.2003 Andrea BELTRATTI: Socially Responsible Investment in General Equilibrium
CTN 94.2003 Parkash CHANDER: The γ-Core and Coalition Formation
IEM 95.2003 Matteo MANERA and Angelo MARZULLO: Modelling the Load Curve of Aggregate Electricity Consumption Using Principal Components
IEM 96.2003 Alessandro LANZA, Matteo MANERA, Margherita GRASSO and Massimo GIOVANNINI: Long-run Models of Oil Stock Prices
KNOW 98.2003 John CROWLEY, Marie-Cecile NAVES (lxiii): Anti-Racist Policies in France. From Ideological and Historical Schemes to Socio-Political Realities
KNOW 100.2003 Alaknanda PATEL (lxiii): Cultural Diversity and Conflict in Multicultural Cities
KNOW 101.2003 David MAY (lxiii): The Struggle of Becoming Established in a Deprived Inner-City Neighbourhood
KNOW 102.2003 Sébastien ARCAND, Danielle JUTEAU, Sirma BILGE, and Francine LEMIRE (lxiii): Municipal Reform on the Island of Montreal: Tensions Between Two Majority Groups in a Multicultural City
CLIM 103.2003 Barbara BUCHNER and Carlo CARRARO: China and the Evolution of the Present Climate Regime
CLIM 104.2003 Barbara BUCHNER and Carlo CARRARO: Emissions Trading Regimes and Incentives to Participate in International Climate Agreements
CLIM 105.2003 Anil MARKANDYA and Dirk T.G. RÜBBELKE: Ancillary Benefits of Climate Policy
NRM 106.2003 Anne Sophie CRÉPIN (lxiv): Management Challenges for Multiple-Species Boreal Forests
NRM 107.2003 Anne Sophie CRÉPIN (lxiv): Threshold Effects in Coral Reef Fisheries
SIEV 108.2003 Sara ANIYAR (lxiv): Estimating the Value of Oil Capital in a Small Open Economy: The Venezuela’s Example

1000 Carlo CARRARO, Alessandro LANZA and Valeria PAPPONETTI: One Thousand Working Papers
This paper was presented at the Workshop “Growth, Environmental Policies and Sustainability” organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001

This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on “Property Rights, Institutions and Management of Environmental and Natural Resources”, organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001

This paper was presented at the International Conference on “Economic Valuation of Environmental Goods”, organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001

This paper was circulated at the International Conference on “Climate Policy – Do We Need a New Approach?”, jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001

This paper was presented at the Seventh Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Venice, Italy, January 11-12, 2002

This paper was presented at the First Workshop of the Concerted Action on Tradable Emission Permits (CATEP) organised by the Fondazione Eni Enrico Mattei, Venice, Italy, December 3-4, 2001

This paper was presented at the ESF EURESCO Conference on Environmental Policy in a Global Economy “The International Dimension of Environmental Policy”, organised with the collaboration of the Fondazione Eni Enrico Mattei, Acquafrredda di Maratea, October 6-11, 2001

This paper was presented at the First Workshop of “CFEWE – Carbon Flows between Eastern and Western Europe”, organised by the Fondazione Eni Enrico Mattei and Zentrum fur Europäische Integrationsforschung (ZEI), Milan, July 5-6, 2001

This paper was presented at the Workshop on “Game Practice and the Environment”, jointly organised by Università del Piemonte Orientale and Fondazione Eni Enrico Mattei, Alessandria, April 12-13, 2002

This paper was presented at the ENIGME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002

This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002

This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003

This paper was presented at the ENIGME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002

This paper was presented at the ENIGME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003

This paper was presented at the International Conference on "Theoretical Topics in Ecological Economics", organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003
### 2002 SERIES

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Editor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIM</td>
<td>Climate Change Modelling and Policy</td>
<td>Marzio Galeotti</td>
</tr>
<tr>
<td>VOL</td>
<td>Voluntary and International Agreements</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>SUST</td>
<td>Sustainability Indicators and Environmental Valuation</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resources Management</td>
<td>Carlo Giupponi</td>
</tr>
<tr>
<td>KNOW</td>
<td>Knowledge, Technology, Human Capital</td>
<td>Dino Pinelli</td>
</tr>
<tr>
<td>MGMT</td>
<td>Corporate Sustainable Management</td>
<td>Andrea Marsanich</td>
</tr>
<tr>
<td>PRIV</td>
<td>Privatisation, Regulation, Antitrust</td>
<td>Bernardo Bortolotti</td>
</tr>
<tr>
<td>ETA</td>
<td>Economic Theory and Applications</td>
<td>Carlo Carraro</td>
</tr>
</tbody>
</table>

### 2003 SERIES

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
<th>Editor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIM</td>
<td>Climate Change Modelling and Policy</td>
<td>Marzio Galeotti</td>
</tr>
<tr>
<td>GG</td>
<td>Global Governance</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>SIEV</td>
<td>Sustainability Indicators and Environmental Valuation</td>
<td>Anna Alberini</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resources Management</td>
<td>Carlo Giupponi</td>
</tr>
<tr>
<td>KNOW</td>
<td>Knowledge, Technology, Human Capital</td>
<td>Gianmarco Ottaviano</td>
</tr>
<tr>
<td>IEM</td>
<td>International Energy Markets</td>
<td>Anil Markandya</td>
</tr>
<tr>
<td>CSRM</td>
<td>Corporate Social Responsibility and Management</td>
<td>Sabina Ratti</td>
</tr>
<tr>
<td>PRIV</td>
<td>Privatisation, Regulation, Antitrust</td>
<td>Bernardo Bortolotti</td>
</tr>
<tr>
<td>ETA</td>
<td>Economic Theory and Applications</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>CTN</td>
<td>Coalition Theory Network</td>
<td></td>
</tr>
</tbody>
</table>