

Papyrakis, Elissaios; Gerlagh, Reyer

**Working Paper**

## Natural Resources: A Blessing or a Curse?

Nota di Lavoro, No. 8.2003

**Provided in Cooperation with:**

Fondazione Eni Enrico Mattei (FEEM)

*Suggested Citation:* Papyrakis, Elissaios; Gerlagh, Reyer (2003) : Natural Resources: A Blessing or a Curse?, Nota di Lavoro, No. 8.2003, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/118036>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**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.*

## **Natural Resources: A Blessing or a Curse?**

Elissaios Papyrakis and Reyer Gerlagh

NOTA DI LAVORO 8.2003

**JANUARY 2003**

|                                    |
|------------------------------------|
| NRM – Natural Resources Management |
|------------------------------------|

Elissaios Papyrakis, *IVM, Institute for Environmental Studies,  
Vrije Universiteit, Amsterdam, The Netherlands*  
Reyer Gerlagh, *IVM, Institute for Environmental Studies,  
Vrije Universiteit, Amsterdam, The Netherlands*

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:  
[http://www.feem.it/web/attiv/\\_wp.html](http://www.feem.it/web/attiv/_wp.html)

Social Science Research Network Electronic Paper Collection:  
[http://papers.ssrn.com/abstract\\_id=XXXXXX](http://papers.ssrn.com/abstract_id=XXXXXX)

The opinions expressed in this paper do not necessarily reflect the position of  
Fondazione Eni Enrico Mattei

# Natural Resources: A Blessing or a Curse

## Summary

We examine empirically the effect of natural resource abundance on economic growth. We find that natural resources have a negative impact on growth when considered in isolation, but a positive impact on growth when including in the analysis other variables such as corruption, investments, openness, terms of trade, and schooling, and treating these variables as independent. However, when we take account of the effect of natural resources on the other variables and furthermore consider the indirect effect on growth, that is, when we examine possible transmission channels, we find a strong negative effect of natural resources on growth. Finally, we calculate the relative importance of each transmission channel.

**Keywords:** Natural Resources, growth, transmission channels

**JEL:** C21, O13, Q33

*The research has been funded by the Dutch National Science Foundation (NWO) under contract nr. 016.005.040.*

*Address for correspondence:*

Elissaios Papyrakis  
IVM/VU  
De Boelelaan 1087  
1081 HV Amsterdam  
The Netherlands  
Phone: +31 - 20 - 44 49502  
Fax: +31 - 20 - 44 49553  
E-mail: [elissaios.papyrakis@ivm.vu.nl](mailto:elissaios.papyrakis@ivm.vu.nl)

## 1. Introduction

It is a well documented fact, but still surprising finding of many studies, that there is a general tendency of natural-resource abundant economies to grow at a slower pace (Sachs and Warner 1995, 1997, 1999a, Gylfason 2000, 2001a, Rodriquez and Sachs 1999, Leite and Weidmann 1999). The last two centuries, countries rich in natural resources, e.g. Russia, Nigeria and Venezuela, experienced growth of comparatively low or mediocre magnitude. Sachs and Warner (1995) claim that this is a historically common pattern. Countries that base their economies on natural resources tend to be examples of development failures. In contrast, countries such as Japan, Hong-Kong, Korea, Singapore and Switzerland, that only had limited access to natural resources, experienced remarkably high economic growth rates. This paper studies, by use of growth regressions, the transmission channels through which natural resource abundance negatively affects growth, that is, the effect of natural resources on corruption, investments, trade, schooling, and then indirectly, on economic growth.

The negative impact of natural resources on growth is a paradox. There is no obvious reason why natural resources frustrate economic growth as experienced by many resource-rich countries. In contrast, natural resources are a potential source of income, and through savings this income could be converted into capital, adding to future output levels, e.g. if resource rents are used for the construction of roads, modernization of telecommunication systems, health and educational programs. Indeed, some countries, although a minority, managed to benefit from their natural wealth. The nineteenth century resource booms in Latin America certainly stimulated economic progress. For example, Ecuador experienced a significantly higher income per capita level after its boom (Sachs and Warner 1999a). Similarly, the industrial revolution that took off in Great Britain and Germany was only possible because of the vast deposits of ore and coal (Sachs and Warner 1995). Norway presents a recent example of a country that seems to manage its natural-resource abundance well, converting it into economic prosperity. Although Norway did not avoid recession for a few years, the way its present and future natural wealth is exploited is an example of carefully planned development. Almost 80 percent of the oil rents are collected through taxes and fees and invested into foreign securities, so that the economy is protected from abrupt and enormous income increases and a fair division of oil rents between generations is achieved (Gylfason, 2001a).

Given the (few) successful examples, it is the objective of this paper to investigate the causes for the under-performance of most countries rich in natural resources. In the literature, several transmission channels are mentioned. A sudden increased income level due to a natural resource

discovery may lead to sloth and less need for sound economic management and institutional quality (Sachs and Warner 1995, Gylfason 2000, 2001a). Also, it may create a false sense of security and weaken the perceived need for investments and growth promoting strategies. Natural resource abundant economies benefit less from technology spillovers, typical for the manufacturing industries, since export of these industries is harmed by an appreciation of the local currency, e.g. through inflationary pressure due to increased domestic demand (Sachs *et al.* 1995, 1999a, Gillis *et al.* 1996, Gylfason 2000, 2001). Finally, as the natural resource sector expands at the cost of other sectors, the returns to human capital decrease and investments in education decline (Gylfason 2001a).

Our analysis follows the methodology set out by Mo (2001), who investigates the transmission channels through which corruption affects growth. We will use cross-country regressions to show that, indeed, on average, natural resources are associated with the phenomena listed above that impede the economic process. Taking account of the relation between natural resources and other indexes used for growth regressions, we are able to better understand the “curse of natural resources”. Specifically, we find that, when abstracting from the negative indirect effects, natural resources positively contribute to economic growth. Yet, taking account of the negative indirect impacts, these outweigh the positive direct contribution of natural resources on economic growth. We emphasize that this is an empirical finding and no economic law. When governments succeed in preventing the appearance of the phenomena through which natural resources harm growth, a country could benefit from its natural wealth.

The next section is devoted to the basic growth regressions. We verify the position that overall, natural resource abundance impedes economic development rather than that it acts as a stimulus. Yet we also find that, taking other indexes into account as independent variables such as corruption, investments, openness, terms of trade, and schooling, resource abundance has a positive impact on growth. Section 3 studies empirically the transmission channels and compares their relative weight in the overall negative impact of natural resources on economic growth. Section 4 concludes.

## **2. Basic Cross-Country Regressions**

To identify the dependence of growth on natural resource abundance, we estimate cross-country growth regressions in the tradition of previous empirical work by Barro (1989) and Sachs and Warner (1995, 1997). We base our equations on the conditional convergence hypothesis, which says that different growth rates between different countries are explained by various characteristics of these countries, whereas high-income countries have lower growth rates than

low-income countries, all other things equal. Thus, per capita economic growth from period  $t_0=1975$  to  $t_T=1996$ , denoted by  $G^i=(1/T)\ln(Y_T^i/Y_0^i)$ , negatively depends on initial per capita income  $Y_0^i$ , it depends on natural resource abundance,  $R^i$ , the sign of dependence is subject for our analysis, and it also depends on a vector of other explanatory variables  $Z^i$ :

$$G^i = \alpha_0 + \alpha_1 \ln(Y_0^i) + \alpha_2 R^i + \alpha_3 Z^i + \varepsilon^i, \quad (1)$$

where  $i$  corresponds to each single country of the sample.

This paper studies the coefficient for resource abundance,  $\alpha_2$ , and its relation to the (vector of) other variables  $Z$ . Before we turn to the data, let us briefly bring to mind the transitional and permanent income effects of a change in a country's resource income  $R^i$ , as described by growth equation (1). We will see that the permanent income effect of resource abundance is given by the ratio  $(-\alpha_2/\alpha_1)$ , assuming conditional convergence, i.e.  $\alpha_1 < 0$ . Consider a country, initially without natural resources, in which a new source of natural resources is discovered and exploited, leading to an instantaneous increase in income; say  $R^i$  is resource income as a share of total income. For the ratio  $-\alpha_2/\alpha_1=1$ , the decrease in  $\alpha_1 \ln(Y_0^i)$  equals the increase in  $\alpha_2 R^i$ , and economic growth is unaffected by the change in natural resource income. That is, the economy as a whole, apart from the natural resource sector, remains on its initial growth path and the natural resource sector provides a permanent income source additional to the income level that was reached without the natural resource. If, however,  $-\alpha_2/\alpha_1 > 1$ , then growth accelerates after the resource discovery, and thus, permanent income exceeds the instantaneous income effect by factor  $-\alpha_2/\alpha_1$ . If, on the other hand,  $-\alpha_2/\alpha_1 < 1$ , then growth is reduced; part of the natural resource income leaks away and the permanent income effect falls short of the temporary income effect. Finally, when  $\alpha_2 < 0$  and  $\alpha_1 < 0$ , the resource leads to a short-lived increase in income, since growth is affected negatively by so much that in the long term, permanent income falls short of income without the natural resource. The latter case represents a situation known as the 'curse of natural resources'.

To assess the long-term income effects of a change in  $R^i$  or  $Z^i$ , let us assume that, initially, an economy is on a steady state or constant growth path, when  $R^i$  changes by  $\Delta R^i$  and  $Z^i$  by  $\Delta Z^i$ . Economic growth adjusts and the economy diverges from its initial path, but in the long term, economic growth returns to the same initial level. Then, the change in  $R^i$  or  $Z^i$  has a permanent effect on income, and equation (1) gives

$$0 = \alpha_1 \Delta \ln(Y^i) + \alpha_2 \Delta R^i + \alpha_3 \Delta Z^i. \quad (2)$$

In turn, we can solve for the long-term income effect  $\Delta Y^i$  resulting from a change in  $R^i$  and  $Z^i$ :

$$\Delta Y^i = (1 - \exp((- \alpha_2 / \alpha_1) \Delta R^i + (- \alpha_3 / \alpha_1) \Delta Z^i)). \quad (3)$$

For small values of  $(\alpha_2 / \alpha_1) \Delta R^i$  and  $(\alpha_3 / \alpha_1) \Delta Z^i$ , we can use the approximation

$$\Delta Y^i \approx -(\alpha_2 / \alpha_1) \Delta R^i - (\alpha_3 / \alpha_1) \Delta Z^i. \quad (4)$$

We will now estimate growth equation (1), using OLS, step-by-step increasing the set of variables  $Z^i$ . The appendix lists all variables and data sources. As a starting point, we only include initial income per capita at period 1975 ( $Ln Y_{75}$ ), and natural resource abundance for which we take the share of mineral production in GDP in 1971 ( $SNR$ ) as a proxy. The results are listed in column entry (1) of Table 1. For this equation, there is a highly significant and negative relationship between economic growth and natural resources. A one per cent point increase in income from mineral resources, relative to total income, decreases growth by 0.075% per year. An increase in income from mineral resources of one standard deviation (0.07), decreases the growth rate by about a half per cent per year. Natural resources indeed seem to be an impediment to economic growth.

Next, in column entry (2), we include an average *Corruption* measure for the 1980-1985 period of time, provided by Transparency International, where higher values of the index correspond to higher levels of corruption and lower levels of institutional quality. The period 1980-1985 is the earliest for which the index is available. In general, we attempt to choose variables referring either to the beginning of the period 1975-1996 or to average values for the entire period to avoid endogeneity problems that may arise between variables. Mo (2001) argues, though, that for the corruption variable, endogeneity is less likely since institutions tend to evolve slowly. The second regression shows a negative sign for the coefficient  $\alpha_0$ , so that it supports the conditional convergence hypothesis. Also, corruption negatively affects economic growth, as expected. An increase in the corruption level of one standard deviation decreases growth by  $2.68 \times 0.44 = 1.17$  per cent. In the long term, this leads to a permanent income decrease of 74 per cent.<sup>2</sup> Corruption hampers the economic process considerably. The coefficient for natural resources remains almost unaffected, though its significance is substantially lowered. An increase in natural resource income of one per cent of total income decreases growth by 0.07% per year, and long-term total income by about  $7.39/1.16=6.4$  per cent (see equation (4)). The regression illustrates the argument that whereas in the short term natural resources increase wealth, in the long term the economy falls back more than it gained.

---

<sup>2</sup>  $1 - \exp(-1.17/1.16) = 0.74$ , see equation (3).

In the subsequent column entries, we include as independent variables the ratio of real gross domestic *Investments* to real GDP averaged over the period 1975-1996, an index of *Openness*, that is the percentage of years during the period 1970-1990 in which the country is considered an open economy according to the Sachs and Warner database, a *Terms of trade* index measuring the average annual growth over 1970-1990 in the ratio of the export price index divided by the import price index, and finally a *Schooling* index by King and Levine measuring (the log of) the average number of years of secondary schooling during 1970-1989, as a proxy of educational quality.

We highlight some observations regarding the sequence of regressions in Table 1. As we move to the right and we include more explanatory variables, the coefficient for natural resources gradually decreases and becomes less significant. What is more, in the last column entries (5) and (6), the coefficient of natural resources has become positive. This suggests that natural resources are not harmful to growth *per se*. In the sixth regression, the possible effect of natural resources on corruption, investments, trade policies, terms of trade, and schooling, and the indirect effect thereof on economic growth, that are the so-called transmission channels, is taken account of through the coefficients of these variables. The coefficient for natural resources only measures the direct effect of natural resource income on growth, and abstracting from the indirect effects of natural resource abundance, we find an almost one-to-one relation between natural resource income and long-term income, that is,  $\alpha_2/\alpha_1 \approx -1$ . An increase in income due to natural resources is permanent. It is the indirect effects that make natural resources harmful to economic growth. This finding calls for a further investigation of the transmission channels. But, before going into the subject in the next section, we want to draw attention to some other features of the sequence of regressions.

The coefficient for corruption also decreases over the sequence of column entries, though the coefficient remains negative. This finding is consistent with the results of Mo (2001), who shows that corruption affects growth mainly through several indirect channels. By including these channels in the regression, the corruption coefficient loosens significance. Yet corruption has no direct positive effect on income, as is the case for natural resources; its coefficient remains negative. Furthermore, the coefficients for investments, openness, terms of trade, and schooling do not vary much over the regression sequence and are intuitive and in line with the values found in the literature. An economy characterized by a high investment ratio, with a higher openness index, a lower initial income per capita, favorable terms of trade, and high educational standards, is expected to experience a relatively high growth rate. (Sachs and Warner 1995, 1997, 1999, Sala-I-Martin 1997, Mo 2001).



TABLE 1. *Growth regressions as in equation (1)*

| Dependent variable: $G_{75-96}$ | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|---------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Constant                        | -2.62               | 10.03               | 11.66               | 12.87               | 12.33               | 12.03               |
| $LnY_{75}$<br>(0.89)            | 0.52**<br>(2.48)    | -1.16***<br>(-3.00) | -1.61***<br>(-4.93) | -1.77***<br>(-5.55) | -1.76***<br>(-5.98) | -1.61***<br>(-3.91) |
| $SNR$<br>(0.07)                 | -7.57***<br>(-4.09) | -7.39**<br>(-2.04)  | -4.41<br>(-1.47)    | -3.11<br>(-1.07)    | 0.93<br>(0.32)      | 1.59<br>(0.59)      |
| <i>Corruption</i><br>(2.68)     |                     | -0.44***<br>(-3.06) | -0.30**<br>(-2.52)  | -0.26**<br>(-2.25)  | -0.19*<br>(-1.76)   | -0.09<br>(-0.86)    |
| <i>Investments</i><br>(8.06)    |                     |                     | 0.16***<br>(4.82)   | 0.13***<br>(4.15)   | 0.15***<br>(5.07)   | 0.16***<br>(5.56)   |
| <i>Openness</i><br>(0.45)       |                     |                     |                     | 1.26**<br>(2.31)    | 1.64***<br>(3.23)   | 1.26**<br>(2.39)    |
| <i>Terms of Trade</i><br>(1.90) |                     |                     |                     |                     | -0.27**<br>(-2.52)  | -0.31***<br>(-3.23) |
| <i>Schooling</i><br>(0.61)      |                     |                     |                     |                     |                     | 0.584<br>(1.229)    |
| $R^2$ adjusted                  | 0.18                | 0.25                | 0.51                | 0.55                | 0.62                | 0.66                |
| $N$                             | 103                 | 47                  | 47                  | 47                  | 46                  | 39                  |

Note: Standard deviations for independent variables in parentheses, based on the sample  $N=39$  of regression (6);  $t$ -statistics for coefficients in parentheses. Superscripts \*, \*\*, \*\*\* correspond to a 10, 5 and 1% level of significance.

### 3. Transmission channels

In this section, we analyze the magnitude and relative importance of the transmission channels, that is, we estimate the effect of natural resources on corruption, investments, openness, terms of trade, and schooling, and the indirect effect thereof on economic growth. We estimate the dependence of the variables  $Z^i$  on resource income:

$$Z^i = \beta_0 + \beta_1 R^i + \mu^i, \quad (5)$$

where  $Z^i$ ,  $\beta_0$ ,  $\beta_2$ , and  $\mu^i$  are vectors of which each element is associated with the corruption, investments, openness, terms of trade, and schooling indexes. Table 2 lists the results for the estimated equation (5). To avoid the problem of different sample sizes (because of available data) among different regressions that would influence our results, we confine the transmission analysis

to the final sample of 39 countries used in the last regression of Table 1. The coefficients are not highly significant but this is due to small sample size. Running the same regressions for the largest possible sample available for each transmission channel provides significant coefficients at the 1% level for the terms of trade and openness indexes and at the 5% level for the investment and schooling indexes. The corruption channel seems to be the weakest channel since it is only significant at the 16% level. The  $R^2$  increases for each transmission channel and the value of the coefficients is robust against the sample size.

TABLE 2. *Indirect Transmission Channels, estimation of equation (5)*

|                | Corruption     | Investments       | Openness          | Terms of Trade   | Schooling        |
|----------------|----------------|-------------------|-------------------|------------------|------------------|
| Constant       | 5.87           | 20.77             | 0.68              | -0.74            | -0.70            |
| SNR<br>(0.07)  | 7.21<br>(1.13) | -28.83<br>(-1.52) | -1.82*<br>(-1.74) | 7.75*<br>(-1.75) | -2.16<br>(-1.50) |
| $R^2$ adjusted | 0.007          | 0.034             | 0.051             | 0.052            | 0.0032           |
| $N$            | 39             | 39                | 39                | 39               | 39               |

Note: *t*-statistics for coefficients in parentheses. Superscripts \*, \*\*, \*\*\* correspond to a 10, 5 and 1% level of significance.

When natural resources explain part of the investment and other variables, this can help us to understand the direct plus indirect impact of natural resources on growth. Substitution of (5) in (1) gives

$$G^i = (\alpha_0 + \alpha_3 \beta_0) + \alpha_1 \ln(Y_0^i) + (\alpha_2 + \alpha_3 \beta_1) R^i + \alpha_3 \mu^i + \varepsilon^i, \quad (6)$$

where  $\alpha_2 R^i$  is the direct effect of natural resources on growth,  $\alpha_3 \beta_1 R^i$  is the indirect effect of natural resource abundance on growth, and  $\mu^i$  are the residuals of (5). The estimated values for the coefficients  $\alpha_1$ ,  $\alpha_2 + \alpha_3 \beta_1$ , and  $\alpha_3$  are listed in Table 3.

TABLE 3. *Growth regression, taking account of indirect effects as in equation (6)*

| Dependent variable: $G_{75-96}$             | (7)                 |
|---|---------------------|
| Constant                                    | 16.53               |
| $\ln Y_{75}$<br>(0.89)                      | -1.61***<br>(-3.90) |
| $SNR$<br>(0.07)                             | -9.60***<br>(-4.30) |
| $\mu_1$ ( <i>Corruption</i> )<br>(2.63)     | -0.091<br>(-0.86)   |
| $\mu_2$ ( <i>Investments</i> )<br>(7.82)    | 0.16***<br>(5.56)   |
| $\mu_3$ ( <i>Openness</i> )<br>(0.43)       | 1.26**<br>(2.39)    |
| $\mu_4$ ( <i>Terms of Trade</i> )<br>(1.82) | -0.31***<br>(-3.23) |
| $\mu_5$ ( <i>Schooling</i> )<br>(0.59)      | 0.58<br>(1.23)      |
| $R^2$ adjusted                              | 0.66                |
| $N$   | 39                  |

*Note: Standard deviations for independent variables in parentheses; t-statistics for coefficients in parentheses. Superscripts \*, \*\*, \*\*\* correspond to a 10, 5 and 1% level of significance.*

The coefficient of natural resources (-9.60) now includes both direct and indirect effects. A one per cent increase in natural resource income leads to a decrease in the growth rate of -0.096 per cent, and a decrease in long-term income of about 6 per cent (equation (4)). This finding is consistent with the simple regression (2) in Table 1.<sup>3</sup> An increase in the share of mineral production in GDP of one standard deviation would directly and indirectly (through corruption, investment, openness, the terms of trade and schooling) result in a reduction in annual per-capita growth of 0.67% (-9.60x0.07), and a long-term income decrease of 33% (equation (3)).

Furthermore, we estimate the relative importance of each transmission channel in explaining the overall negative impact of natural resources on economic growth. The direct effect is given by

<sup>3</sup> We notice that the second regression of Table 1 is based on a larger sample.

$\alpha_2$  and the indirect effect by  $\alpha_3\beta_1$  (6). Results are listed in Table 4. Then, we will discuss each separate transmission channel.

TABLE 4. *Relative Importance of Transmission Channels, as in equation (6)*

| Transmission channels | $\alpha_3$<br>(Table 1) | $\beta_1$<br>(Table 2) | Contribution to<br>$\alpha_2 + \alpha_3\beta_1$ | Relative<br>Contribution |
|-----------------------|-------------------------|------------------------|---|--------------------------|
| <i>SNR</i>            |                         |                        | 1.59  | −17%                     |
| <i>Corruption</i>     | −0.09                   | −7.21                  | −0.66   | 7%                       |
| <i>Investment</i>     | 0.16                    | −28.83                 | −4.53   | 47%                      |
| <i>Openness</i>       | 1.26                    | −1.82                  | −2.30   | 24%                      |
| <i>Terms of Trade</i> | −0.31                   | 7.75                   | −2.43   | 25%                      |
| <i>Schooling</i>      | 0.58                    | −2.16                  | −1.26   | 13%                      |
| <b>Total</b>          |                         |                        | <b>−9.60</b>                                    | <b>100%</b>              |

Our estimation of the effect of natural resources on corruption is depicted in the first column entry of Table 2. Natural resources indeed tend to increase the level of corruption, but the indirect effect on growth is relative limited compared to the other transmission channels. This finding is consistent with recent empirical work of Sachs and Warner (1995) and Gylfason (2000). Yet, though the contribution of corruption to the overall negative impact of natural resources seems minor, only 7%, nonetheless, corruption is a significant consequence of natural resource abundance since it alone cancels out about 40 per cent of the positive direct effect of natural resources on economic growth. In the literature, we find the following arguments that explain the effect of natural resources on institutional quality and, more specifically, corruption. Natural resources provide an easy way of receiving rents, and lead to rent-seeking competition rather than productive activities (Krueger 1974). Also, natural resource rents stimulate economic agents to bribe the administration in order to gain access (Sachs and Warner 1995, Gray and Kaufmann 1998, Ascher 1999, Leite and Weidmann 1999, Sachs and Rondriguez 1999, Gylfason 2001a, Torvik 2002). Additionally, natural resources are often associated with the emergence of politically powerful interest groups that attempt to influence politicians prone to corruption in order to adopt policies that are not in favor of the general public interest (Mauro, 1998).

As a second transmission channel we consider investments. This channel is the most important; it accounts for 47% of the negative impact of natural resources on growth. Natural resource wealth decreases the need for savings and investments, since natural resources provide a continuous stream of future wealth, which thus seems less dependent on the transfer of man-made capital to future periods. Yet, world prices for primary commodities tend to be more volatile than world prices for other goods. Therefore, an economy based on primary production will easily shift

from booms to recessions and this creates uncertainty for investors in natural resource economies (Sachs and Warner 1999b). Additionally, under a natural resource boom, increased rents in the primary sector cause a move in factors of production from the manufacturing sector towards the booming primary sector. Often, the manufacturing sector is characterized by increasing returns to scale and positive externalities. A decrease of the manufacturing sector further decreases the productivity and profitability of investments, accelerating the decrease in investments (Sachs and Warner 1995, 1999a, Gillis *et.al* 1996, Gylfason 2000, 2001a).

The third transmission channel we consider is the impact of natural resources on the degree of openness in the economy and the terms of trade. Natural resource abundance reduces the openness of an economy and harms its terms of trade. Since natural resources weaken the manufacturing sector, policy makers may impose import quotas and tariffs that, in the short run, protect domestic producers (Auty 1994, Sachs and Warner 1995). In the long run, such measures harm the openness of the economy and its integration into the global economy. Also, natural resource booms increase domestic income and the demand for goods, triggering inflation and an overvaluation of the domestic currency. The relative price of all non-traded goods increase, the terms of trade deteriorate, and exports become expensive relative to world market prices and decline, a phenomenon known as the “Dutch Disease” (Sachs and Warner 1995, Torvik 2001, Gylfason 2000, 2001a, 2001b, Rodriguez and Sachs 1999).

Finally, we consider the schooling transmission channel. Natural resource booms decrease the manufacturing sector for which human capital is an important production factor. The need for high-quality education declines, and so does the returns to education (Gylfason 2001a). It is also claimed that natural resource abundance creates a false sense of confidence: “easy riches lead to sloth” (Sachs and Warner 1995). An expanding primary sector does not need a high-skilled labor force, and there is no feeling of urgency to increase spending on education. This restricts the future expansion of other sectors that require educational quality (Gylfason 2000, 2001a, 2001b, Sachs and Warner 1999b) and the technological diffusion in the economy (Nelson and Phelps 1966). We find schooling to be a moderately important transmission channel, e.g. more important and more significant than corruption. This contrasts empirical work by Sachs and Warner (1995, 1999a).

#### 4. Conclusions

During the past decades, the paradox of a negative impact of natural resource abundance on economic growth has been widely observed. Many countries rich in oil reserves, gas, or tropical forests used for timber production experienced disappointing growth levels. In contrast, resource-

poor countries surged ahead. Though this is a common trend, it is no empirical law. In the eighteenth and nineteenth century, steel and coal reserves were the stimulant for an industrial revolution and growth. Similarly, in the twentieth century resource abundant countries such as Norway and Iceland experienced remarkable and sustained growth rates. Natural resources seem to stimulate growth but under certain conditions. It is essential to control the indirect possible adverse effects. A natural resource economy that suffers from corruption, low investments, protectionist measures, a deteriorating terms of trade, and low educational standards will probably not benefit from its natural wealth.

An empirical analysis has been performed to show that natural resources increase growth, when abstracting from possible negative indirect effects. The analysis also made clear that, when accounting for the transmission channels, the overall effect of natural resource abundance on economic growth is strongly negative. It was shown that the investment channel is the most important. An extension of the analysis should try to extend the sample used for the empirical analysis, and to identify additional transmission channels through which natural resources affect growth. Also, we would like to investigate more carefully mechanisms behind the transmission channels. Such a better understanding is essential for presenting policy measures that may halt the negative impact of natural resources on economic growth.

### **Acknowledgments**

The research has been funded by the Dutch National Science Foundation (NWO) under contract nr. 016.005.040.

**Appendix: List of variables used in the regressions**

|                       |  |
|-----------------------|--|
| <i>G</i>              | Average annual growth in real GDP per person between 1975-1996, $G = \ln(Y_{1996}/Y_{1975})$ . GDP data from Penn World Tables 6.0 ( <a href="http://pwt.econ.upenn.edu">http://pwt.econ.upenn.edu</a> )   |
| $\ln Y_{75}$          | The log of real GDP per capita in 1975 (1985, International Prices) (Data from The Penn World Tables of Summers and Heston)  |
| <i>SNR</i>            | The share of mineral production in GDP for the 1970-89 period (Sachs and Warner Dataset: <a href="http://www.cid.harvard.edu/ciddata/ciddata.html">http://www.cid.harvard.edu/ciddata/ciddata.html</a> )   |
| <i>Corruption</i>     | The Corruption Perception Index as provided by Transparency International: the degree to which corruption is perceived to exist among public officials and politicians ( <a href="http://www.transparency.org">http://www.transparency.org</a> ) |
| <i>Investments</i>    | Real gross domestic investment (private and public) (1985 International Prices). Average value for the 1975-96 period. (Summers and Heston)  |
| <i>Openness</i>       | The fractions of years during the 1965-1990 period in which the country is rated as an open economy according to the criteria in Sachs and Warner. Data from Sachs and Warner dataset.   |
| <i>Terms of Trade</i> | The average annual growth in the log of external terms of trade between 1970-1990 (where the terms of trade is conceived by the ratio of an export price index to an import price index. Data from Sachs and Warner Database.                    |
| <i>Schooling</i>      | The log of average secondary schooling during 1970-1989 (King and Levine database, <a href="http://www.cid.harvard.edu/ciddata/ciddata.html">http://www.cid.harvard.edu/ciddata/ciddata.html</a> )   |

## References

- Ascher W., (1999). Why Governments Waste Natural Resources: Policy Failures in Developing Countries, The John Hopkins University Press
- Auty M.R., (1994). Industrial Policy Reform in Six Large Newly Industrializing Countries: The Resource Curse Thesis, *World Development*, 22, 11-26
- Barro R., (1989). Economic Growth in a Cross Section of Countries, NBER Working Paper, No 3120
- Barro R., and X. Sala-I-Martin, (1995). *Economic Growth*, Mc-Graw Hill
- Gillis M., Perkins H.D., Roemer M., and D.R. Snodgrass, (1996). *Economics of Development*, Norton
- Gillis M., and R. Repetto, (1998). *Public Policies and the Misuse of Forest Resources*, Cambridge University Press
- Gray C., and D. Kaufmann, (1998). Corruption and Development, *Finance and Development*, March 1998, 7-10
- Gylfason T., (2000). Resources, Agriculture, and Economic Growth in Economies in Transition, *Kyklos*, 4, 545-580
- Gylfason T., (2001a). Natural Resources, Education, and Economic Development, *European Economic Review*, 45, 847-859
- Gylfason T., (2001b). Nature, Power and Growth, *Scottish Journal of Political Economy*, Vol 48, No 5, 558-588
- Krueger A., (1974). The Political Economy of the Rent-Seeking Society, *American Economic Review*, 64, 291-303
- Leite C., and J. Weidmann (1999). Does mother Nature Corrupt? Natural Resources, Corruption and Economic Growth, IMF Working Paper
- Mauro, P., (1998). Corruption: Causes, Consequences and Agenda for Further Research, *Finance and Development*, March 1998, 10-14
- Murphy, K., Shleifer, A., and R.W. Vishny (1993). Why is Rent-seeking so Costly to Growth? *American Economic Review*, Papers and Proceedings 83, 409-414
- Mo P.H., (2001). Corruption and Economic Growth, *Journal of Comparative Economics* 29, 66-79



- Nelson R.R. and P.S. Phelps (1966). Investment in Humans, Technological Diffusion, and Economic Growth, *American Economic Review*, 61, 69-75
- Rodriguez F., and J.D. Sachs (1999). Why Do Resource-Abundant Economies Grow More Slowly?, *Journal of Economic Growth*, 4, 277-303
- Sachs, D.J., and A.M. Warner (1995). Natural Resource Abundance and Economic Growth, NBER Working Paper, No 5398
- Sachs, D.J., and A.M. Warner (1997). Fundamental Sources of Long-Run Growth, *American Economic Review*, 87, 184-188
- Sachs, D.J., and A.M. Warner (1999a). The Big Push, Natural Resource Booms and Growth, *Journal of Development Economics*, 59, 43-76
- Sachs, D.J., and A.M. Warner (1999b). Natural Resource Intensity and Economic Growth. In Mayer J., B. Chambers, and A. Farooq (eds.), *Development Policies in Natural Resource Economics*, Edward Elgar
- Sala-I-Martin X.X., (1997). I Just Ran Two Million Regressions. *American Economic Review*, 87, 178-183
- Summers R., and A. Heston (1991). The Penn World Table: An Expanded Set of International Comparisons, 1950-1988, *The Quarterly Journal of Economics*, 106, 327-368
- Torvik R., (2002). Natural Resources, Rent Seeking and Welfare, *Journal of Development Economics*, 67, 455-470

## NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

### Fondazione Eni Enrico Mattei Working Paper Series

Our working papers are available on the Internet at the following addresses:

[http://www.feem.it/web/attiv/\\_wp.html](http://www.feem.it/web/attiv/_wp.html)

<http://papers.ssrn.com>

|                  |         |  |
|------------------|---------|--|
| SUST             | 1.2002  | <i>K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW: <u>Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa</u></i>                                 |
| ETA              | 2.2002  | <i>Efrem CASTELNUOVO and Paolo SURICO: <u>What Does Monetary Policy Reveal about Central Bank's Preferences?</u></i>   |
| WAT              | 3.2002  | <i>Duncan KNOWLER and Edward BARBIER: <u>The Economics of a "Mixed Blessing" Effect: A Case Study of the Black Sea</u></i>   |
| CLIM             | 4.2002  | <i>Andreas LÖSCHEL: <u>Technological Change in Economic Models of Environmental Policy: A Survey</u></i>   |
| VOL              | 5.2002  | <i>Carlo CARRARO and Carmen MARCHIORI: <u>Stable Coalitions</u></i>  |
| CLIM             | 6.2002  | <i>Marzio GALEOTTI, Alessandro LANZA and Matteo MANERA: <u>Rockets and Feathers Revisited: An International Comparison on European Gasoline Markets</u></i>                                |
| ETA              | 7.2002  | <i>Effrosyni DIAMANTOUDI and Eftichios S. SARTZETAKIS: <u>Stable International Environmental Agreements: An Analytical Approach</u></i>  |
| KNOW             | 8.2002  | <i>Alain DESDOIGTS: <u>Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus</u></i>   |
| NRM              | 9.2002  | <i>Giuseppe DI VITA: <u>Renewable Resources and Waste Recycling</u></i>  |
| KNOW             | 10.2002 | <i>Giorgio BRUNELLO: <u>Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries</u></i>   |
| ETA              | 11.2002 | <i>Mordecai KURZ, Hehui JIN and Maurizio MOTOLESE: <u>Endogenous Fluctuations and the Role of Monetary Policy</u></i>  |
| KNOW             | 12.2002 | <i>Reyer GERLAGH and Marjan W. HOFKES: <u>Escaping Lock-in: The Scope for a Transition towards Sustainable Growth?</u></i>   |
| NRM              | 13.2002 | <i>Michele MORETTO and Paolo ROSATO: <u>The Use of Common Property Resources: A Dynamic Model</u></i>  |
| CLIM             | 14.2002 | <i>Philippe QUIRION: <u>Macroeconomic Effects of an Energy Saving Policy in the Public Sector</u></i>  |
| CLIM             | 15.2002 | <i>Roberto ROSON: <u>Dynamic and Distributional Effects of Environmental Revenue Recycling Schemes: Simulations with a General Equilibrium Model of the Italian Economy</u></i>            |
| CLIM             | 16.2002 | <i>Francesco RICCI (I): <u>Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity</u></i>   |
| ETA              | 17.2002 | <i>Alberto PETRUCCI: <u>Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy</u></i>   |
| Coalition Theory | 18.2002 | <i>László Á. KÓCZY (liv): <u>The Core in the Presence of Externalities</u></i>   |
| Network Theory   | 19.2002 | <i>Steven J. BRAMS, Michael A. JONES and D. Marc KILGOUR (liv): <u>Single-Peakedness and Disconnected Coalitions</u></i>   |
| Coalition Theory | 20.2002 | <i>Guillaume HAERINGER (liv): <u>On the Stability of Cooperation Structures</u></i>  |
| Network Theory   | 21.2002 | <i>Fausto CAVALLARO and Luigi CIRAULO: <u>Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems</u></i>   |
| NRM              | 22.2002 | <i>Barbara BUCHNER, Carlo CARRARO, Igor CERSOSIMO and Carmen MARCHIORI: <u>Back to Kyoto? US Participation and the Linkage between R&amp;D and Climate Cooperation</u></i>                 |
| CLIM             | 23.2002 | <i>Andreas LÖSCHEL and ZhongXIANG ZHANG: <u>The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech</u></i> |
| ETA              | 24.2002 | <i>Marzio GALEOTTI, Louis J. MACCINI and Fabio SCHIANTARELLI: <u>Inventories, Employment and Hours</u></i>   |
| CLIM             | 25.2002 | <i>Hannes EGLI: <u>Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany</u></i>   |
| ETA              | 26.2002 | <i>Adam B. JAFFE, Richard G. NEWELL and Robert N. STAVINS: <u>Environmental Policy and Technological Change</u></i>  |
| SUST             | 27.2002 | <i>Joseph C. COOPER and Giovanni SIGNORELLO: <u>Farmer Premiums for the Voluntary Adoption of Conservation Plans</u></i>   |
| SUST             | 28.2002 | <i><u>The ANSEA Network: Towards An Analytical Strategic Environmental Assessment</u></i>  |
| KNOW             | 29.2002 | <i>Paolo SURICO: <u>Geographic Concentration and Increasing Returns: a Survey of Evidence</u></i>  |
| ETA              | 30.2002 | <i>Robert N. STAVINS: <u>Lessons from the American Experiment with Market-Based Environmental Policies</u></i>   |

|           |         |   |
|-----------|---------|---|
| NRM       | 31.2002 | <i>Carlo GIUPPONI and Paolo ROSATO: <u>Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon</u></i>               |
| NRM       | 32.2002 | <i>Robert N. STAVINS: <u>National Environmental Policy During the Clinton Years</u></i>   |
| KNOW      | 33.2002 | <i>A. SOUBEYRAN and H. STAHN : <u>Do Investments in Specialized Knowledge Lead to Composite Good Industries?</u></i>  |
| KNOW      | 34.2002 | <i>G. BRUNELLO, M.L. PARISI and Daniela SONEDDA: <u>Labor Taxes, Wage Setting and the Relative Wage Effect</u></i>  |
| CLIM      | 35.2002 | <i>C. BOEMARE and P. QUIRION (lv): <u>Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences</u></i>   |
| CLIM      | 36.2002 | <i>T. TIETENBERG (lv): <u>The Tradable Permits Approach to Protecting the Commons: What Have We Learned?</u></i>  |
| CLIM      | 37.2002 | <i>K. REHDANZ and R.J.S. TOL (lv): <u>On National and International Trade in Greenhouse Gas Emission Permits</u></i>  |
| CLIM      | 38.2002 | <i>C. FISCHER (lv): <u>Multinational Taxation and International Emissions Trading</u></i>   |
| SUST      | 39.2002 | <i>G. SIGNORELLO and G. PAPPALARDO: <u>Farm Animal Biodiversity Conservation Activities in Europe under the Framework of Agenda 2000</u></i>  |
| NRM       | 40.2002 | <i>S.M. CAVANAGH, W. M. HANEMANN and R. N. STAVINS: <u>Muffled Price Signals: Household Water Demand under Increasing-Block Prices</u></i>  |
| NRM       | 41.2002 | <i>A. J. PLANTINGA, R. N. LUBOWSKI and R. N. STAVINS: <u>The Effects of Potential Land Development on Agricultural Land Prices</u></i>  |
| CLIM      | 42.2002 | <i>C. OHL (lvi): <u>Inducing Environmental Co-operation by the Design of Emission Permits</u></i>   |
| CLIM      | 43.2002 | <i>J. EYCKMANS, D. VAN REGEMORTER and V. VAN STEENBERGHE (lvi): <u>Is Kyoto Fatally Flawed? An Analysis with MacGEM</u></i>   |
| CLIM      | 44.2002 | <i>A. ANTOCI and S. BORGHESI (lvi): <u>Working Too Much in a Polluted World: A North-South Evolutionary Model</u></i>   |
| ETA       | 45.2002 | <i>P. G. FREDRIKSSON, Johan A. LIST and Daniel MILLIMET (lvi): <u>Chasing the Smokestack: Strategic Policymaking with Multiple Instruments</u></i>  |
| ETA       | 46.2002 | <i>Z. YU (lvi): <u>A Theory of Strategic Vertical DFI and the Missing Pollution-Haven Effect</u></i>  |
| SUST      | 47.2002 | <i>Y. H. FARZIN: <u>Can an Exhaustible Resource Economy Be Sustainable?</u></i>   |
| SUST      | 48.2002 | <i>Y. H. FARZIN: <u>Sustainability and Hamiltonian Value</u></i>  |
| KNOW      | 49.2002 | <i>C. PIGA and M. VIVARELLI: <u>Cooperation in R&amp;D and Sample Selection</u></i>   |
| Coalition | 50.2002 | <i>M. SERTEL and A. SLINKO (liv): <u>Ranking Committees, Words or Multisets</u></i>   |
| Theory    |         |   |
| Network   |         |   |
| Coalition | 51.2002 | <i>Sergio CURRARINI (liv): <u>Stable Organizations with Externalities</u></i>   |
| Theory    |         |   |
| Network   |         |   |
| ETA       | 52.2002 | <i>Robert N. STAVINS: <u>Experience with Market-Based Policy Instruments</u></i>  |
| ETA       | 53.2002 | <i>C.C. JAEGER, M. LEIMBACH, C. CARRARO, K. HASSELMANN, J.C. HOURCADE, A. KEELER and R. KLEIN (liii): <u>Integrated Assessment Modeling: Modules for Cooperation</u></i>  |
| CLIM      | 54.2002 | <i>Scott BARRETT (liii): <u>Towards a Better Climate Treaty</u></i>   |
| ETA       | 55.2002 | <i>Richard G. NEWELL and Robert N. STAVINS: <u>Cost Heterogeneity and the Potential Savings from Market-Based Policies</u></i>  |
| SUST      | 56.2002 | <i>Paolo ROSATO and Edi DEFRANCESCO: <u>Individual Travel Cost Method and Flow Fixed Costs</u></i>  |
| SUST      | 57.2002 | <i>Vladimir KOTOV and Elena NIKITINA (lvii): <u>Reorganisation of Environmental Policy in Russia: The Decade of Success and Failures in Implementation of Perspective Quests</u></i>                                    |
| SUST      | 58.2002 | <i>Vladimir KOTOV (lvii): <u>Policy in Transition: New Framework for Russia's Climate Policy</u></i>  |
| SUST      | 59.2002 | <i>Fanny MISSELDT and Arturo VILLAVICENCO (lvii): <u>How Can Economies in Transition Pursue Emissions Trading or Joint Implementation?</u></i>  |
| VOL       | 60.2002 | <i>Giovanni DI BARTOLOMEO, Jacob ENGWERDA, Joseph PLASMANS and Bas VAN AARLE: <u>Staying Together or Breaking Apart: Policy-Makers' Endogenous Coalitions Formation in the European Economic and Monetary Union</u></i> |
| ETA       | 61.2002 | <i>Robert N. STAVINS, Alexander F. WAGNER and Gernot WAGNER: <u>Interpreting Sustainability in Economic Terms: Dynamic Efficiency Plus Intergenerational Equity</u></i>   |
| PRIV      | 62.2002 | <i>Carlo CAPUANO: <u>Demand Growth, Entry and Collusion Sustainability</u></i>  |
| PRIV      | 63.2002 | <i>Federico MUNARI and Raffaele ORIANI: <u>Privatization and R&amp;D Performance: An Empirical Analysis Based on Tobin's Q</u></i>  |
| PRIV      | 64.2002 | <i>Federico MUNARI and Maurizio SOBRERO: <u>The Effects of Privatization on R&amp;D Investments and Patent Productivity</u></i>   |
| SUST      | 65.2002 | <i>Orley ASHENFELTER and Michael GREENSTONE: <u>Using Mandated Speed Limits to Measure the Value of a Statistical Life</u></i>  |
| ETA       | 66.2002 | <i>Paolo SURICO: <u>US Monetary Policy Rules: the Case for Asymmetric Preferences</u></i>   |
| PRIV      | 67.2002 | <i>Rinaldo BRAU and Massimo FLORIO: <u>Privatisations as Price Reforms: Evaluating Consumers' Welfare Changes in the U.K.</u></i>   |
| CLIM      | 68.2002 | <i>Barbara K. BUCHNER and Roberto ROSON: <u>Conflicting Perspectives in Trade and Environmental Negotiations</u></i>  |
| CLIM      | 69.2002 | <i>Philippe QUIRION: <u>Complying with the Kyoto Protocol under Uncertainty: Taxes or Tradable Permits?</u></i>   |
| SUST      | 70.2002 | <i>Anna ALBERINI, Patrizia RIGANTI and Alberto LONGO: <u>Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents</u></i>  |
| SUST      | 71.2002 | <i>Marco PERCOCO: <u>Discounting Environmental Effects in Project Appraisal</u></i>   |

|      |          |  |
|------|----------|--|
| NRM  | 72.2002  | <i>Philippe BONTEMS and Pascal FAVARD: <u>Input Use and Capacity Constraint under Uncertainty: The Case of Irrigation</u></i>  |
| PRIV | 73.2002  | <i>Mohammed OMRAN: <u>The Performance of State-Owned Enterprises and Newly Privatized Firms: Empirical Evidence from Egypt</u></i>   |
| PRIV | 74.2002  | <i>Mike BURKART, Fausto PANUNZI and Andrei SHLEIFER: <u>Family Firms</u></i>   |
| PRIV | 75.2002  | <i>Emmanuelle AURIOL, Pierre M. PICARD: <u>Privatizations in Developing Countries and the Government Budget Constraint</u></i>   |
| PRIV | 76.2002  | <i>Nichole M. CASTATER: <u>Privatization as a Means to Societal Transformation: An Empirical Study of Privatization in Central and Eastern Europe and the Former Soviet Union</u></i>  |
| PRIV | 77.2002  | <i>Christoph LÜLSFESMANN: <u>Benevolent Government, Managerial Incentives, and the Virtues of Privatization</u></i>  |
| PRIV | 78.2002  | <i>Kate BISHOP, Igor FILATOTCHEV and Tomasz MICKIEWICZ: <u>Endogenous Ownership Structure: Factors Affecting the Post-Privatisation Equity in Largest Hungarian Firms</u></i>  |
| PRIV | 79.2002  | <i>Theodora WELCH and Rick MOLZ: <u>How Does Trade Sale Privatization Work? Evidence from the Fixed-Line Telecommunications Sector in Developing Economies</u></i>   |
| PRIV | 80.2002  | <i>Alberto R. PETRUCCI: <u>Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy</u></i>  |
| CLIM | 81.2002  | <i>Timothy SWANSON and Robin MASON (Ivi): <u>The Impact of International Environmental Agreements: The Case of the Montreal Protocol</u></i>   |
| PRIV | 82.2002  | <i>George R.G. CLARKE and Lixin Colin XU: <u>Privatization, Competition and Corruption: How Characteristics of Bribe Takers and Payers Affect Bribe Payments to Utilities</u></i>  |
| PRIV | 83.2002  | <i>Massimo FLORIO and Katuscia MANZONI: <u>The Abnormal Returns of UK Privatisations: From Underpricing to Outperformance</u></i>  |
| NRM  | 84.2002  | <i>Nelson LOURENÇO, Carlos RUSSO MACHADO, Maria do ROSÁRIO JORGE and Luís RODRIGUES: <u>An Integrated Approach to Understand Territory Dynamics. The Coastal Alentejo (Portugal)</u></i>   |
| CLIM | 85.2002  | <i>Peter ZAPFEL and Matti VAINIO (Iv): <u>Pathways to European Greenhouse Gas Emissions Trading History and Misconceptions</u></i>   |
| CLIM | 86.2002  | <i>Pierre COURTOIS: <u>Influence Processes in Climate Change Negotiations: Modelling the Rounds</u></i>  |
| ETA  | 87.2002  | <i>Vito FRAGNELLI and Maria Erminia MARINA (Iviii): <u>Environmental Pollution Risk and Insurance</u></i>  |
| ETA  | 88.2002  | <i>Laurent FRANCKX (Iviii): <u>Environmental Enforcement with Endogenous Ambient Monitoring</u></i>  |
| ETA  | 89.2002  | <i>Timo GOESCHL and Timothy M. SWANSON (Iviii): <u>Lost Horizons. The noncooperative management of an evolutionary biological system.</u></i>  |
| ETA  | 90.2002  | <i>Hans KEIDING (Iviii): <u>Environmental Effects of Consumption: An Approach Using DEA and Cost Sharing</u></i>   |
| ETA  | 91.2002  | <i>Wietze LISE (Iviii): <u>A Game Model of People's Participation in Forest Management in Northern India</u></i>   |
| CLIM | 92.2002  | <i>Jens HORBACH: <u>Structural Change and Environmental Kuznets Curves</u></i>   |
| ETA  | 93.2002  | <i>Martin P. GROSSKOPF: <u>Towards a More Appropriate Method for Determining the Optimal Scale of Production Units</u></i>   |
| VOL  | 94.2002  | <i>Scott BARRETT and Robert STAVINS: <u>Increasing Participation and Compliance in International Climate Change Agreements</u></i>   |
| CLIM | 95.2002  | <i>Banu BAYRAMOGLU LISE and Wietze LISE: <u>Climate Change, Environmental NGOs and Public Awareness in the Netherlands: Perceptions and Reality</u></i>  |
| CLIM | 96.2002  | <i>Matthieu GLACHANT: <u>The Political Economy of Emission Tax Design in Environmental Policy</u></i>  |
| KNOW | 97.2002  | <i>Kenn ARIGA and Giorgio BRUNELLO: <u>Are the More Educated Receiving More Training? Evidence from Thailand</u></i>   |
| ETA  | 98.2002  | <i>Gianfranco FORTE and Matteo MANERA: <u>Forecasting Volatility in European Stock Markets with Non-linear GARCH Models</u></i>  |
| ETA  | 99.2002  | <i>Geoffrey HEAL: <u>Bundling Biodiversity</u></i>   |
| ETA  | 100.2002 | <i>Geoffrey HEAL, Brian WALKER, Simon LEVIN, Kenneth ARROW, Partha DASGUPTA, Gretchen DAILY, Paul EHRlich, Karl-Goran MALER, Nils KAUTSKY, Jane LUBCHENCO, Steve SCHNEIDER and David STARRETT: <u>Genetic Diversity and Interdependent Crop Choices in Agriculture</u></i> |
| ETA  | 101.2002 | <i>Geoffrey HEAL: <u>Biodiversity and Globalization</u></i>  |
| VOL  | 102.2002 | <i>Andreas LANGE: <u>Heterogeneous International Agreements – If per capita emission levels matter</u></i>   |
| ETA  | 103.2002 | <i>Pierre-André JOUVET and Walid OUESLATI: <u>Tax Reform and Public Spending Trade-offs in an Endogenous Growth Model with Environmental Externalities</u></i>   |
| ETA  | 104.2002 | <i>Anna BOTTASSO and Alessandro SEMBENELLI: <u>Does Ownership Affect Firms' Efficiency? Panel Data Evidence on Italy</u></i>   |
| PRIV | 105.2002 | <i>Bernardo BORTOLOTTI, Frank DE JONG, Giovanna NICODANO and Ibolya SCHINDELE: <u>Privatization and Stock Market Liquidity</u></i>   |
| ETA  | 106.2002 | <i>Haruo IMAI and Mayumi HORIE (Iviii): <u>Pre-Negotiation for an International Emission Reduction Game</u></i>  |
| PRIV | 107.2002 | <i>Sudeshna GHOSH BANERJEE and Michael C. MUNGER: <u>Move to Markets? An Empirical Analysis of Privatisation in Developing Countries</u></i>   |
| PRIV | 108.2002 | <i>Guillaume GIRMENS and Michel GUILLARD: <u>Privatization and Investment: Crowding-Out Effect vs Financial Diversification</u></i>  |
| PRIV | 109.2002 | <i>Alberto CHONG and Florencio LÓPEZ-DE-SILANES: <u>Privatization and Labor Force Restructuring Around the World</u></i>   |
| PRIV | 110.2002 | <i>Nandini GUPTA: <u>Partial Privatization and Firm Performance</u></i>  |
| PRIV | 111.2002 | <i>François DEGEORGE, Dirk JENTER, Alberto MOEL and Peter TUFANO: <u>Selling Company Shares to Reluctant Employees: France Telecom's Experience</u></i>  |

|      |          |   |
|------|----------|---|
| PRIV | 112.2002 | <i>Isaac OTCHERE</i> : <u>Intra-Industry Effects of Privatization Announcements: Evidence from Developed and Developing Countries</u>   |
| PRIV | 113.2002 | <i>Yannis KATSOULAKOS and Elissavet LIKOYANNI</i> : <u>Fiscal and Other Macroeconomic Effects of Privatization</u>  |
| PRIV | 114.2002 | <i>Guillaume GIRMENS</i> : <u>Privatization, International Asset Trade and Financial Markets</u>  |
| PRIV | 115.2002 | <i>D. Teja FLOTHO</i> : <u>A Note on Consumption Correlations and European Financial Integration</u>  |
| PRIV | 116.2002 | <i>Ibolya SCHINDELE and Enrico C. PEROTTI</i> : <u>Pricing Initial Public Offerings in Premature Capital Markets: The Case of Hungary</u>   |
| PRIV | 1.2003   | <i>Gabriella CHIESA and Giovanna NICODANO</i> : <u>Privatization and Financial Market Development: Theoretical Issues</u>   |
| PRIV | 2.2003   | <i>Ibolya SCHINDELE</i> : <u>Theory of Privatization in Eastern Europe: Literature Review</u>   |
| PRIV | 3.2003   | <i>Wietze LISE, Claudia KEMFERT and Richard S.J. TOL</i> : <u>Strategic Action in the Liberalised German Electricity Market</u>   |
| CLIM | 4.2003   | <i>Laura MARSILLANI and Thomas I. RENSTRÖM</i> : <u>Environmental Policy and Capital Movements: The Role of Government Commitment</u>   |
| KNOW | 5.2003   | <i>Reyer GERLAGH</i> : <u>Induced Technological Change under Technological Competition</u>  |
| ETA  | 6.2003   | <i>Efrem CASTELNUOVO</i> : <u>Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model</u>   |
| SIEV | 7.2003   | <i>Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI</i> : <u>The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers</u> |
| NRM  | 8.2003   | <i>Elissaios PAPYRAKIS and Reyner GERLAGH</i> : <u>Natural Resources: A Blessing or a Curse?</u>  |

(I) This paper was presented at the Workshop “Growth, Environmental Policies and Sustainability” organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001

(Ii) 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

(Iii) 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

(Iiii) 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

(Iv) 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

(Iv) 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

(Ivi) 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, Acquafredda di Maratea, October 6-11, 2001

(Ivii) 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 für Europäische Integrationsforschung (ZEI), Milan, July 5-6, 2001

(Iviii) 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

### 2002 SERIES

|             |   |
|-------------|---|
| <b>CLIM</b> | <i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti )                   |
| <b>VOL</b>  | <i>Voluntary and International Agreements</i> (Editor: Carlo Carraro)                   |
| <b>SUST</b> | <i>Sustainability Indicators and Environmental Valuation</i><br>(Editor: Carlo Carraro) |
| <b>NRM</b>  | <i>Natural Resources Management</i> (Editor: Carlo Giupponi)                            |
| <b>KNOW</b> | <i>Knowledge, Technology, Human Capital</i> (Editor: Dino Pinelli)                      |
| <b>MGMT</b> | <i>Corporate Sustainable Management</i> (Editor: Andrea Marsanich)                      |
| <b>PRIV</b> | <i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)               |
| <b>ETA</b>  | <i>Economic Theory and Applications</i> (Editor: Carlo Carraro)                         |

### 2003 SERIES

|             |   |
|-------------|---|
| <b>CLIM</b> | <i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti )                   |
| <b>GG</b>   | <i>Global Governance</i> (Editor: Carlo Carraro)  |
| <b>SIEV</b> | <i>Sustainability Indicators and Environmental Valuation</i><br>(Editor: Anna Alberini) |
| <b>NRM</b>  | <i>Natural Resources Management</i> (Editor: Carlo Giupponi)                            |
| <b>KNOW</b> | <i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)               |
| <b>IEM</b>  | <i>International Energy Markets</i> (Editor: Anil Markandya)                            |
| <b>CSRM</b> | <i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)            |
| <b>PRIV</b> | <i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)               |
| <b>ETA</b>  | <i>Economic Theory and Applications</i> (Editor: Carlo Carraro)                         |