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AN ASSESSMENT OF SUSTAINABLE HUMAN DEVELOPMENT FROM A GLOBAL PERSPECTIVE

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An Assessment of Sustainable Human Development from a Global Perspective

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Abstract

The foundation of the Human Development (HD) paradigm provided by the United Nations Development Programme (UNDP) can be found in the capability approach developed by Amartya Sen. In recent few years, a further dimension has been considered inside the capability approach, and therefore in the definition of HD, that is the concept of Sustainable Development (SD). SD has represented one of the most important policy goals at the global level and how to design specific policy actions and measure performance and results continues to present a challenge. Within an integrated paradigm of Sustainable Human Development (SHD), there are many aspects to be taken account, such as the role of the globalization process, the effects related to the quality of institutions and the role of human capital accumulation. Furthermore, there are some scepticism about a full integrated measure of SHD, in contrast with a separated but integrated model for evaluation of goals and policy actions. Two different approaches seem to be the most appealing for this second integrated evaluation purpose. The effects of natural resources endowment on development are mainly analyzed through the so-called Resource Curse Hypothesis (RCH), while the effects of economic growth and development process on environmental quality are part of the so-famous Environmental Kuznets Curve (EKC). Furthermore, last contributes on RCH and EKC have shown the important role of institutions and HD dimensions in order to build a SD path. In this paper, our tentative is to give a description of all these phenomena, with specific emphasis on HD and SD dimensions, by using an empirical model which collects inputs both from RCH and EKC studies.

Key words: Environmental Kuznets curve, Human development, Resource curse, Sustainable development
JEL: O15; Q01; Q56

1. INTRODUCTION

The foundation of the Human Development (HD) paradigm provided by the United Nations Development Programme (UNDP) can be found in the capability approach developed by Amartya Sen. In recent few years, a further dimension has been considered inside the capability approach, and therefore in the definition of HD, that is the concept of Sustainable Development (SD).

In recent few years, SD has represented one of the most important policy goals at the global level and how to design specific policy actions and measure performance and results continues to present a challenge.

Human development as a participatory and dynamic process is a concept that matches the description of SD in the well-known Brundtland Report perfectly. Sustainable development was defined as "[…] development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). In the word "ability", there is the conceptual link to the HD approach. In light of the pioneering Brundtland Report, UNDP has followed up this approach by widening the theoretical framework of HD and capabilities in order to represent a much more comprehensive development strategy.

From a theoretical perspective, an integrated Sustainable Human Development (SHD) paradigm has been defined as the development that promotes the capabilities of present people without compromising the capabilities of future generations (Sen, 2000).

At international level, a full acknowledgement of environmental quality as an essential part of the development strategy is related to the Millennium Development Goals (UN, 2000), where ensuring environmental sustainability is considered as one of the priorities for the next decades.

The request for a global partnership for managing environmental issues clearly corresponds to the fact that many environmental problems should be considered as global concerns when natural resources are a global public good. This brings to international responsibility where developing countries have not enough available assets to manage natural resources or, in other words, when the income per capita is not enough to ensure the satisfaction of basic needs, and environment is considered as a luxury good. As we will see below, income per capita is one of the leading factors of a willingness to pay (WTP) for SD and, in the case of developing countries, public actions are necessary to create a WTP for environmental protection. In this sense, the achievement of higher income levels can be interpreted twofold: as a means to achieve a wider range of capabilities and higher HD levels and as a means to achieve better environmental standards through increasing WTP. At the same time, higher HD levels allow strengthening the capacity of institutions of receiving the pressure from public opinion, thus reinforcing a virtuous cycle.

Furthermore, it is worth noting that international relationships and the globalisation process could help diffusing both information about the right environmental-friendly behaviours and the technologies developed mainly in the advanced economies.

In order to build an empirical analysis on SHD it is necessary to adopt a measurement definition of SD. Different approaches measuring SD are now available in the literature but not every indicator is completely appropriate in an SHD perspective. If we consider that HD is oriented towards people's well-being and freedom of choice, purely environmental indices geared towards evaluating the degree of pollution or degradation are not useful in a capability approach. In this paper we will only analyse macroeconomic indicators that evaluate the long-term sustainability of a development process such as the Genuine Saving provided by the World Bank, the Index of Sustainable Economic Welfare (ISEW) used by Cobb and Cobb (1994) and adopted by Friends of the Earth, and the Environmental Net Domestic Product (EDP) coming from the integrated System of Environmental and Economic Accounts (SEEA), jointly sponsored by the United Nations and the World Bank.

Finally, recent efforts to develop models for analysis of causal linkages between HD, environmental sustainability and economic growth (EG) provide the general framework in which an assessment of

SHD from a global perspective could be included. The integration of environmental issues into development theories is currently widely analysed in two main empirical approaches. The effects of economic growth and HD on environmental quality are part of the Environmental Kuznets Curve (EKC) whereas the effects of natural resources endowment on EG and institutional quality are mainly analysed through the Resource Curse Hypothesis (RCH).

The aim of this paper is to give a general description of all these issues, trying to integrate all these aspects in a single model. In order to do this, the EKC model allows us to describe the relationship between HD and SD. Substituting the income variable with the HD dimensions as independent variables in the EKC, we would give a broad definition of development rather than pure EG. Furthermore, we have changed the dependent variable in the EKC, usually defined as a physical environmental measurement, using a wider measurement of macroeconomic sustainability, following the analysis of Anand and Sen (2000), where environment is considered as a means to promote capabilities of individuals, adopting a weak definition of sustainability. At the same time, we have accounted for the fact that in any case income per capita is an important factor in determining WTP for a better environment which is one of the explanations at the basis of an EKC relationship, and it is considered as well an important means to achieve a wide range of capabilities and HD levels. In order to do this we have adopted the RCH, allowing us to model EG paths depending on a number of factors, including initial levels of HD, quality of institutions and natural resources endowment. Accounting for the factors affecting EG allows responding to some criticisms moved to the EKC, where the reduced form is considered as a misleading formulation of environment-economic growth relationship. In this sense, the RCH is a useful tool to understand which are the factors affecting EG, and therefore influencing environmental performances.

Working in such a complex framework, the paper is structured as follows: Section 2 generally describes how the capability approach constitutes the framework in which the SHD could be placed. Section 3 poses some evidence on the measurement of SD and the available approaches developed within the existing literature. Section 4 describes specifically the EKC and the RCH as two of the most appealing models for the analysis of the relationships among EG, HD and SD. Section 5 reports the integrated model and the empirical results, while Section 6 provides some concluding remarks.

2. FROM THE CAPABILITY APPROACH TO SUSTAINABLE HUMAN DEVELOPMENT

The capability framework introduced by Amartya Sen (1979, 1982, 1983, 1985) represents an alternative approach that has completely changed the vision of economic theory for social scientists and

practitioners.[1] We can define it as a normative framework for the evaluation of individual well-being and social arrangements and the design of policies for social improvements (Robeyns, 2005).[2]

According to Sen (1992), the central question in all the approaches to the ethics of social arrangements is "equality of what?". In Sen's thought, theories like Utilitarianism, Liberalism or Rawls' justice theory (Rawls, 1972) have only given a partial answer to this question by reducing the problem of equity to "equality of income" or "equality of well-being". The capability approach has replaced the traditional idea of utility with functionings and capabilities concepts, where "functions" are indicated as attainments of different attributes and capability as the ability to attain (Sen, 1985, 1987).

Furthermore, in the capability approach a central point is that of conceptualising the notion of agency: "what the person is free to do and achieve in pursuit of whatever goals or values he or she regards as important" (Sen, 1985). The concept of agency was helpful in obtaining an informational basis for assessment of inequality, poverty, justice, and development (Robeyns, 2005).

The relationship between income and capabilities changes according to the reference point for society, households and individuals. Even Karl Marx in his division of society into classes, based his parameters exclusively on the working process of the production and avoided considering the level of wages and salaries (income) as the only criterion to pursue the equality goal (Sen, 1992). Sen puts the expansion of freedom both as the primary goal and primary means of development at the centre of his analysis (Sen, 1999).

Nonetheless, even in the capabilities approach, scholars express different opinions on which functionings and inequalities to value. Sen points out that individuals should have the freedom to determine what they value themselves and, at the society-wide level, he maintains that open, pluralistic debate should shape which basic functionings are to be valued by society (Sen 1994, 1999). In contrast, Martha Nussbaum, who used the capability approach as the basis for a partial theory of justice (Nussbaum, 2000), has defined a list of basic capabilities in contraposition with Sen's idea of freedom to determine functionings.[3]

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[1] The capability approach is not exactly a theory but provides a tool to conceptualise and evaluate phenomena like poverty, inequality or well-being. Capability approach is not a theory but a framework (Robeyns, 2005).

[2] Origins of this approach can be found in Aristotle and Marx writings, see Sen (1992), Nussbaum (2000), ul Haq (2003).

[3] The Nussbaum's list includes ten Basic Capabilities. 1. Life. Being able to live to the end of a human life of normal length. 2. Bodily health and integrity. Being able to have good health, including reproductive health; being adequately nourished. 3. Bodily integrity. Being able to move freely from place to place; being able to be secure against violent assault, including sexual assault. 4. Senses, imagination, thought. Being able to use the senses; being able to imagine, to think, and to reason. 5. Emotions. Being able to have attachments to things and persons outside ourselves; being able to love those who love and care for us; being able to grieve at their absence, to experience longing, gratitude, and justified anger; not having one's emotional developing blighted by fear or anxiety. 6. Practical reason. Being able to form a conception of the good and to engage in critical reflection about the planning of one's own life. (This entails protection for liberty of conscience). 7. Affiliation. Being able to live for and in relation to others, to recognize and show concern for other human beings, to engage

The HD paradigm has evolved in recent years to become the idea of SHD. If the basis of the HD paradigm can be found in the capability approach (Fukuda Parr, 2003; Fukuda Parr and Kumar, 2003), the SHD paradigm is, in the same way, behind the notion of capability. The main objective of HD is to create an enabling environment for people to enjoy long, healthy, and creative lives. It is concerned both with building up human capabilities and with using those human capabilities fully (ul Haq, 2003). In this context, income and economic growth are both a means to development, and not an end in itself. The main insight of the UNDP when the first Human Development Report (HDR) was brought out was to answer the question of how economic growth transfers or fails to transfer into HD. The focus on the development process adopting an HD perspective was a shift from EG to people and to how development enlarges their choices. These choices can be infinite and change over time (ul Haq, 2003). Therefore, SHD can be generally understood to be an expansion of capabilities, both equitable and durable. In this sense, the HD approach applies to the freedom to lead lives that people value today and in the future. It is indeed a point of view that is strictly consistent with the extension from the fulfilment of needs to the enhancement of human freedoms on a sustainability basis. Therefore, an SHD based on capability framework, can be defined as the development that promotes the capabilities of present people without compromising the capabilities of future generations (Sen, 2000).

SHD is closer to the notion of agency than to the narrower one of well-being. The latter refers to a personal situation in term of achieved functioning and also includes sympathy and concern for others whereas the former is more inclusive insofar as it also relates to the willingness to actually support other individuals in pursuing their projects of life regardless of the impacts on one's own well-being.

In this sense, the HD approach is the most appropriate framework in which environmental concerns can be addressed in connection with peculiarities of individuals, including not only income per capita level, but also other qualitative characteristics.

The dimensions affecting well-being levels in an HD approach (health and education above all) are all useful tools to understand the effective WTP of individuals for better environmental standards. Following Van Liere and Dunlap (1980), factors different from income affecting WTP could be age, social class, residence, political preference, gender. The age hypothesis states that younger people tend to be more concerned about environmental quality than older people, but this assertion is not supported by empirical results. Following the social class hypothesis, environmental concern is positively

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in various forms of social interaction; being able to imagine the situation of another and to have compassion for that situation; having the capability for both justice and friendship. 8. Other species. Being able to live with concern for and in relation to animals, plants, and the world of nature. 9. Play. Being able to laugh, to play, to enjoy recreational activities. 10. Control over one's environment. (A) Political: being able to participate effectively in political choices that govern one's life; having the rights of political participation, free speech and freedom of association; (B) Material: being able to hold property (both land and movable goods); having the right to seek employment on an equal basis with others (Nussbaum, 2000).

associated with social class as indicated by education, income, and job. The influence of social class at micro level could be represented by HD achievements at macro level. The residence hypothesis affirms that urban residents are more likely to be environmentally concerned than rural residents. Considering that the development process goes along with increasing migration flows from rural locations towards urban settles, in theory this mechanism can be used for reinforcing the EKC model. On the contrary, urban pollution is widely increasing all over the world, and in particular in developing countries. This means that the negative influence on environmental quality related to higher concentration of poor individuals (with small access to clean technologies in daily life, as well as basic services) in an urban context is by far stronger than the positive effect related to the residence hypothesis. Finally, the political and the sex factors have been tested by many contributions, but the hypothesised positive relationship between democrats and males with environmental concerns has not been confirmed unanimously.

Summing up, all these different factors affect the income elasticity of demand for environmental amenities. As argued by Martínez-Alier (1995), there are different interpretations of the diffusion channels of WTP linked to the income factor. For instance, the post-materialist thesis (Hirsch, 1976) explains environmental concerns in terms of change in cultural values oriented towards quality of life, while a standard "materialist" interpretation of WTP for environmental protection directly derived from the constraints brought by increasing demand for decreased available (environmental) goods. Looking at empirical investigations, this theoretical divide is confirmed by opposite results investigating the role of income inequality related to environmental protection. Hill and Magnani (2002), Magnani (2000), and Torras and Boyce (1998) – among the others - have empirically tested the negative influence of income inequality on environmental protection, adopting an EKC model.

On the contrary, Scruggs (1998) has shown that if marginal degradation is constant as income share rises, it makes no difference from an environmental perspective whether wealthy or poor persons get the additional income. If degradation is decreasing in income, greater inequality would actually reduce degradation.

Following Magnani (2000), it must be noting that if EG brings rising income only for a restricted population group, the WTP for higher environmental standards would come from a small number of individuals, reducing the potentiality of pressure by public opinion. On the contrary, if development policies are oriented towards increasing health and educational levels, using EG for expanding welfare expenditures, the WTP for environmental protection will raise. Therefore, investigating which factors affect EG and income per capita, can implicitly suggest which factors influence WTP for environmental protection and sustainable development paths.

3. MEASURING SUSTAINABLE HUMAN DEVELOPMENT

SHD is a comprehensive framework where HD and SD definitions are included. The basic idea of expanding human capability for poor people, involving the assertion of unacceptability of discrimination, must apply to present and future generations thus guaranteeing a minimum level of capabilities that should be available in a long-term horizon.

In terms of intergenerational justice, HD becomes a means in itself where improving health and education is also instrumental in achieving higher stocks of human capital which will be the basis for higher well-being for future generations. Higher HD corresponds to an increasing WTP for environmental protection, thus preserving the capacity of a society to guarantee at leas the same level of capabilities for future generations. Thus HD should be seen as a major contribution to the achievement of sustainability. At the same time, natural resources and environment should constitute a means to achieving better standards of living just as income represents a means to increasing human well-being in a mutually reinforcing process (Anand and Sen, 2000).

In terms of sustainability, the real question that needs to be asked is HD, but at what cost? Some type of mechanism that accounts for overexploitation of natural resources needs to be incorporated.

Therefore, some economic prosperity is a necessary condition for increasing expenditure on welfare, and income growth could be a first sign of improvement in well-being levels. However, in a sustainability context, if such income growth were the output of overexploitation of capital assets, including natural ones, growth could not be sustained in the long run, with consequent declining welfare levels for people and fewer available assets in the whole economic system (Dasgupta and Mäler, 2001).

There is general consensus on pros and cons related to the HD measures, while on the contrary, there is great uncertainty about the measurement of SD. Taking into account the theoretical background here adopted, we shall only consider the debate on how to measure SD by using macroeconomic sustainability indices.

3.1 Macroeconomic sustainability indicators

The debate on the formulation of a macroeconomic sustainability index is mainly based on the definition of *Hicksian* national income where the present income should be defined as the maximum amount that can be consumed while keeping the value of total capital constant, including natural resources (Harris and Fraser, 2002).

The orderly formal model and social utility function used in the optimal control theory correspond to a wealth-constant criterion with a resulting green Net National Product (gNNP) as a measurement of

sustainable consumption path. According to Solow, a gNNP could be considered as the return on wealth: "properly defined and properly calculated, this year's net national product can always be regarded as this year's interest on society's total stock of capital" (Solow, 1992, p. 17).

The formulation of a *Hicksian* income accounting for depletion and degradation of natural capital can be expressed as follows:

$$g\,\mathrm{NNP} = \mathrm{C} + \dot{\mathrm{K}} - (\mathrm{F_R} - \mathrm{f_R})(\mathrm{R} - \mathrm{g}) - \mathrm{b}(\mathrm{e} - \mathrm{d}) \qquad [1]$$

where $C + \dot{K}$ represent standard NNP while other terms are adjustments for consumption and degradation of natural capital. In particular, the economic value of natural resources consumption - resources extracted (R) minus natural growth rate (g) for renewables - is given by the resource rental rate (F_R) net of the marginal cost of extraction (f_R) whereas pollution - emissions (e) minus natural dissipation rate (d) - is evaluated by the marginal social cost of abatement (b).

Capital assets can be identified as the whole factors that affect well-being (*means*), representing a composite index to verify if the development path is sustainable in the long run, both in economic and welfare terms. If there is positive resource accumulation, then welfare level is also sustainable. On the contrary, reaching a high welfare level without a capital constraint does not guarantee that the same well-being will be constant or growing in the long run (Dasgupta and Mäler, 2001). The notion of gNNP and the empirical indices developed during these years are mainly based on a weak sustainability criterion, with perfect substitutability of all forms of capital stocks (Pezzey, 1992).[4]

The first empirical attempt to quantify a modified income indicator in order to account for the environment was developed by Nordhaus and Tobin (1972) with the calculation of a Measure of Economic Welfare (MEW) in which specific evaluation of elements such as quality of life determinants, income distribution, leisure time and quality of environment was functional in order to build a modified income level that was more welfare oriented than standard national accounts.

Later on, a further extension of MEW was developed by Cobb and Cobb (1994) with an Index of Sustainable Economic Welfare (ISEW). In this case, the national accounts were reduced by the expenditure for reducing negative effects due to environmental degradation - as an approximation of

[4] In an integrated SHD approach, the maintenance of a constant or growing utility level could be interpreted as a functional condition (a means) for maintaining or enhancing a wider concept of well-being such as HD. Preserving productive capacity intact is not, however, an obligation to leave the world as we find it in every single detail. What needs to be conserved is a generalized capacity to create well-being, not any particular thing or resource. Since we do not know what the preferences of future generations will be, sustainability should only be set in terms of conserving the capacity to produce well-being. This assumption does not preclude preserving specific resources where substitutes are not available or have an independent value such as clean air or fresh water (Anand and Sen, 2000).

environmental damage – linked to water, air and soil pollution whereas some elements of natural capital depletion and long-term environmental damage were considered (i.e. climate change).

The calculation of ISEW was applied to a few case studies such as Austria, Chile, Germany, Italy, the Netherlands, Sweden and the United States. The ISEW was considered to be a great effort towards measuring SD but, nonetheless, it was criticized for arbitrary variable definitions from one country to another, producing results that were not directly comparable (Neumayer, 2000).

Another macroeconomic sustainability index has been derived from the application of the System of Environmental and Economic Accounts (SEEA) jointly developed by UN and the World Bank (Ahmad *et al*., 1989). By applying environmental satellite accounts, a modified Environmentally-adjusted Net Domestic Product (EDP) can be calculated that is perfectly comparable with traditional income measures. The accounting rules adopted for EDP fully adopt the *Hicksian* definition of income level as a constant flow without reducing all capital stock available for a certain economic system, without any subjective assumption linked to defensive expenditures and income distribution, as in the ISEW methodology.

EDP was calculated for many case studies, both for developing countries such as Colombia, Philippines, Ghana, India, Indonesia, Mexico, Papua New Guinea and Thailand and industrialized economies such as Korea, Japan and the United Kingdom (Hamilton and Lutz, 1996). The complexity of all the required satellite accounts has negatively affected the final results with partially incomplete EDP for some countries, again not fully comparable in a cross-section analysis.

The third index is the Genuine Saving (GS) - formally defined in Hamilton (2000) and empirically provided by the World Bank in the World Development Report - formulated directly from the gNNP expression.

Like the previous two indices, GS is based on the assumption of resource perfect substitutability, so it is interpreted as a limit value of sustainability where a positive value of GS corresponds to a weak sustainable path, a GS equal to zero represents the minimum level of sustainability and negative values of GS are interpreted as signals of long-term unsustainability.

GS has been calculated by the World Bank using only three environmental factors and obtaining a homogeneous index for all countries (economic assessment of rents from fuels and mineral resources, rents from forest consumption in excess of net natural growth rate and, finally, the evaluation of marginal social cost of CO_2 emissions).

GS values are available for long time series and for a wider range of countries than ISEW and EDP but surely give an over-estimation of sustainability due to several missing environmental aspects.

Considering that the aim of this paper is to address for the relationships between EG, SD and HD, and

adopting as a general framework the SHD definition given by Sen (2000) where a weak sustainability criterion is suggested to be accounted for in a HD perspective, the GS will be used in our empirical analysis as a macroeconomic sustainability indicator.

3.2 Alternative approaches measuring SHD

In recent years, a great deal of attention has been dedicated to the specific sustainability interpretation of HD with various critiques and proposals for implementing a "green HDI". Several indicators have been developed within the HDR, where gender or poverty are included in specific modified HDIs such as the Human Poverty Index (HPI) and the Gender-related Development Index (GDI). Nevertheless, no integration with environmental aspects appears in the latest editions.

Many contributions have analysed different empirical solutions in order to evaluate such aspects and adopted two different approaches: the first one is oriented towards full integration by directly modifying the HDI with the inclusion of environmental aspects (Costantini and Monni, 2005; Hinterberger *et al.*, 1999; Sagar and Najam, 1998; WEF, 2002); the second one analyses how environmental aspects could be associated with the traditional HDI in order to evaluate how sustainable the HD process is (Atkinson *et al*., 1997; Dasgupta and Mäler, 2001; Jha and Murthy, 2003; Neumayer, 2001).

The inclusion of an environmental dimension in a "green HDI" appeared in Hinterberger *et al.* (1999) and Sagar and Najam (1998) where the main HDI methodology has been maintained. Successively, a noticeable contribution is the construction of an Environmental Sustainability Index (ESI) produced within the World Economic Forum (WEF), with a huge amount of environmental information and well-being aspects (68 indicators) all included in a synthetic index. ESI values have unfortunately only been available for a few years and could not be used for analyses in historical perspectives. On the contrary, Costantini and Monni (2005) provide a Sustainable Human Development Index (SHDI) where the income dimension has been modified taking into account a gNNP notation and a fourth environmental dimension has been included in the index. In this specific case, the authors provide a historical perspective for policy analysis that is only related to European countries.

The second approach underlines some scepticism about using an integrated green HDI based on methodological and empirical problems. First, there is no direct relationship between resource exploitation and environmental degradation on the one hand and the level of HD on the other. Secondly, while the variables included in the HDI are all clear on where improvement is to be made – the longer people live, the better educated they are and the higher is the well-being level – this is more difficult for environmental variables (Neumayer, 2001).

In particular, Dasgupta and Mäler (2001) and Neumayer (2001) suggested a comparison between GS and HDI with the specific purpose of evaluating if such countries with higher performance in terms of increasing HDI have adopted a sustainable or non-sustainable development path. Jha and Murthy (2003) analysed the effects of EG and HD on specific environmental aspects related to pollution emissions, underling the important role of HD in reducing negative environmental impacts produced by EG and the industrialization process.

From this brief literature overview, in our opinion a comparison between HD achievements and sustainability issues probably represents the best way to proceed in a global context, where a number of aspects should be taken into account. In this sense, the most appealing models developed recently are the EKC and the RCH. While the EKC allows explaining the relationship between EG and environmental quality, the RCH has been used for explaining which are the most important factors explaining divergent EG performances, such as the role of initial level of natural resources endowment, the degree of trade openness, the role of FDI, the effects related to the quality of institutions and the human capital accumulation. In the following Section the two models are briefly overviewed, while in Section 5 there is a proposal for an integration of the two models in order to build a complex framework addressing for the main determinants of a SHD path.

4. EMPIRICAL MODELS ADDRESSING FOR DEVELOPMENT AND ENVIRONMENT

The environmental effects related to EG are mainly analysed through the so-called Environmental Kuznets Curve (EKC) formulation where relationships between EG and pollution are synthesized. Two main arguments have been proposed to explain the EKC. On the demand side, there is the role of public opinion in requiring policy actions to reduce environmental degradation where environment is no more a luxury good, as it is in poor economies. On the supply side, the focus is on the role of structural changes in the economic system, where EG is followed by technological innovation and change in the productive structure (from basic industries to high-tech services) producing a reduction in polluting emissions (Barbier, 2003). The explanations of the EKC on the demand side are closely related to the factors (i.e., income per capita and income distribution, education level, population density and urban population, etc.) affecting the WTP for environmental protection, as well as to the factors related to institutions (stringency of environmental regulation).

The classical reduced functional form representing the EKC is given by equation [2]:

$$E_i = \beta_0 + \beta_1 X_i + \beta_2 X_i^2 + \beta_3 X_i^3 + \beta_4 Z_i + e_i \qquad [2]$$

where E_i represents the general level of environmental stress and X_i the income per capita. The inverted *U*-shaped curve deriving from such a formula requires β_1 to be positive, β_2 negative and β_3 positive.[5] The vector Z_i represents various additional variables included in EKC studies, representing different aspects of the economic system in order to better shape the relationship between income and environment addressing for the explanations given to the inverted *U*-shaped curve, as the role of structural changes and technological changes on the supply side, or the role of income elasticity and the quality of institutions on the demand side.

Many contributes have tested empirically the existence of an EKC, using cross-country relationships (Grossman and Krueger, 1995; Shafik, 1994; Stern *et al.*, 1996), time series analyses for selected countries (Egli, 2002; Vincent, 1997), or panel data for subsets of countries and time series with different length (de Bruyn *et al*., 1998; Torras and Boyce, 1998). Further contributions have introduced other control variables in order to improve representation of the effects linked to trade openness and the manufacturing sector (Cole, 2004; Hettige *et al.*, 2000; Tisdell, 2001) or linked to well-being aspects such as income distribution, education and health (Gangadharan and Valenzuela, 2001; Hill and Magnani, 2002; Magnani, 2000), democracy, corruption and other institutional aspects (Dasgupta *et al*., 2006; Farzin and Bond, 2005; Lopez and Mitra, 2000). Rather than adding explanatory variables, Jha and Murthy (2003) attempt to build a modified EKC using HD dimensions as the explanatory variables of polluting emissions, confirming an inverted *U*-shaped curve even with a broad notion of development.

Finally, many contributes try to shed some light on possible failures in the theoretical interpretation of the EKC (Arrow *et al.*, 1995; Munasinghe, 1999; Stern and Common, 2001). A critical examination of the EKC literature highlights that the estimated relationship suffers from a number of theoretical and empirical criticisms, as the existence of omitted variables, the reduced functional form, and problems related to measurement issues both for the dependent and the independent variables.

In this particular context, we are interested in addressing for critiques related to the reduced form adopted in the EKC model, thus analysing factors affecting EG. In this sense, the empirical models recently developed to explain the RCH seem to include many factors quoted by empirical studies as possible indirect explanations of the EKC, as well as possible omitted variables. Therefore, rather than adding other explanatory variables in the EKC, an integrated model with EKC and RCH could be a solution.

The RCH postulates that countries with high natural resources endowments have experienced low EG

[5] The cubic term derives from the empirical evidence found by Grossman and Krueger (1995), where the relationship between income and emissions becomes positive again for certain types of pollution for higher income levels.

rates relatively to those countries with scarce stocks of natural resources. The resource curse is paradoxical because production of natural resources has been the initial source of nearly all development, provides an almost immediate source of foreign exchange, attracts foreign capital and skills, and provides both raw materials for processing and a market for manufactured inputs. Nonetheless, over the last fifty years, many countries rich in natural (commercial) resources experienced rates rather lower than other countries with scarce resources (Auty, 2001; Ross, 1999; Sachs and Warner, 1995).

Despite these first findings, many contributions have tried to shed some light on possible explanations of the EG paths depending on other conditions than the resources endowment, and these additional variables are mainly interesting for our research purpose. The main body of literature suggests five different explanations for the RCH: the Dutch disease effect, the misallocation of revenues from resources exploitation, the rent seeking behaviour, the quality of institutions, and the role of human capital.

The Dutch disease effect depends on the possibility that a resource boom will divert a country's resources away from activities that are more conducive to long run growth.[6] The resource boom causes the appreciation of the exchange rate, producing a contraction in manufacturing exports, or displacement of capital and labour factors away from manufacturing towards the extractive industries, raising manufacturing costs as a result (Torvik, 2001). Moreover, the relative abundance of natural resources could be a source of bias in the correct allocation of financial and investment flows (Stiglitz, 2000). Due to large initial investments necessary to the exploitation of oil and mineral reserves, often there is not market competition and the exploitation of resources is managed by few oligopolistic firms, often controlled by foreign multinational organizations. The capital flows coming from resource exploitation could be invested abroad, loosing most of the revenues from national resource endowments. The facility of capital investment on international markets could partially increase the exit of such revenues.

Directly linked to the Dutch disease effect, a second explanation is based on the role of savings. Among resource-rich countries, empirical evidence has shown that those countries with the highest savings rate – measured using the GS index provided by the World Bank - generally have managed to escape the resource curse (Atkinson and Hamilton, 2003; Boyce and Emery, 2005; Neumayer, 2004). Countries that manage their resource wealth more in accordance with the optimality criteria will fare better than those who do not.

[6] The term 'Dutch disease' was used for the first time to explain the negative economic impacts occurred in the Netherlands during the '60 after the discovery of natural gas reserves in the North Sea.

The third explanation of the RCH is linked to the presence of rent seeking behaviours, based on the assumption that resource rents are easily appropriable, and this in turn brings to distortion in public policies and pressure from lobbies and oligopolistic companies toward seeking public favours (Baland and Francois, 2000; Torvik, 2002). Concentration of rents in the hands of a few private owners directs revenue away from human resources and infrastructure, traditional agriculture, and small enterprise, in favour of consumption (and rent dissipation).

A fourth explanation looks deeply at the relationships between the quality of institutions and the capacity to manage resources exploitation with theoretical (Mehlum *et al.*, 2006) and empirical studies (Bulte *et al.*, 2005; Isham *et al.*, 2003; Leite and Weidmann, 1999; Sala-i-Martin and Subramanian, 2003). The linkages between the resource curse and the role of institutions may be divided into two strands: where the quality of institutions are hurt by resource abundance and constitutes the intermediate causal link between resources and economic performance; where resources interact with the quality of institutions such that resource abundance is a blessing when institutions are good and a curse when institutions are bad. The first linkage (destruction of institutions or an obstacle to the formation of solid institutions) can be found in many examples, including Saudi Arabia, Sudan, Nigeria, Angola, Congo, just to mention a few. On the other side, it may be that natural resources endowment does not negatively affect institutional quality, as occurred for Chile, Malaysia, and Norway.

Finally, a fifth explanation classifies recent contributes that have stressed the importance of other characteristics, linked to the absence of adequate investments in enhancing human resources. In particular, Gylfason (2001) has emphasized that resource abundance might have the effect of "crowding out" the accumulation of human capital, reducing the incentives for investments in education or knowledge sectors. Moreover, as claimed by Papyrakis and Gerlagh (2004), the resource blessing countries are those with the highest level of secondary education.

The last two explanations offer specific links between EG, SD in terms of natural resource stocks, HD, where institutional quality and education are specific dimensions of the wider concept of HD and the capabilities approach. Therefore, the different explanations of the RCH allow considering a number of possible conditioning variables useful for explaining factors indirectly affecting the EKC.

5. EMPIRICAL RESULTS

After a brief review of empirical models addressing for EG and environment, the value added of this paper is to form an integrated model addressing for the relationship between SD and HD, and at the same time considering EG as a means for achieving SD and HD, and therefore addressing also for the

determinants of EG. Before going into the results of the model, it is useful to check if the selected variables are consistent with our research hypothesis (definitions of variables acronyms in Table A1).

If we look at row data, it is quite clear that countries with higher GS are those with better institutions, higher education level, better improvements in HDI and less natural resources as percentage of GDP (Table 1). On the contrary, countries with negative GS are characterized by negative values for institutional quality, less investments in expanding human capabilities (lower HDI changes), and higher dependence on natural resources (Table 2).

In this paper we adopt the definition of natural resources developed in the RCH literature (Bulte *et al*., 2005; Isham *et al*., 2003) where a distinction is adopted between natural resources classified as "diffuse" resources, agriculture and food production, and as "point" resources, fossil fuels and mineral production, recognising that this second type is the main responsible for the negative effects on economic growth.

Table 1 –Countries with positive GS

Sustainable Countries	EG	TRADE	RL 2004	LIFE 1970	EDU 1970	HDI change	HDI 2003	POINT RESOURCE	GS 2003
Botswana	6.00	110.87	0.73	0.45	0.15	0.12	0.57	4.28	23.09
Brazil	1.91	18.26	-0.21	0.56	0.26	0.41	0.79	0.75	3.73
Chad	-0.25	46.05	-1.15	0.22	0.03	0.10	0.34	0.38	3.61
Chile	2.52	51.50	1.16	0.62	0.47	0.51	0.85	9.99	7.42
China	6.58	26.82	-0.47	0.61	0.46	0.48	0.76	1.66	33.30
Ghana	-0.17	47.64	-0.16	0.40	0.36	0.14	0.52	3.24	16.65
Hong Kong	4.30	224.92	1.42	0.75	0.49	0.65	0.92	0.64	21.68
India	2.65	17.16	-0.09	0.41	0.26	0.32	0.60	0.40	10.25
Indonesia	3.82	51.27	-0.91	0.38	0.20	0.43	0.70	11.95	2.53
Ireland	4.01	114.59	1.62	0.77	0.87	0.71	0.95	1.68	13.46
Japan	2.40	21.25	1.39	0.78	0.92	0.60	0.94	0.16	10.62
Kenya	1.03	60.24	-0.98	0.42	0.13	0.02	0.47	15.37	3.96
Korea	5.47	62.23	0.67	0.58	0.56	0.66	0.90	0.78	18.62
Malaysia	3.79	135.34	0.52	0.61	0.46	0.47	0.80	9.82	31.42
Mauritania	0.34	103.37	-0.62	0.29	0.04	0.21	0.48	35.53	15.04
Netherlands	1.73	104.60	1.78	0.81	0.89	0.57	0.94	7.12	7.26
Norway	2.83	74.15	1.95	0.82	0.88	0.72	0.96	4.79	7.27
Peru	0.09	33.31	-0.63	0.48	0.46	0.33	0.76	5.28	4.63
Philippines	1.05	64.45	-0.62	0.54	0.54	0.30	0.76	3.26	13.54
Rwanda	0.39	31.72	-0.90	0.32	0.04	0.16	0.45	9.66	0.75
Senegal	0.16	68.21	-0.20	0.26	0.11	0.21	0.46	4.48	4.46
Sweden	1.59	62.25	1.85	0.83	0.78	0.63	0.95	1.50	9.04
Tanzania	0.33	47.84	-0.49	0.34	0.03	..	0.42	14.59	1.21
Thailand	4.24	68.49	-0.05	0.56	0.25	0.42	0.78	1.68	12.90
Zambia	-1.39	74.41	-0.54	0.36	0.15	-0.14	0.39	46.16	6.17
Average	*2.22*	*68.84*	*0.20*	*0.53*	*0.39*	*0.38*	*0.70*	*7.81*	*11.30*

Considering punctual observations in Table 1, there are some exceptions where countries such as Chile, Indonesia and Malaysia present relatively higher resource abundance and positive GS. The three countries are all characterized by high increases in HDI and medium-high values (compared with other

developing countries) for initial capabilities (life expectancy and secondary education) and even good performances in terms of EG. These last observations confirm us that expanding capabilities is one of the most effective policy actions implemented during the last decades followed by increasing sustainability and increasing available income per capita.

Finally, it is worth noting that globalisation seems to be a neutral phenomenon, where the classification of countries as sustainable and non-sustainable does not coincide with Dollar and Kraay's classification of globalisers and non-globalisers (Dollar and Kraay, 2004). If we consider average data, trade flows as % of GDP (and the same applies for FDI as % of GDP) are not substantially different for countries classified in Tables 1 and 2.[7] Therefore, the level of HD (and human capital accumulation) and indirectly good institutional quality do matter and shape the direction and the impact of the current wave of globalisation.[8]

Table 2 –Countries with negative GS

Non-Sustainable Countries	EG	TRADE average	RL 2004	LIFE 1970	EDU 1970	HDI change	HDI 2003	POINT RESOURCE	GS 2003
Algeria	0.93	55.38	-0.73	0.47	0.20	0.44	0.72	22.56	-6.72
Angola	..	111.63	-1.33	0.20	0.09	..	0.45	..	-32.95
Belize	3.30	117.21	0.25	0.65	..	..	0.75	0.69	-4.21
Benin	0.73	46.69	-0.47	0.32	0.08	0.18	0.43	0.10	-4.83
Bolivia	0.21	49.42	-0.55	0.35	0.31	0.36	0.69	19.29	-7.89
Burkina Faso	1.31	35.12	-0.62	0.25	0.02	0.09	0.32	0.01	-2.12
Cameroon	1.01	49.00	-1.00	0.33	0.13	0.14	0.50	1.51	-2.99
Colombia	1.55	32.56	-0.70	0.60	0.36	0.36	0.79	0.91	-4.09
Congo, Rep.	0.82	109.10	-1.18	0.35	0.48	-0.05	0.39	6.90	-32.23
Gabon	0.75	96.88	-0.51	0.32	..	..	0.64	33.68	-1.47
Gambia	0.47	105.12	-0.32	0.19	0.09	0.26	0.47	30.11	-0.17
Iran	-0.04	39.33	-0.83	0.46	0.45	0.39	0.74	8.82	-2.25
Kazakhstan	..	89.56	-0.98	..	..	..	0.76	..	-26.10
Kuwait	-2.87	98.96	0.65	0.69	0.66	0.34	0.84	68.45	-33.88
Madagascar	-1.66	41.74	-0.30	0.34	0.13	0.17	0.50	1.35	-16.29
Niger	-1.81	44.02	-0.92	0.21	0.02	0.06	0.28	2.02	-5.99
Nigeria	0.12	56.00	-1.44	0.30	0.08	0.20	0.45	20.84	-31.53
Russian Fed.	..	56.73	-0.70	..	..	..	0.80	..	-13.72
Saudi Arabia	0.40	76.54	0.20	0.46	0.22	0.43	0.77	67.62	-24.96
Sierra Leone	-1.98	46.88	-1.10	0.16	0.12	..	0.30	3.73	-11.12
Suriname	0.21	88.98	-0.25	0.64	..	..	0.76	47.72	-12.83
Syria	2.15	53.62	-0.40	0.51	0.43	0.39	0.72	7.76	-16.62
Venezuela,	-1.42	47.12	-1.10	0.67	0.44	0.19	0.77	24.98	-23.95
Zimbabwe	-0.51	54.01	-1.53	0.43	0.08	-0.09	0.51	14.12	-4.25
Average	*0.17*	*66.73*	*-0.66*	*0.40*	*0.23*	*0.23*	*0.60*	*18.25*	*-13.46*

[7] In this specific context, we adopt trade flows (export + imports) as % of GDP as a measure of globalisation rather then other indices measuring trade openness or liberalisation process, considering that the vast majority of development accelerations do not take place in the context of standard economic liberalization programmes (Rodrik, 2004). When evaluating the effect of globalisation, what is really important is not the impact of policies but the consequences of the actual increase in measurable globalisation indices such as trade flows and FDI (Williamson, 2002).

[8] All data in this paper were taken from World Development Indicators (online database, 2004) provided by the World Bank, and from Human Development Reports (various years) provided by the UNDP.

In order to build a complex framework valid for an integrated assessment of HD, SD and EG, it is necessary to partially modify the EKC formulation accounting for sustainability and not only for environmental degradation. Therefore, following Costantini and Monni (2006), the inverted *U*-shaped relation between GDP per capita and pollutant emissions - depicted in the EKC - can be re-formulated by using a modified EKC (MEKC), replacing the GDP per capita with a modified Human Development Index (HDIM) that does not include the income factor and replacing the pollution emissions with the negative value of Genuine Saving per capita (-GS) as a measure of non-sustainability. This simple accounting rule allows the original EKC - where the dependent variable is a negative effect related to economic growth – to be compared with the MEKC. Furthermore, the absence of the GDP index in the HDIM eliminates multicollinearity between the GS and the HDI.

The value added of such analysis is the presence of depletion and degradation value of natural resources contained in the GS index compared with the simple pollutant emissions considered in a classical EKC model. In addition, using a HD measure and not a simple EG level allows broader considerations to be made on the sustainability of the development path or if future generations could enjoy the same well-being level (and not only income). In line with classic EKC, the inclusion of other control variables such as trade flows and manufactures as the share of value added allows analysing the other factors affecting SD.

Furthermore, the role of institutions has been investigated as one of the determinants of an EKC relationship, following recent contributions addressing for corruption and democracy (Dasgupta *et al*., 2006; Farzin and Bond, 2005; Lopez and Mitra, 2000). As argued by Lopez and Mitra (2000), corruption and rent-seeking behaviour can influence the relationship between income and the environment. Additionally, Magnani (2000) suggests that well-defined property rights, democratic systems, and respect of human rights can increase levels and efficacy of environmental policy. Farzin and Bond (2005) consider environmental quality as mostly a public good, where in many cases the costs for abating pollution are huge, and individuals within a society are unable to provide sufficient resources to protect environment, even if their WTP is high. As such, it is usually the state that provides these goods. At the same time, the state's environmental policy is partly influenced by individuals' preferences for environmental quality. Therefore, the quality of institutions (or the level of democracy) could be interpreted as a proxy of the WTP of a society to protect environmental resources.

As the quality of institutions affects both the EG path and the SD path, an integration of the RCH and the EKC seems to have solid foundations. Furthermore, following most recent contributions on RCH (Gylfason and Zoega, 2006; Isham *et al*., 2003; Sala-i-Martin and Subramanian, 2003), the quality of institutions is modelled as an endogenous variable.

The full model specification is as follows:

$$s_t = f_1(h_t, i_t, m_t, t_t) \quad [3]$$

$$g_{t-0} = f_2(y_0, r_0, e_0, l_0, e_\Delta, l_\Delta, i_t, t_{t-0}, f_{t-0}, d_{t-0}, v_{t-0}) \quad [4]$$

$$i_t = f_3(y_0, r_0, e_0, l_0, e_\Delta, l_\Delta, t_{t-0}, f_{t-0}, d_{t-0}, v_{t-0}) \quad [5]$$

$$h_t = f_4(y_0, y_t, e_0, l_0, v_{t-0}) \quad [6]$$

$$y_t = f_5(y_0, g) \quad [7]$$

The alternative formulation of the EKC is represented in eq. [3], where the current negative value of the GS (s_t) is a function of the current level of HD (h_t) excluding the income dimension (HDIM), the quality of institutions (i_t), the structural composition of the economic sectors (m_t) given by the share of manufacturing value added on national value added, and the degree of openness of the economy (t_t) expressed as the sum of exports and imports as percentage of GDP.

The economic growth rate (g_{t-0}), described in eq. [4], is a function of initial income per capita (y_0), initial level of natural resources endowment (r_0), initial level of education (e_0) and life expectancy at birth (l_0), changes occurred to education and health during the considered period as a proxy of human capital accumulation (e_Δ and l_Δ respectively),[9] the degree of openness of the economy calculated as the average value of the entire period (t_{t-0}), FDI inflows (f_{t-0}), the inflation rate (d_{t-0}) and the level of investments during the considered period (v_{t-0}).[10]

The role of endogenous institutions is modelled in eq. [5] accounting for variables suggested by recent contributions on the RCH as initial income, natural resources endowment, the degree of openness, and other variables as the investments and the inflation rate as a proxy of macroeconomic stability, and adding new factors related to HD dimensions (education and health both in terms of initial levels and changes over the analysed period).

Different variables for institutional quality have been used in the empirical studies addressing for the EKC and the RCH. In this paper, we have adopted the definition of institutional quality provided by Kaufman *et al*. (2003), where six different characteristics describe this aspect: rule of law, political instability, government effectiveness, control of corruption, regulatory framework, and property rights

[9] The accumulation of human capital as a flow variable could be better represented by using public expenditures for education and health but, in order to have a wider sample of countries, changes in stock variables have been adopted.

[10] The adoption of an average value over the whole period for macroeconomic indicators is a standard technique adopted in EG empirical studies in order to reduce possible bias related to business cycle and to non homogeneous data for different years (e.g., Sala-i-Martin and Subramanian, 2003).

and rule-based governance. In particular, the measure related to rule of law (RL) has been widely analysed in the most recent literature concerning the RCH (Bulte *et al*., 2005; Gylfason, 2001; Isham *et al*., 2003). There exist many alternative indicators provided by international agencies measuring in different ways the quality of institutions and governance issues, but unfortunately it is almost always the case that these indicators don't cover a wide sample of countries. It is the case of the Corruption Perspectives Index provided by Transparency International (TICPI) and used by Dasgupta *et al*. (2006) for representing the World Bank's CPIAE (Country Policy and Institutional Assessment for Environment), which rates countries from 1 to 6 in ascending order of effectiveness in environmental governance. The authors affirm that CPIAE and TICPI are highly correlated; hence TICPI has been used because of its larger dataset. Considering that dataset for RL is much wider than TICPI, we have decided to maintain RL as the institutional variable in order to have as many observations as possible.[11]
In the same venue, Farzin and Bond (2005) measure the quality of institutions from a partially different point of view, addressing for the form of the political regime rather than the general capacity of institutions to manage natural resources, implementing public policies to enhance HD and capabilities achievements.
The interpretation of EG as a means both for HD and SD allows modelling the linkages between the EKC and the RCH. Following the empirical results in Ranis *et al*. (2000), the equation representing the influence of EG as a means for achieving higher HD levels (eq. [6]) has been modelled considering only few determinants of HD as initial and current level of income per capita (y_0 and y_t), initial level of education and life expectancy at birth, as well as the level of investments. Finally, eq. [7] allows transforming the EG performances into the current level of income per capita.
As in Isham *et al.* (2003), we have adopted a three stages least squares (3SLS) method of estimation, since the model specification has heteroskedasticity of error terms for the MEKC. The results are consistent both with other estimations of the EKC accounting for institutional quality (Dasgupta *et al*., 2006; Farzin and Bond, 2005) and with empirical analyses of the RCH with endogenous institutions (Gylfason and Zoega, 2006; Isham *et al*., 2003; Sala-i-Martin & Subramanian, 2003) where major transmission channels of the resource curse to growth stagnation are linked to institutional quality and not directly to EG.[12]
Results in Table 3 represent estimates that both use only equations [3], [4], and [5] – models (1) and (2)

[11] To check robustness of RL we have computed a simple OLS regression between RL and TICPI finding a strong positive correlation with an R-squared around 0.90.
[12] We tested whether there is endogeneity between income growth and institutions, and the Hausman test confirms that instrumenting for institutions gives efficient and consistent results, with *p*-values associated to the Hausman test lower than 5%. We tested the same model using a SUR estimates in order to check for correlation of error terms and results are quite similar to the results reported in Table 3.

– and use the complete model (including equations [6] and [7]) – model (3) - in order to account for the difference between HD driven or not by EG performance. Results for the two specifications are quite similar, and the inclusion of the two additional equations does not affect the robustness of the estimates both for RCH and MEKC.[13]

One specific value added of such a complete model is that it allows transforming the threshold value of HDIM corresponding to the maximum non-sustainable GS level into a GDP measure (and vice versa) using equations [6] and [7], which can be compared with the GDP value corresponding to the threshold levels of pollutant emissions given by the standard EKC.

If we compare results of a standard EKC with the turning point value of the MEKC, it is worth noting that the HD threshold level of the inverted *U*-shaped curve is around 0.60 where it is clearly a medium development level (that is perfectly consistent with the average HDI value reported in Table 2 for countries with negative values of GS). The turning points of a standard EKC founded for example in many contributions for CO_2 emissions are often around 30.000 US$ per capita, thus corresponding to a HDIM level around 0.95 (using equation [7]). These first results confirm the main criticisms of the EKC, related especially to the possibility of a different EG path - a turning point well below the predicted ones from classic EKC for developing countries as claimed by Munasinghe (1999) - which could invert the negative environmental effects caused by the development process well before what has occurred in the past for developed countries.[14]

The role of HD dimensions is quite clear and unanimous where a higher initial level of HD corresponds to positive effects on institutional quality and on EG. Improvements in the HD level over past decades seem to have a significant effect on the current institutional quality, with a positive and strongly consistent estimate. Therefore, the important role of public investments for health and education and, more generally, for achieving a wider range of available capabilities for all, has been recognised even for the quality of institutions.

Considering the initial level of HD, results show the great importance of initial level of life expectancy (at 1970) as one of the necessary conditions for a successful development process. This is perfectly in line even with EG theory where initial life expectancy at birth is one of the most effective explanatory variables used within a traditional conditional convergence model (Bhargava *et al*., 2000).

[13] The robustness of the estimates reported in Table 3 has been tested by the insertion of regional dummies and by reproducing the same system without Sub-Saharan African countries.

[14] It Must be noticed that values of HD threshold level for MEKC are calculated in terms of HDIM, excluding the income dimension, while values of HDI reported in Tables 1 and 2 are those provided by UNDP with all the three dimensions. Nevertheless, values of HDIM are very similar to HDI values for the majority of countries included in our sample, thus the comparison seems to be correct.

Table 3 – Integrated Model for EG, HD and SD (estimates for period 1970-2003)

Variables	RCH(1)	INST(1)	MEKC(1)	RCH(2)	INST(2)	MEKC(2)	RCH(3)	INST(3)	MEKC(3)	HDI(3)
Initial GDP	-0.459*	0.260*		-1.054*	0.152**		-1.115*	0.154*		0.004*
	(-2.11)	(2.91)		(-5.84)	(1.74)		(-6.34)	(1.78)		(0.14)
TRADE	0.969			1.008*	0.421*		0.726	0.432*		
	(1.42)			(1.93)	(2.03)		(1.46)	(2.10)		
FDI	0.191			0.101	0.118*		0.050	0.116*		
	(1.40)			(0.80)	(2.02)		(0.41)	(2.00)		
INFLATION					-0.259*		0.132	-0.254*		
					(-3.50)		(0.52)	(-3.47)		
INVESTMENTS	4.163*			3.104*	-0.154		2.991*	-0.153		0.082*
	(7.33)			(5.85)	(-0.51)		(5.81)	(-0.51)		(1.43)
RL (2003)	0.306			0.995*			1.404*		-0.140*	
	(0.48)			(2.00)			(2.98)		(-13.15)	
Initial LIFE EXPECT.		-0.721		5.527*	0.282		5.543*	0.267		0.841*
		(-0.87)		(3.66)	0.325		(3.80)	0.311		(6.45)
Initial SEC. EDU.		2.442*		-1.812	1.481*		-2.288*	1.487*		0.065
		(4.06)		(-1.58)	(2.57)		(-2.08)	(2.91)		(0.85)
Change LIFE EXPECT		-0.051			-0.035		2.52*	-0.026		
		(-0.26)			(-0.20)		(3.92)	(-0.15)		
Change SEC. EDU		0.149*			0.085*		-0.02	0.024*		
		(1.98)			(1.13)		(-0.05)	(2.45)		
DIFFUSE	-4.364*	-0.240		-3.689*	-0.947		-3.371*	-0.974		
	(-2.29)	(-0.26)		(-2.21)	(-1.11)		(-2.12)	(-1.16)		
POINT	-4.232*	-0.744*		-2.566*	-0.650**		-2.220*	-0.742*		
	(-3.28)	(-1.30)		(-2.32)	(-1.23)		(-2.11)	(-1.72)		
GDP (2003)										-0.002
										(-0.08)
HDIM (2003)			5.879*			5.652*			6.270*	
			(4.62)			(4.59)			(5.21)	
HDIM^2 (2003)			-4.691*			-4.541*			-4.977*	
			(-5.05)			(-5.03)			(-5.63)	
TRADE (2003)			-0.076*			-0.087*			-0.091*	
			(-1.94)			(-2.22)			(-2.41)	
MANUF. (2003)			0.001			0.005			0.009	
			(0.02)			(0.10)			(0.17)	
CONSTANT	12.242*	-2.611*	-10.039*	12.141*	-1.121*	-9.956*	12.418*	-1.153*	-10.153*	0.379*
	(7.67)	(-5.00)	(-22.30)	(8.82)	(-1.39)	(-23.03)	(9.24)	(-1.44)	(-24.05)	(2.91)
Numb. Obs	70	70	70	70	70	70	70	70	70	70
Adj Rsq	0.67	0.70	0.40	0.75	0.79	0.40	0.74	0.79	0.52	0.86

Statistics for t-Student in parenthesis. * p-values < 0.05, ** p-values < 0.1.

Such a relationship allows an understanding of the major role played by the availability of basic capabilities in order to implement further policies oriented to human capital accumulation (secondary education among the others), in order to improve institutional quality.

A specific consideration should be made for transition economies where central planning economies have guaranteed a high level of health and education in the past. However, over the last fifteen years, the transition process has been followed by a collapse of the institutions and therefore transition economies present high initial level of life expectancy and, at the same time, negative value for institutional quality (RL).[15]

After the satisfaction of such a necessary condition, the human capital accumulation process, formally represented by increasing levels of gross secondary school enrolment ratio, would help to reach higher economic development levels, providing the instruments to enlarge people' choices and therefore improving social accountability and democratic participation.[16]

With regard to sustainability, following a path shaped as an inverted-*U* curve, increasing HD is first associated with increasing exploitation of natural resources until a threshold level where such relation becomes positive and an increase in HD positively affects sustainability. The achievement of an SD path, especially for countries highly dependent from natural resources exploitation, could only be assured by adequate investments in human capital or through the expansion of capabilities for present and future generations. As underlined in Anand and Sen (2000), HD is a basic means for reaching SD and, at the same time, preserving natural resources (or investing revenues in other forms of capital) constitutes a means for ensuring increasing capabilities for future generations.

An increase in EG and in HD is associated with growing resource consumption in the first stages of development, where the industrialisation process requires great efforts from primary industries in the first development stage and the development of heavy (polluting) industries in the second stage. If the EG and HD process is followed by sufficient human capital accumulation with better institutions and qualified human resources, the industrialisation process will move towards a further development stage characterised by the major role of services and technology diffusion, thus reducing pollution and using

[15] According to Rodrik (2004), the application of the policy recommendations provided by international organisations (the so-called Washington Consensus) is not the best way to lead central planning economies towards a market system, if other conditions such as the quality of institutions, social accountability, the democratic participation to political process among others, are not taken into account.

[16] In any case it should be taken in mind that the quality of institutions conventionally measured by indices provided by Kaufman *et al*. (2003) could not consider all the forms of institutional changes occurring in developing countries. The case for China is ideal, where institutions represented as Rule of Law appear with very low quality, while economic performances are tremendous. One possible explanation is that institutional reforms occurring in China have not followed traditional schemes, and as a general issue the multiplicity and non-uniqueness of institutional arrangements are all important aspects to be considered. What is necessary is that reform strategies are sensitive to domestic opportunities and constraints.

less natural resources. A virtuous cycle of this kind could be reinforced by public investments for health and education and more widely for social capabilities. The role of skilled labour force in conjunction with a higher income level are all necessary conditions for the adoption of an environmentally- friendly consumption path and production techniques.

In this context, the role of international trade and FDI inflows seems to be positive in the sense that circulation of capital, people and technologies has a positive impact on the quality of institutions, and indirectly both on the EG performance and the sustainability of the HD achievements. These results are again obtained mainly through the institutional channel, where the capacity to manage natural resources in a SHD path could benefit from increasing foreign contacts related to increasing trade flows and FDI (Stiglitz, 2000).

Finally, we maintain that natural resource endowment could be a source of low EG rates if the institutions in a country do not have the ability to manage the resources in the right way. Therefore, investment policies geared towards human capital formation (education and high skilled labour forces) are to be considered the most effective actions for reaching a higher development level. On the contrary, if a large consumption of natural resources during the first stages of the development process is not pursued by appropriate investment policies to replace depleted resources, it could the case that the development path would not sustainable in the long-term.

7. CONCLUSIONS

Different causal linkages have been analysed among EG, HD, and SD, providing some general results about the sustainability of a development process.

The first one is that achieving an adequate sustainability level with a positive capital accumulation process is a very difficult task in the first stage of development. The satisfaction of basic human needs is a necessary condition for such an objective, and environmental protection is considered as a secondary (or luxury) good.

The second one is the key role of human capital accumulation as a means to reaching and maintaining higher welfare levels. While developing countries should promote environmental protection as soon as possible, industrialised countries could help this process through a coordinated know-how and technological transfer to avoid the great degradation and depletion of natural resources, which typically occurred during the past decades. Achieving a higher standard of living and maintaining natural capital could be complementary rather than competing objectives, mutually reinforcing an upward spiral of development and economic growth.

Our results confirm that HD should be the first objective of international development policies, where

the increasing in human well-being is necessary to provide a sustainability path. Active participation of industrialised countries, following the general framework of the Millennium Development Goals, is one of the necessary conditions for development. Furthermore, the globalisation process in its broad definition could be a source of great advantages even for developing countries, if they would have the required instruments to manage this process in a positive direction, enhancing human capabilities, with higher health and education level. Higher technological level would transform resource-intensive economies into knowledge-intensive ones, reducing depletion and degradation of natural resources, and reinforcing the virtuous cycle of EG and HD.

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APPENDIX A

Table A1: Data sources and definitions

EG	Economic Growth, annual growth rate of GDP per capita (constant 1995 $), 1970-2003
Initial GDP	Natural logarithm of GDP per capita (constant 1995 $), 1970
OPENNESS	Fraction of years in which the country is rated as an open economy (Sachs and Warner, 1995b)
FDI	Natural logarithm of Foreign direct investment, net inflows (% of GDP) average 1970-2003
INFLATION	Natural logarithm of Inflation (GDP deflator), average 1970-2003
INVESTMENTS	Natural logarithm of Gross private capital flows (% of GDP) average 1970-2003
RL	Rule of Law (Kauffman et al., 2003)
Initial LIFE EXPECT.	Life expectancy at birth (UNDP-HDR normalization criterion), 1970
Initial SEC. EDU.	Gross secondary enrollment ratio, (UNDP-HDR normalization criterion), 1970
Change LIFE EXPECT.	Change in life expectancy at birth, 1970-2002
Change SEC. EDU.	Change in gross secondary enrollment ratio, 1970-2002
DIFFUSE	Diffuse resources (Agriculture + Food) as % of GDP, average 1970-1975
POINT	Point resources (Oil + Minerals) as % of GDP, average 1970-1975
TOT-RES	Total Natural Resources as % of GDP, average 1970-1975
GDP	Natural logarithm of GDP per capita (constant 1995 $)
HDI	Human Development Index, standard UNDP methodology
HDIM	HDI without GDP Index
TRADE	Natural logarithm of Trade (imports + exports) as % of GDP
MANUF.	Natural logarithm of Industry, value added (% of GDP)
GS	Natural logarithm of Genuine Saving per capita (constant 1995 $)

Table A2: Main statistics

Variable	Obs	Mean	Std.	Min	Max
GS	165	-3.515	1.997	-8.860	-0.220
HDIM	153	0.729	0.196	0.227	0.971
Init GDP	115	7.415	1.538	4.695	10.628
EG	115	1.227	1.883	-4.646	6.578
INVESTMENT	174	23.075	5.983	9.799	41.968
TRADE	175	78.776	38.474	17.164	224.917
MANUFACTURE	139	46.836	30.979	0.185	98.556
FDI	158	2.111	2.096	0.047	15.136
INFLATION	175	2.206	0.890	0.052	5.215
RL	176	-0.080	0.997	-2.310	2.010
LIFE70	156	0.534	0.196	0.156	0.827
LIFECH	129	0.390	0.290	0.013	0.965
EDU70	156	0.288	0.318	-0.513	1.534
EDUCH	129	1.636	5.404	-0.329	60.722
RESOURCES	124	0.173	0.171	0.000	0.764

Table A3: Correlation matrix

	GS	HDIM	Init GDP	EG	INVEST	TRADE	MANUF	FDI	INFLA	RL	LIFE70	LIFECH	EDU70	EDUCH
HDIM	-0.675													
Init GDP	-0.622	0.817												
EG	-0.408	0.509	0.241											
INVESTMENT	-0.488	0.521	0.309	0.689										
TRADE	-0.095	0.102	0.122	0.209	0.358									
MANUFACTURE	-0.265	0.531	0.421	0.585	0.390	0.097								
FDI	-0.240	0.281	0.273	0.264	0.281	0.756	0.183							
INFLATION	0.025	-0.062	-0.182	-0.352	-0.227	-0.232	-0.268	-0.143						
RL	-0.493	0.737	0.830	0.534	0.417	0.214	0.518	0.307	-0.384					
LIFE70	-0.614	0.934	0.886	0.456	0.478	0.143	0.535	0.293	-0.143	0.794				
LIFECH	0.065	-0.124	-0.264	-0.037	-0.114	-0.079	-0.020	-0.052	-0.037	-0.189	-0.351			
EDU70	-0.612	0.858	0.887	0.396	0.452	0.163	0.488	0.272	-0.248	0.845	0.907	-0.250		
EDUCH	0.383	-0.596	-0.581	-0.132	-0.186	-0.139	-0.326	-0.238	0.114	-0.501	-0.615	0.123	-0.705	
RESOURCES	0.024	-0.229	-0.220	-0.323	-0.043	0.441	-0.477	0.087	0.135	-0.271	-0.250	-0.054	-0.204	0.032