



Integrated paradigm for sustainable development: A panel data study[☆]

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ABSTRACT

The concept of sustainable development requires countries all over the world to use their natural resources rationally while pursuing their economic development, and at the same time to consider the quality of environment as a determinant of their societies' welfare. First, the method of principle component analysis and composite indicators are adopted to construct an overall sustainable development index and resource intensity measure using Millennium Development Goals (MDG) and World Development Indicator Data. Second, this paper applies an integrated paradigm to investigate the relationship between natural resource availability, economic growth, and the environment using a panel of 62 countries over the period 1990–2007. This interlocking relationship is analyzed through estimating the Resource Curse Hypothesis model and the Environmental Kuznets Curve model simultaneously while taking into consideration an important dimension—namely institutional quality. The results suggest that the way countries are dealing with sustainability in the context of MDG is negatively affecting the quality of the environment. Moreover, it proposes that countries with good institution quality are not taking the environmental problems seriously.

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1. Introduction

In the developing world, there is a clear tradeoff between economic growth and environmental security. In the early stages of development, sustainability is difficult to maintain as countries try to achieve capital accumulation, with basic human needs being prioritized over environmental protection. Later, as development is attained, human capital, wealth and strong institutions mean that the industrial processes are likely to use fewer natural resources and produce less pollution. Following the approach of [Costantini and Monni \(2008\)](#), this paper revisits the relationship between natural resource availability, economic growth and the environment, using an integrative paradigm and a panel of 62 countries during the years 1990–2007. This is implemented through combining the Resource Curse Hypothesis model (RCH), which focuses on the impact of resource abundance on economic growth, with the Environmental Kuznets Curve (EKC), which considers the effect of

economic growth on environment. Moreover, institutional quality is considered as an extra aspect in the system of equations.

The RCH literature is based on the empirical model proposed by [Sachs and Warner \(1997\)](#). This model was based on endogenous growth theory with a Dutch disease feature. [Sachs and Warner \(1997\)](#) stressed the idea that a negative relationship between natural resource abundance and economic growth imposed a conceptual puzzle, as it was expected that resource abundance should increase investment and thereby growth rates. However, what was noticed was that resource-poor economies were the world's star performers like Korea, Taiwan and Hong Kong, while many resource-rich economies underwent adverse reactions in growth during the 1970s and 1980s. Other authors built on this model by adding or altering different independent variables and different econometric methodologies. Therefore, the RCH model's structure is based on growth rate of per capita income as a dependent variable and independent variables such as initial per capita, trade policy, government efficiency, and investment rates. On the other hand, the theory suggests that EKC has an inverted U-shape curve relating economic growth to environmental degradation such as air pollutants, river quality, carbon emissions, and deforestation. Different studies could not establish the hypothesized inverted U-shaped relationship for all kinds of indicators.

This paper aims at extending the study implemented by [Costantini and Monni \(2008\)](#) that relates the three above mentioned dimensions within a cross-country framework to a simultaneous panel equation

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construction. These empirical results will provide further means of recognizing the interrelation between natural resources, economic growth and the environment and the importance of understanding these links for sustainable development. Moreover, it provides input for policy debates over sustainable development paths that satisfy countries' needs while preserving the environment for future generations for developing countries. The remainder of the paper is organized as follows. Section 2 first sheds light on RCH and EKC literature. Section 3 portrays the research methodology. In Section 4, the data used is described and the construction of indices measuring the dimensions of sustainability and resource intensity is illustrated. The estimation results are presented in Section 5. Section 6 concludes while offering some policy recommendations.

2. Literature review

2.1. Role of natural resources in growth models

Natural resources were seen to be of unlimited supply throughout the history of economic thought (Auty and Mikesell, 1998). The main focus was on capital and labor. By the end of the nineteenth century, conventional economists believed that natural resources can be excluded from being a constraint by increasing capital and technological progress. On the other hand, by the late 19th and early 20th century, the conservationists had opposed this idea and advocated the wise use of resources. Barnett and Morse (1963) were the first to theoretically analyze natural resource scarcity and its impact on growth. Following World War II, an emerging interest in the economic growth of developing countries led to the formulation of a number of growth models based on the production function, such as Cobb–Douglas and Harrod–Domer functions. Still, natural resources were not dealt with in these growth models due to the belief that natural resources would not hinder world growth. In the early 1970s, the rapid increase in the price of minerals and oil made professional economists realize that natural resource scarcity can be a constraint on economic growth. In modern world economy, international markets determine prices of natural resources. Scarcity or abundance is not the only factor that affects growth of a certain country but also the prices of the natural resources. Therefore, growth in resource-based countries could be explained in terms of natural resource prices in domestic and world markets, the quantity demanded by world countries, and movements in real exchange rates (Auty and Mikesell, 1998). A resource-abundant country can face lower economic growth compared to a resource-scarce country if a distortion in these factors occurs.

In the 20th century, the resource curse phenomenon was established as an important empirical finding in environmental and natural resource economics. It puts forward that natural resource-abundant economies have a tendency to grow more slowly than economies without considerable resources (Atkinson and Hamilton, 2003; Auty, 2001; Gylfason and Zoega, 2002; Sachs and Warner, 1997, 2001). Even so, the availability of natural resources does not necessarily imply a resource curse, but on average resource-abundant countries lag behind countries with fewer resources. Over the last four decades, for example, the Organization of Petroleum Exporting Countries (OPEC) as a whole experienced a negative growth rate of per capita gross domestic product (GDP) (Gylfason, 2001).

During the past six decades, numerous empirical works have accumulated on the RCH. These studies used different functional forms to scrutinize the phenomena of resource curse. Table 1 summarizes some of the work done on RCH modeling. As may be seen from the table, growth modeling was adopted in diverse research applying various econometric techniques. In most cases cross-country data was analyzed (Atkinson and Hamilton, 2003; Costantini and Monni, 2008; Sachs and Warner, 1997). Further studies used regional data to prove the existence of resource curse in specific countries like Indonesia and China (Komarulzaman and Alisjahbema, 2006; Shuai and Zhogying, 2009). Others focused on adopting the same model introduced by Sachs and Warner (1997), but the main interest was testing if different resource intensity measures could affect the significance of the curse. Variables such as gross fixed capital formation, inflation rate, education expenditure and institution quality were employed as conditioning variables representing other macroeconomic aspects that have an effect on economic growth. The results obtained showed that there is a significantly negative relationship between natural resource abundance and economic growth which proved that the resource curse exists. In spite of the results reached, further studies are needed to identify better indicators to measure resource intensity, human capital accumulation and sustainability. In addition, testing different econometric techniques—such as investigating the endogeneity of some variables that affect unbiasedness and consistency of the coefficients in the estimated model—is called for.

2.2. Environmental Kuznets curve (EKC) model

Environmental Kuznets curve (EKC) model is an empirical relationship between per capita income and indicators of environmental degradation. Grossman and Krueger (1991, 1995) were the first to notice this relationship when they were investigating the effect of the North American Free Trade Agreement (NAFTA) on the environment. It was

Table 1
Various resource curse hypothesis models.

Author	Dependent variable	Independent variable	Econometric model used
Sachs and Warner (1997)	Real per capita growth rate of GDP	Initial GDP per capita, share of primary exports, open economy index, investment ratio, bureaucratic efficiency index, external trade index, ratio of income share, African countries dummy, Asian countries dummy, and Latin American countries dummy	OLS method using cross-country data
Atkinson and Hamilton (2003)	Per capita growth rate of GDP	Initial GDP per capita, years of attainment in school, investment ratio, resource rent, Sub-Saharan Africa dummy, Central America dummy, Latin America dummy, Middle East and North Africa dummy, and East Asia dummy	OLS method using cross-country data
Costantini and Monni (2008)	Per capita growth rate of GDP	Initial GDP per capita, trade, foreign direct investment, GDP deflator, life expectancy, secondary education, diffuse resources, point resources, and institution quality	Simultaneous equation of cross-country analysis
	Institution quality	Initial GDP per capita, trade, foreign direct investment, GDP deflator, life expectancy, secondary education, diffuse resources, and point resources	
Shuai and Zhogying (2009)	Per capita growth rate of GDP	GDP per capita income lagged one, energy exploitation intensity, fixed assets investment, enrolled students in higher education, research and development, trade, and institutions index	Random and fixed effect panel data analysis

Source: Authors' summary on some of the recent work on RCH modeling.

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