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Physical limits to resource access and utilisation and their economic implications in Mediterranean economies

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ABSTRACT

This paper applies Ecological Footprint accounting to Mediterranean countries to track ecological asset balances and investigate the long-term feasibility of fulfilling natural resource and service needs. Our findings are that the Mediterranean region currently uses approximately 2.5 times more natural resources and ecological services than their ecosystems can provide. We argue that when consumption exceeds local availability, countries either resort to depletion of ecological assets or turn to international trade in order to satisfy their demands. Access to outside resources is however limited by (a) the availability of resources on international markets and (b) their affordability. Countries highly dependent on natural resource imports therefore expose their economies to the macroeconomic consequences of price volatility. We find that trade-related effects of natural resource price volatility are significant for Mediterranean economies as a 10% increase in the price of natural resources corresponds with a change in the trade balance between +7% and −2.4% of the GDP. We conclude that, in a world characterised by the existence of physical limits to the availability of global ecological assets, a systemic risk may exist for Mediterranean economies due to the concurrence of (1) ecological asset scarcity, (2) increasing prices and (3) challenging financial situations.

1. Introduction

Transitioning towards sustainable human development requires better understanding and management of the relationships between ecosystems' life-supporting capacity, humanity's effective use of the services that they provide, and the economic consequences of overburdening them (Costanza and Daly, 1992; Daly and Farley, 2004; Pulselli et al., 2008). While the Earth provides many ecosystem services (MEA, 2005), no single indicator can comprehensively monitor humanity's use of these services and inform on the implications of this use in a way that captures the full complexity of these relationships (Bossel, 1999; Ewing et al., 2012; Galli et al., 2012a; Singh et al., 2012).

Decision-makers face the challenge of interpreting complex information from a broad range of sources to inform their policy choices and investment decisions (Moldan et al., 2012; Ness et al., 2007; Warhurst, 2002). In trying to simplify complex systems and issues to facilitate decision-making, key factors may end up being omitted (Ewing et al., 2012). In such a way, considerations of social well-being or environmental integrity may have become sidelined by decision makers focusing primarily on short-term economic or political considerations,

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leading to resource and ecosystem services limitations being ignored as irrelevant to economic planning and national prosperity (Costanza et al., 2014; Wackernagel and Galli, 2012).

However, natural capital's significance in determining a country's success is increasing (Kubiszewski et al., 2013; Niccolucci et al., 2007, 2012) and managing the planet's ecological assets is becoming a central issue for decision makers around the world (Best et al., 2008). A proper understanding of the way human activities interact with the Earth's ecosystems is thus needed (Vörösmarty et al., 2000; Weisz and Lucht, 2009).

Given the unique characteristics of the region – a socio-economic laboratory where the North and the South, the East and the West merge – Global Footprint Network started a Mediterranean Programme in 2012 to support leaders and decision makers in developing a cross-cutting approach to environmental public policy for tracking and managing human demands on nature and their economic implications. Over the past five decades, the Mediterranean region has been shaped by the combined effects of environmental and economic trends: economic growth led to an increase in consumption levels that was compounded by a doubling of the region's population (UNEP/MAP-Plan Bleu, 2009). Similar trends worldwide have led to increasing global resource overuse that is affecting the availability and price of essential natural resources (see EEA, 2011; UNEP, 2012).

An increasing competition for access to resources is occurring at a time in which the economic performance of many Mediterranean countries is weakening. Together, the combination of excessive resource demand, global scarcity, and economic crisis may put the region's resource security at risk (Ahmed, 2013a; Brown, 2012; Grantham, 2011). As many other regions of the world are experiencing similar population and consumption trends, the situation in the Mediterranean holds important lessons for decision-makers across the globe.

By using Ecological Footprint accounting, this paper analyzes the situation of ecological assets in the Mediterranean region and its constituent countries.[1] Potential risks due to higher and more volatile prices that threaten the region's future access to resources and the effects on its economic performance and societal well-being are then discussed.

2. Ecological Footprint Accounting (EFA) methodology

2.1. *Ecological Footprint and biocapacity: two sides of an ecological balance sheet*

All economic activities ultimately depend on ecological assets, such as productive land and marine areas, and the services and resources they produce (Costanza et al., 2014; Daly, 1977, 1990; Georgescu-Roegen, 1971; Perrings, 1987). In the globalised world we live in, access to these key life-supporting resources is often mediated through international trade (Lambin and Meyfroidt, 2011; Mayer et al., 2005; Peters et al., 2011; Weinzettel et al., 2013; Wiedmann, 2009). Up to date, however, few indicators or accounting tools exist – namely Footprint-type of indicators (EC et al., 2014; Galli et al., 2013a) – that are able to track the flow of natural resources from their point of origin to their point of consumption. Ecological Footprint Accounting (EFA) is one of such tools; it provides an "ecological bank statement" for countries and can be used to highlight resource demand and supply trends (therefore identifying eventual overconsumption) as well as potential economic, environmental and social consequences.

Introduced in the early 1990s by Mathis Wackernagel and William Rees (Wackernagel and Rees, 1996), EFA tracks demand for biologically productive land and marine areas to produce the natural resources and ecological services that humans consume (Borucke et al., 2013; Wackernagel et al., 2002). This demand for productive areas is expressed in global hectares (gha), which represent hectares with world average biological productivity (Galli et al., 2007; Monfreda et al., 2004; Galli, 2015).

Although EFA is applicable at scales ranging from single products to the world as a whole, country-level assessments are often regarded as the most complete (Kitzes et al., 2009). The aggregate demand of a country's population is thus called the country's *Ecological Footprint of consumption* (EF_C) and is derived by tracking production, import and export economic activities as reported in Eq. (1):

$$EF_C = EF_P + EF_I - EF_E = \sum_{i=1}^{n} \frac{P_i}{Y_{W,i}} \times EQF_i + \sum_{i=1}^{n} \frac{I_i}{Y_{W,i}} \times EQF_i - \sum_{i=1}^{n} \frac{E_i}{Y_{W,i}} \times EQF_i \quad (1)$$

where:

- EF_P, EF_I and EF_E, are the Ecological Footprint of production, import and export activities, respectively;
- P_i, I_i and E_i are the produced, imported, and exported amount of each product *i* (in tonnes), respectively;
- $Y_{W,i}$ is the world-average (W) annual yield (in t wha^{-1} yr^{-1}) for the production of each product *i*, given by the tonnes of product, *i*, produced annually across the world divided by all areas in the world on which this product is grown.
- EQF_i is the equivalence factor[2] for the land type producing each product *i*.

Since Ecological Footprint is a consumption-based measure tracking both production and trade data, it can provide valuable information on the resources and services embedded in international trade flows and how they affect countries' patterns of production and consumption.

[1] The Mediterranean is here defined as the countries that directly border the Mediterranean Sea plus three countries – Jordan, Macedonia, and Portugal – that are ecologically characterised by biomes typical of the Mediterranean region. For reasons of data availability, countries with populations of under 500,000 are excluded from the analysis. As 1961 is the earliest year for which Ecological Footprint data is available, the analysis is here performed for the period 1961–2010 (this is the last year for which all data are available).

[2] Equivalence Factors (EQFs) captures the difference between the productivity of a given land type and the world-average productivity of all biologically productive land types (see also Galli et al., 2007).