Economic Analysis and Policy 55 (2017) 158–168

Contents lists available at ScienceDirect

Economic Analysis and Policy

journal homepage: www.elsevier.com/locate/eap

Full length article

Global marine fisheries with economic growth

Yogi Sugiawan [a,b], Moinul Islam [a], Shunsuke Managi [a,c,*]

[a] *Urban Institute & Departments of Urban and Environmental Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan*
[b] *Planning Bureau, National Nuclear Energy Agency of Indonesia (BATAN), Jl. Kuningan Barat, Mampang Prapatan, Jakarta 12710, Indonesia*
[c] *QUT Business School, Queensland University of Technology, Level 8, Z Block, Gardens Point, 2 George St, Brisbane QLD 4000, Australia*

A R T I C L E I N F O

Article history:
Received 1 August 2017
Received in revised form 7 August 2017
Accepted 8 August 2017
Available online 23 August 2017

Keywords:
Environmental Kuznets curve
Global marine fisheries
Pooled mean group

A B S T R A C T

This study explores the state of global marine fisheries and empirically analyzes its relationship to economic factors. We apply the pooled mean group estimator method to examine 70 fishing countries for the period of 1961–2010. We use both catch and the estimated size of stock as proxies for marine ecosystems. Our results confirm that economic growth initially leads to the deterioration of marine ecosystems. However, for a per capita income level of approximately 3,827 USD for the catch model and of 6,066 USD for the biomass model, we found beneficial impacts of economic growth on the sustainability of marine fisheries. Over the next two decades, we expect to see a decline in catch and indications of stock recovery.

1. Introduction

The ocean provides an enormous amount of resources that are essential not only for providing basic human needs but also for supporting human wealth. However, the ocean's ability to provide sustainable benefits for human well-being is limited by its regenerative capacity, which is currently deteriorating due to overexploitation, pollution and coastal development (Halpern et al., 2012). This has spurred persistent debates regarding the state of global marine fisheries over the last two decades. Several scientists believe that marine fisheries tend to be unsustainable and that the stock of global marine fisheries is facing threats of serial depletion (Hutchings, 2000; Jackson et al., 2001; Pauly et al., 2002; Srinivasan et al., 2010; Worm et al., 2006, 2007; Zeller et al., 2009). This is indicated by the increasing number of fish species that are classified as overfished or as collapsed (Branch et al., 2011; Froese et al., 2012), by declining catch trends (Pontecorvo and Schrank, 2012; Zeller and Pauly, 2005), and by the declining mean trophic levels of catch (Myers and Worm, 2003; Pauly et al., 1998; Pauly and Palomares, 2005). Additionally, Worm et al. (2006) raised concerns even further by arguing that if current trends of fish over-exploitation continue, global marine fisheries are projected to collapse by 2048. On the other hand, arguments against this view contend that current fishing practices are sustainable and that concerns of the collapse of global marine fisheries are slightly exaggerated and misleading (Hilborn, 2007; Murawski et al., 2007; Pauly et al., 2013). Proponents of this view argue that assessments of stock abundance that use catch data as a proxy are not reliable, as a declining catch does not solely denote a declining stock and vice versa. Gephart et al. (2017) show that in addition to cases of fishery collapse, catch levels are also prone to a broad variety of disruptions and shocks such as natural and man-made disasters, policy changes,

* Corresponding author at: Urban Institute & Departments of Urban and Environmental Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
E-mail address: managi.s@gmail.com (S. Managi).

http://dx.doi.org/10.1016/j.eap.2017.08.004
0313-5926/

increasing fuel costs, and low fish prices. Hence, Worm et al.'s (2006) gloomy projections of the collapse of global marine fisheries, which are based on the assessment of catch time series data, are somewhat misleading (Hilborn, 2007; Murawski et al., 2007).

Regardless of ongoing disputes between these two contradictory views, the amount of fish stock that is being overfished and that has collapsed is rather high. Branch et al. (2011) explain that proportions of fish stocks that are overfished and that have collapsed have been stable in the range of 28%–33% and 7%–13%, respectively. This denotes an occurrence of resource deterioration due to the exploitation of fish that exceeds maximum sustainable yields and the regenerative capacities of oceans. Economists explain changes in resource availability and environmental degradation based on economic factors. In a simple case, resource degradation is a transient consequence of economic development that is inevitable. However, after reaching a certain level of economic growth, the beneficial impacts of economic growth on resource quality will be achieved, ameliorating damages to nature. If this holds for global marine fisheries, then stock decline can be only temporary and it need not be considered a threat to sustainability over the long term, as further economic growth is expected to lead to stock recovery through the institution of better management systems and policies. This is referred to as the environmental Kuznets curve (EKC) hypothesis. Alternatively, we might find a monotonic relationship or even complex relationship that mainly depends on resource stock estimates and catch data.

Most previous studies due to data availability issues have focused mainly on the impacts of economic growth on pollution levels, which act as an inversely proportional proxy for environmental quality (Grossman and Krueger, 1991; Managi et al., 2009). These studies aim to test the existence of the EKC hypothesis and to find a turning point in the economy after which environmental damages will be ameliorated. However, to the best of our knowledge, only a few studies have examined income–natural resource relationships (see for instance Ewers, 2006; Nguyen Van and Azomahou, 2007; Caviglia-Harris et al., 2009; Al-mulali et al., 2015), and none have examined global marine fisheries within this framework. Our main contributions are at least twofold. First, we attempt to estimate the abundance of marine fisheries by relying on a method proposed by Martell and Froese (2013). Second, we apply an economic model to assess the sustainability of global marine fisheries by examining historical relationships between global marine ecosystems and economic growth. We employ time-series catch and estimated stock data as proxies for measuring the state of the global marine ecosystem.

The remainder of this paper is organized as follows. Section 2 describes the current state of global marine fisheries and its association with economic development. Section 3 discusses the research methodology and data used. Section 4 presents the main study findings and an analysis of the results. Section 5 presents the study's conclusions and its policy implications.

2. Economic development and the state of global marine fisheries

The impacts of economic development on resource abundance can be differentiated into three stages (Grossman and Krueger, 1991). The first stage is referred to as the scale effect, which is characterized by a persistent utilization of heavy machinery, indicating a structural change in an economy. At this stage, economic development has negative impacts on the environment and spurs an upward trend of environmental degradation and resource depletion (Panayotou, 1993). However, as incomes increase, the structure of the economy may change, shifting from a resource-intensive economy to a service- and knowledge-based technology-intensive economy (see Tsurumi and Managi, 2010 for more information). This stage is referred to as the composition effect, which is characterized by the development of cleaner industries and by more stringent environmental regulations that limit environmental pressures. Tamaki et al. (2017) show that better resource management practices are beneficial not only for reducing resource exhaustion but also for increasing production efficiency. Finally, a wealthy nation is capable of allocating a higher share of R&D expenditures (Komen et al., 1997), leading to the invention of new technologies that will gradually replace obsolete technologies that tend to be dirtier and less efficient. This stage is referred to as the technical effect, which also contributes to improvements in environmental quality. The cumulative effects of these three different stages of economic development create an inverted U-shaped relationship between economic growth and resource abundance known as the EKC hypothesis.

Although the EKC hypothesis enticingly proposes the existence of a turning point after which further economic growth may lead to environmental improvements, it has some limitations that are worth mentioning. First, the estimated turning point of the EKC can occur amidst very high levels of income. Hence, the beneficial impacts of economic growth on environmental quality are difficult or even impossible to achieve. For instance, Jalil and Mahmud (2009), Bölük and Mert (2015) and Sugiawan and Managi (2016) find a relatively high EKC turning point that lies outside of the observed sample period for the case of carbon dioxide emissions. Second, the EKC hypothesis is not applicable to all environmental/resource problems. For instance, Sinha and Bhattacharya (2017) show a reverse trend of SO_2 emissions, supporting the existence of the EKC hypothesis for 139 cities in India for 2001–2013. However, Nguyen Van and Azomahou (2007) find no evidence of the EKC hypothesis for the case of deforestation in 59 developing countries for 1972–1994. In addition, Liao and Cao (2013) reject the validity of the EKC hypothesis for global carbon dioxide emissions, although they find a flattening trend in carbon dioxide emissions for high-income countries. Another caveat pertains to the fact that the beneficial impacts of economic growth on environmental quality are only temporary. De Bruyn et al. (1998) argue that over the long-term, new technologies will emerge, creating new pollutants and environmental problems. Hence, although the inverted U-shaped relationship is initially observed, a new turning point will appear, leading to a positive correlation between income and environmental degradation. As a result, an N-shaped curve is likely to be observed over the long term. Finally, the composition and technical effects of the economy may also have negative effects on the environment (Tsurumi and Managi, 2010). This might occur