Analysis

Biodiversity conservation, loss of natural capital and interest rates

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ABSTRACT

It is argued that there is neither regular relationship between changes in the level of the market rate of interest and variations in the rate of biodiversity loss nor does such a regular relationship occur between alterations in the market rate of interest and changes in the rate of natural resource extraction. However, some texts suggest otherwise. Microeconomic examples are given in which a rise in the market rate of interest results in increased biodiversity loss and others in which it does not. It is also posited that the rate of biodiversity loss (as well as the rate of natural resource extraction) tends to rise with the level of aggregate investment and aggregate economic activity. It is demonstrated, using macroeconomic models, that the market rate of interest can increase or decrease with a rise in aggregate investment and also with an increase in the level of aggregate economic activity. Therefore, changes in biodiversity loss (and in the rate of natural resource extraction) are independent of variations in the market rate of interest in macroeconomic models.

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1. Introduction

The view is widely accepted in natural resource economics that a rise in the market rate of interest usually increases the rate of exploitation of natural resources (reduces their conservation) because it lowers the net present value of deferring their use, that is their user cost. For example, (Tietenberg, 2003, pp.92–93) states in his widely adopted textbook that "The general conclusions which hold for all models we consider, is that higher discount rates tend to skew resource extraction toward the present because they give the future less weight in balancing the relative value of present and future resource use". Similarly, Colin Clark (1976) has argued that a rise in the market rate of interest tends to increase the rate of exploitation of privately owned natural biological resources and increases the likelihood of their extirpation, other things being held constant.

The purpose of this article is to emphasise that there is no regular general relationship between the level of the market rate of interest and the rate of depletion of natural capital, particularly biological capital. This is most clearly seen when macroeconomic relationships are taken into account. The results depend on the hypothesis that the rate of exploitation of natural resources and the extent of transformation of natural environments tends to rise with the level of aggregate economic activity, for example, as measured by the level of GDP.

Although all growing economic activity tends to have this effect (cf. Georgescu-Roegen, 1971), it is possible that the major impact on the depletion of natural resources, including biological resources, arises from increasing levels of aggregate investment, that is from the positive rate of accumulation of man-made capital.

In developing the above theme, I shall focus mainly on biodiversity loss but the analysis applies to natural resource loss generally. The analysis is developed by first considering the relationship between loss of natural capital (especially natural biodiversity) and the general level of economic activity. The role of man-made capital in that process is given particular attention. Natural resource economists have mostly relied on microeconomic models to claim that a rise in the market rate of interest tends to increase the rate of natural resource extraction. This is true within the assumption of some microeconomic models but it is not true for others. However, the view that a rise in the market rate of interest usually results in accelerated extraction of natural resources and growing biodiversity loss is shown to be dubious when macroeconomic factors determining the market rate of interest are taken into account. It is shown that there is no regular relationship between the level of aggregate investment, the level of aggregate economic activity and the market rate of interest. In some circumstances, it is found that the market rate of interest increases as the level of aggregate investment and economic activity rise and vice-versa. Therefore, when macroeconomic considerations are taken into account, accelerated natural resources extraction and biodiversity loss can easily occur when market rates of interest are rising or falling. After this is established, a discussion of the results and the conclusions follow.

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2. The Rate of Natural Resource Depletion and Biodiversity Loss Depends on the Level of Aggregate Economic Activity and Investment

Most neo-Malthusian economists hypothesise that natural resource depletion and deterioration of natural environments tends to increase with the level of economic activity, for example, the growth of GDP (see, for example, Daly, 1980). At the same time, it is recognised that this is not an exact relationship. As pointed out by Ehrlich (1989), for instance, it is possible to have economic growth without increasing environmental deterioration in special circumstances, for example, if new technologies are developed and applied that are less damaging to natural environments than earlier ones and if everything else remains unchanged. However, a problem is that other things do not always remain the same. A reduction in natural resource utilisation per unit of aggregate output is often more than offset by a large increase in output so that consequently, the total use of natural resources rises (cf. Tisdell, 2001). Neo-Malthusians, such as Paul Ehrlich, claim that the rate of environmental deterioration depends basically on the level of human population, consumption (or economic production) per head of population and the environmental impact of the technology used in economic production. Despite technological improvements, it is clear that globally the environmental and natural resource footprint resulting from economic growth globally has accelerated with the passage of time. One of the consequences of this has been a loss of natural biodiversity.

For example, the Millennium Ecosystem Assessment (2005, p.2) concluded that "Virtually all Earth's ecosystems have been dramatically transformed through human actions". Its main finding was as follows: "Human actions are fundamentally changing the diversity of life on Earth, and most of these changes represent a loss of biodiversity. Changes in important components of biological diversity were more rapid in the last 50 years than at any time in human history. Projections and scenarios indicate that these rates will continue or accelerate in the future" (Millennium Ecoystem Assessment, 2005, p.2). Most of this loss in biodiversity can be attributed directly or indirectly to continuing economic growth globally.

As indicated by early neoclassical theories of economic growth (e.g. Solow, 1956; Swan, 1956), investment in man-made physical capital (capital accumulation) has been a significant contributor to economic growth, but increases in the quantity of labour, improved technology, greater investment in education and other factors (such as economies resulting from greater market size) have also played a very important role in promoting economic growth. Denison (1962) found that the latter qualitative contributors to economic growth have risen in significance with the passing of time to become more important than the quantitative factors (physical capital and labour) as contributors to economic growth. Prior to this, Deane (1955) argued that the prime-mover in Britain's economic growth resulting in the Industrial Revolution was technological progress rather than a high savings and investment ratio in Britain.

In any case, it seems that a combination of factors contribute to the continuing transformation of natural ecosystems by humans and consequent biodiversity loss. Both the availabilities of labour and man-made physical capital provide means to transform natural ecosystems. In addition, technological change (for example, growing knowledge about more effective methods to extract economic production from natural resources and ecosystems), greater education (by transmitting skills and knowledge to facilitate natural resource extraction), and increases in market size (for example, as a result of the processes involved in economic globalisation) tend also to contribute to the growing transformation of natural ecosystems, and to biodiversity loss. They facilitate extended as well as intensified economic utilisation of natural resources, including natural environments. Myers (1981) provides an example of how expanding international trade (market extension) results in the loss of natural ecosystems and Tisdell (2003) has identified several ways in which globalisation (market extension) and technological change have contributed to loss of genetic diversity in livestock. Similar processes also contribute to biodiversity loss in crops.

Swanson (1994) was among the first economists in modern times to emphasise the impact of the economic transformation of natural ecosystems on the loss of natural genetic diversity. Habitat loss is the primary cause of biodiversity loss in the wild (Millennium Ecoystem Assessment, 2005). However, the significance of such changes for loss of species was noted much earlier. For example, Harting (1880, p. 209) writing about the extinction of wild animals in Britain observed:

> "Lake and moor have become fields of yellow grain; forest has been changed into morass, morass into moor, and moor again into forest, until finding nowhere to rest in peace, the dear, the beaver, the reindeer, the wild boar, and the wolf, have become in Britain amongst the things that were."

While loss of habitat due to land and water conversion by humans (mainly for economic reasons) is not the only source of biodiversity loss in the wild, it is probably the most important factor contributing to such loss (see Millennium Ecoystem Assessment, 2005, p.8). Other factors include climate change, the introduction of invasive species, overexploitation of wild populations or their destruction as pests, and pollution. Virtually all these sources of biodiversity loss are due to a combination of factors, but economic factors seem to be important in all cases. The Millennium Ecosystem Assessment (2005, p.42) states that indirect drivers of biodiversity loss include demographic, economic, socio-political cultural and technological factors.

Aggregate economic investment plays a major role in biodiversity loss in the wild. Usually, land and water conversion involves an initial investment (for example, for land clearing and the establishment of agriculture) and is facilitated by the use of physical capital and new technologies. A similar situation prevails for the increased exploitation of wild species or their destruction as pests. Climate change and increased pollution are influenced by the nature of economic growth which in turn, is related to the level and nature of economic investment to a significant extent. Because much new technology is embodied in new physical capital and this new capital is often required in order for societies to take advantage of improved education and skills, the level of investment still appears to be of prime significance for economic growth and biodiversity loss. Thus, because of interdependence of the growth variables, the level of aggregate net investment still remains a major determinant of economic growth even if improved education and technological advances have become more important as contributors to economic growth as, for example, postulated by Denison (1962).

It is observed in the Millennium Ecosystem Assessment (2005, p.4) that the distribution of species on Earth is becoming more homogenous and at the same time, the number of species and their varieties is declining (cf. Tisdell, 1999, Ch. 4). This is true not only for wild species, but is also so for varieties of cultured species. Continuing investment increased knowledge and technological change have all contributed to this process of genetic loss (cf. Tisdell, 2003).

In the light of the above considerations, I argue in this article that the level of the market rate of interest has neither regular relationship to the rate of biodiversity loss nor to the rate of exploitation of natural resources. This is so when factors determining the level of the market rate of interest are taken into account in macroeconomic models. The established view that higher rates of interest usually accelerate biodiversity loss and the rate of extraction of natural resources has evolved from the consideration of particular microeconomic models specified using partial analysis. This dominant hypothesis needs to be reconsidered in view of the implications of macroeconomic models, and when some modifications are made to the microeconomic models normally used to illustrate this hypothesis. This will now be shown.