



Ecological Macroeconomic Models: Assessing Current Developments



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ABSTRACT

Our society faces a dilemma. While continued economic growth is ecologically unsustainable, low or negative rates of economic growth are accompanied by adverse social impacts. Hence there is a need for macroeconomic tools that can help identify socially sustainable post-growth pathways. The emerging field of ecological macroeconomics aims to address this need and features a number of new macroeconomic modelling approaches. This article provides (1) a review of modelling developments in ecological macroeconomics, based on the literature and interviews with researchers, and (2) an analysis of how the different models incorporate policy themes from the post-growth literature. Twenty-two ecological macroeconomic models were analysed and compared to eight policy themes. It was found that environmental interactions and the monetary system were treated most comprehensively. Themes of income inequality, work patterns, indicators of well-being, and disaggregated production were addressed with less detail, while alternative business models and cross-scale interactions were hardly addressed. Overall, the combination of input-output analysis with stock-flow consistent modelling was identified as a promising avenue for developing macroeconomic models for a post-growth economy. However, due to the wide interpretation of what “the economy” entails, future research will benefit from employing a range of approaches.

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1. Introduction

As many authors have argued in this journal and beyond, the large-scale degradation of ecosystems requires a fundamental transformation of our economic system away from continuous economic growth (Jackson, 2009; Martínez-Alier et al., 2010; Victor, 2008). Kallis et al. (2012) distinguish between three strands of interacting literatures arguing this case, namely “steady-state economics”, “the new economics of prosperity”, and “degrowth”. All of these literatures aim to develop a vision for a prosperous economy that does not rely on economic growth. For simplicity they will be referred to together as “post-growth” approaches in this study.

The approaches that are collected here under the term “post-growth” differ in their visions of what a sustainable and prosperous economy would look like and what kind of material living standards would be possible under conditions of environmental constraints. However, as concluded by Kallis et al. (2012), the three approaches advocate very similar policies and institutions. For the purpose of this study it is these similarities that are considered important, rather than the differences, so that the grouping of the three approaches under the term of “post-growth” is considered justified.

It is important to say that the goal of these approaches is not zero (or declining) GDP growth. The goal is to reduce and then stabilise material and energy use within ecological limits (O'Neill, 2012, 2015a). Due to the high degree of coupling between resource use and economic activity (Ayres and Warr, 2009; Wiedmann et al., 2015), the result may be a stabilisation (or decline) in GDP, but this is not the goal *per se*. It is, however, a consequence that post-growth economics needs to be able to deal with.

One of the most important challenges that all post-growth visions face is the fact that in the current system negative or low rates of economic growth are generally associated with adverse social impacts, such as large-scale unemployment (Kallis et al., 2013). This challenge is difficult to address as there is a lack of macroeconomic frameworks and modelling tools to test how proposed post-growth policies could produce a stable transition and viable alternative to economic growth (Jackson et al., 2015). There is a need to develop new macroeconomic modelling approaches or adapt existing ones to investigate potential post-growth futures.

In this context it is interesting to observe that over the past few years a new literature on “ecological macroeconomics” has emerged that is concerned with developing macroeconomic theory and models suitable for analysing sustainability challenges (e.g. Rezaei et al., 2013; Røpke, 2013). While the modelling research in ecological macroeconomics is only partially driven by the challenge of modelling a post-growth economy, the models that are being developed may still constitute valuable

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tools for investigating post-growth futures. The literature on ecological macroeconomic models is growing rapidly and includes several new modelling approaches. However, there has so far been no systematic review and assessment of the characteristics that these new models possess and the types of economic changes they are capable of modelling. This study aims to fill this gap by exploring two interlinked research questions:

- 1) What kind of macroeconomic models are currently being developed in the ecological macroeconomics literature?
- 2) What is the capacity of these models to explore and assess policies proposed for a post-growth economy?

The first research question is addressed through a review of current models, based on the emerging literature and interviews with leading researchers. The second research question is approached by comparing the models against policy themes derived from the post-growth literature. This comparison serves to identify which aspects of the post-growth agenda are represented and how they are modelled.

A key motivation for conducting this study is the rapid development of the field of ecological macroeconomic modelling. As there are many researchers working on many new models, a systematic review of the models that are being developed is a much needed resource for researchers in both the post-growth and ecological macroeconomics communities if they are to engage with the latest work that is being done. In addition, this study makes an important contribution to the research in both fields by identifying important research gaps and priorities.

To focus the review, this study assesses current models against a set of themes derived from policies proposed in the post-growth literature. This frame of analysis was adopted for three reasons. First, although macroeconomic models seem to be a very useful tool for exploring post-growth pathways, a better understanding of the extent to which different post-growth policies can be modelled is required. Second, even though some members of the ecological macroeconomics community may not subscribe fully to the normative vision of the post-growth literature, understanding how to manage an economy with stagnating or even declining GDP is becoming increasingly important as more and more economies (particularly in Europe) struggle to achieve growth. Thus many of the policies proposed to manage an economy without growth, such as a reduction in income inequality or reform of the monetary system, are becoming increasingly relevant to researchers in the ecological macroeconomics community. And third, the research communities on post-growth and ecological macroeconomics already overlap and are increasingly engaging with each other, as could be witnessed at both the 11th International Conference of the European Society for Ecological Economics held at the University of Leeds in 2015, and the 5th International Degrowth Conference held in Budapest in 2016.

There are a small number of existing studies that have reviewed the field of macroeconomic modelling in relation to sustainability topics: the reviews by Scricciu et al. (2013) and Pollitt et al. (2010), in particular, stand out. However, our study goes beyond previous work in two important ways. First, it focuses explicitly on the ability of models to represent post-growth policies rather than general sustainability aspects. Second, it focuses on models developed in the ecological macroeconomics literature which are not featured prominently in other reviews, especially since many of them have only been published very recently.

With this in mind, the remainder of this article is organised as follows. Section 2 provides a brief review of the emerging field of ecological macroeconomics to give the context in which new models are being developed. This review is followed in Section 3 by a description of the methods used for collecting and analysing the data on post-growth policies and macroeconomic models. Section 4 presents and discusses the results of the analysis. It includes an overview of post-growth policies and important model elements, a review of the modelling approaches employed in ecological macroeconomics, and an assessment of how the

modelling approaches map onto the model requirements derived from post-growth policies. Section 5 concludes.

2. Ecological Macroeconomics

In recent years, and in the wake of the financial crisis, there has been increasing interest in macroeconomic topics among ecological economists, an area that has been termed by some as “ecological macroeconomics” (e.g. Jackson, 2009; Rezai et al., 2013). This interest is reflected in a special issue on macroeconomics recently published in this journal (Rezai and Stiglitz, 2016). As the term “ecological macroeconomics” has only emerged recently there is not yet a mutually agreed definition of what it entails. However, when reviewing the literature three important themes can be identified.

The first theme, which has also informed the framing of this study, is the need to manage an economy without growth. Early roots of the concept of ecological macroeconomics can be traced back to Daly (1991) who called for a research agenda on “environmental macroeconomics”, while Jackson (2009) spoke explicitly of the need for an “ecological macroeconomics”. Another early work that is regularly cited as a seminal contribution to ecological macroeconomics, even though it did not use the term, is the modelling study by Victor and Rosenbluth (2007). All of these authors are strongly associated with the post-growth literature, and have contributed to ecological macroeconomics from the beginning. For researchers approaching ecological macroeconomics from a post-growth perspective, the emphasis is not only on developing new analytical approaches for understanding the economy, but it is also about a normative redefinition of the economy’s purpose. For example, Røpke (2013, p. 50) asserts a need to redefine “what is meant by a healthy national economy” and sets out several challenges that ecological macroeconomics can help address. These challenges include environmental problems, large-scale inequality, global security concerns, and financial instability.

However, not all of the research in the newly emerging field of ecological macroeconomics is concerned with the aims and proposed policies of the post-growth literature. The second important theme is a wider emphasis on developing new analytical methods and models that can represent the dependence of the macroeconomy on the natural environment (Harris, 2008; Fontana and Sawyer, 2016). Important concerns include how macroeconomic processes, such as unemployment, growth and inflation, depend on natural resources and produce wastes, and how environmental damages feed back into the macroeconomy (Dafermos et al., 2017). For example, Rezai et al. (2013) stress that environmental policies can potentially have counterintuitive macroeconomic effects, such as macroeconomic rebound effects from higher investment. Taking a systems perspective, Røpke (2016) argues that ecological macroeconomics needs to go beyond studying the systems of resource extraction and waste management at the boundaries of the economic system and has to consider the social processes that indirectly drive environmental impacts, including economic systems of production, trade, and money.

The third important theme that emerges in the ecological macroeconomics literature is the combination of post-Keynesian and ecological economics approaches. In general authors in the field of ecological macroeconomics reject the orthodox growth models that are often used to analyse environment–economy interactions (e.g. Edenhofer et al., 2014; Nordhaus, 2008), largely on the basis that the underlying assumptions of orthodox models are fundamentally flawed. These assumptions include the idea that rational, utility-maximising, or profit-maximising behaviour by firms and consumers in markets will lead to an optimal, equilibrium growth path (Taylor et al., 2016). Instead, Rezai and Stiglitz (2016) stress that ecological macroeconomics should build upon the insights gained in other heterodox economic fields, such as Marxist, neo-Ricardian, and evolutionary economics. So far it is mostly the work of post-Keynesian authors that has been integrated into ecological macroeconomics, as post-Keynesian and ecological economics share many basic assumptions (e.g. Gowdy, 1991; Kronenberg, 2010b).

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