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Ecological macroeconomics: Introduction and review☆

1. Introduction

The Great Recession of the past years has brought macroeconomics back. Many of the recession's phenomena, causes and consequences alike, cannot be understood using solely microeconomic decision-making. Over the past decades the economics profession has pursued the implications of rational choices and enshrined them in so-called "micro-foundations" as a hallmark of modern economic theory. By focusing on the choices and actions of individual consumers, firms, or the government, however, one can easily miss important determinants of the economic system which only arise at the meso- or the macroeconomic levels where institutions, coordination, and complexity in general are important and sometimes even can take on a life of their own. To lesser extent, ecological economics has fallen prone to similar pitfalls by mostly focusing the unit of investigation on low-level, small-scale subsystems of the economy. There are, of course, notable exceptions including the early contributors Boulding and Georgescu-Roegen and the general interest of ecological economists in the field of (ecological) macroeconomics has been increasing.

We find the neglect of ecological macroeconomics, and ecological growth theory in particular, surprising since its need springs from the simple and most basic tenet of ecological economics: the world is finite. As the scale of the world economy continues to grow, humanity is increasingly confronted with the planet's biophysical limits. Ecological economics has been pointing to this unsustainability of economic growth incessantly. Progress on these questions of throughput and economic growth has been made in terms of collecting and implementing the necessary empirical data in input–output analysis and by pointing to unsustainable practices in the consumption and production of material goods. Ecological economists have also been successful in demonstrating the inadequacy of conventional macroeconomic thinking in addressing the fundamental social problems a transition to sustainability confronts. Neoclassical macroeconomics assumes that setting caps and price signals is sufficient to steer the market economy towards a sustainable pattern of growth and resource use. Others believe that a more far reaching transition is fundamental, requiring serious rethinking of the growth paradigm and the associated standard economic assumptions and the consideration of societal institutions and power relations.

Meanwhile projected growth rates of resource use remain positive and GDP growth remains an unquestioned imperative for macroeconomists throughout the world. This focus on rising consumption and material well-being is understandable in less developed countries where labor productivity growth is deemed a necessary condition for the alleviation of poverty and the advancement of development. However, even in OECD countries most macroeconomists continue to see growth as a socially stabilizing necessity in times of record unemployment (both in magnitude and duration) and faltering aggregate demand. The Great Recession painfully reminds us that reductions in economic activity, while providing breathing space for the biophysical system, bear socially unacceptable consequences. Social institutions do not have to rely on an expanding economic system and exactly how to reorganize our societies to cut the link between growth and welfare is central to ecological macroeconomics.

In order to formulate consistent policy proposals for the economy as a whole, ecological economic theories need to take in essential macroeconomic thinking. Dominant macroeconomic theory takes a supply-side approach, which implies full utilization of all resources by assuming rational behavior and well-functioning markets. Under omnipresent full employment, however, many of the social problems associated with the fundamental transformation to sustainability do not arise. Post-Keynesian growth theories have been applied to develop less-rigid macroeconomic frameworks to allow disentangling of the policy implications advocated by ecological economists for the economy as a whole. Sustainable consumption, reduced working time, and "green" investment are examples of such concepts. However, the macroeconomic implications of these policies are not immediately obvious: If consumption is reduced, saving increases. Higher saving can lead to lower output and employment due the Paradox of Thrift. An increased saving ratio can, however, also feed into higher investment and higher economic growth. Reducing working time can spur technological progress, because firms want to adopt labor-saving technologies, potentially leading to higher output due to higher labor productivity. "Green" investments can help to reduce the impact of economic activity on the environment, but they themselves can spur economic activity along the lines of a macroeconomic rebound effect.

There is encouraging progress on merging ecological with macroeconomic thinking. In this introduction we trace the origins and recent developments of this progress. We also highlight where we believe further steps need to be taken: growth and distribution, sustainable organization of real production and finance, and social well-being. Non-neoclassical economists have been developing theories on all of these issues without resorting to an optimizing, full-employment framework for a long time. Such theories include Marxist, neo-Ricardian, and evolutionary economics. Ecological economists should, by standing on their

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shoulders, strengthen their own theories and devise practical and comprehensive policy recommendations.

While not represented in this special section, it must be noted that, concurrently to ecological macroeconomics, the Degrowth movement has been evolving out of the political ecology school and asking many of the questions that are relevant to ecological macroeconomics. The focus of Degrowth has been less on the current economic structures and more on the societal transformation necessary for sustainability with a particular emphasis on power, the social relations of production, and conflict. While there exist differences in their normative approaches and their research focus, degrowth and ecological macroeconomics share many of the immediate policy proposals for sustainability.[1]

2. The Historical Origin and Evolution of Ecological Macroeconomics

The origins of ecological macroeconomics date back to the origins of economics itself. Given the importance of agricultural land in the feudal societies, the Physiocrats saw it as the predominant determinant of the wealth of nations. Even Adam Smith, who saw a nation's wealth in the potential of the division of labor in a country's rising manufacturing sector, recognized landed nobility as an important class in the distribution of income. In the theories of the Classical Political Economists David Ricardo and Thomas Malthus, the carrying capacity of land is the ultimate limiting factor of an economy's scale.

With the rise of industry and the continuous decline of agriculture's share in GDP, land fell by the wayside of macroeconomics. Questions of sustainability were reduced to scarcity considerations in neoclassical models (Dasgupta and Heal, 1974; Solow, 1974; Stiglitz, 1974) and less utilitarian analysis based on systems modeling (Meadows et al., 1972). Over the course of the 1980s, however, it became clear that the defining constraints for material throughput would also be the planet's sinks and not just its sources with the ecological economists' emphasis on throughput as an analytical link between the two. It was in this context that Daly introduced the concept of ecological macroeconomics as "[t]he physical exchanges crossing the boundary between system and subsystem constitute the subject matter of environmental macroeconomics" (Daly, 1991, p. 35). Daly also understood that limits to growth would conflict with other policy goals, most importantly an equitable distribution of income and outlined how such a joint solution for social and ecological sustainability could be achieved.[2] In terms of growth theory, ecological economists have been arguing that economic growth can only be understood in terms of material throughput and, in particular energy (Ayres and Warr, 2009).

The ideas, questions, and theories outlined by Ayres, Daly, and others were not taken up for a considerable length of time. Instead the debate within ecological economics focused on measuring and establishing indicators such as the "green" satellite accounts (in the form of green material flow accounting), the environmental Kuznets Curve, natural capital, and the application of moral philosophy to ethical judgments of resource use (Harris, 2001). Questions of scale were addressed using resulting indicators such as the footprint and Human Appropriation of Net Primary Production (HANPP) and entered only cursorily in discussions of the IPAT and Kaya identities where scale enters implicitly through affluence and population. The level and growth of productivity and income per person are, however, endogenous variables which macroeconomics with its many varieties tries to explain. A suite of papers has tried to approach the question of ecological macroeconomics, as defined by Daly, by introducing a notion of "optimal" scale in the simple textbook IS-LM. The carry capacity of the environment is represented as a stylized EE schedule which traces "the physical exchanges crossing the boundary between system and subsystem" in Daly's words and the IS-LM-EE model constitutes a model for ecological macroeconomics, albeit with the simple insight that higher levels of output have to be accompanied by higher levels of resource productivity and lower levels of waste in order to keep throughput constant (Heyes, 2000; Lawn, 2003; Sim, 2006).

The collapse of the world economy and the ongoing Great Recession revived the interest in economic growth and its social necessity and desirability, and alternatives. Recent contributions can be seen as distinct from the previous literature on the (optimal) scale of the economy in following the macroeconomic tradition and focusing on the (de-)growth rate rather than the absolute size of the economy. This refocusing of the debate is in part due to the recognition of growth as an endogenous variable and the effects of growth on policy- and welfare-relevant variables such as employment, income, and the stability of the economy and its financial system. Another reason for the growing interest in macroeconomics is the ecological economists' skepticism towards the power of innovation and technological fixes. Most (neoclassical) environmental economists would assume that the establishment of 'right' prices, i.e. those reflecting scarcity, through permits, taxes, or direct regulation, suffices for the invisible hand to direct resources towards energy- and resource-saving technologies and "green" growth. Ecological economists are closer to the Post-Keynesian economists in their understanding of deep, fundamental uncertainty and endorsement of the Precautionary Principle: as innovations can fail and have unintended consequences. The issue of scale remerges and needs to be understood at its root. Ecological macroeconomics, therefore, is necessarily concerned with growth theory although recent contributions discussed below also branch out into monetary, distributional, and welfare economics.

Given their methodological overlap, ecological economists reached into the (Post-)Keynesian growth toolbox early on.[3] Victor and Rosenbluth (2007), Victor (2008), Jackson (2009) are early contributions to this new variety of ecological macroeconomics trying to understand how throughput (usually with a focus on fossil fuel emissions) can be stabilized at sustainable levels in macroeconomic models of output and growth. Given that all components of aggregate demand (consumption, investment, government, and, where relevant, net exports) are considered simultaneously and that standard policy tools such as tax and employment policy are used as policy instruments, these contributions are using standard macroeconomic reasoning. At the same time, Post-Keynesian economists have been considering the question of resource use (mostly climate change) in their theoretical work and policy proposal. While some of this work viewed climate change as a welcome opportunity for public infrastructure expenditure during the recession (so-called "Green New Deals") and as means of restarting growth, there have been more earnest attempts to engage with the community of ecological economics.[4]

3. Current Frontiers in Ecological Macroeconomics

Ecological macroeconomics has made significant progress over the past years and it is rapidly expanding its understanding of current macroeconomics. Two of the most important developments in macroeconomics over the past decades have been the study of the connection between the distribution of income and the growth of the economy

[1] For an introduction to Degrowth see D'Alisa et al. (2014) and the special section on The Economics of Degrowth (Ecological Economics, 2012, vol.84) and Degrowth: Form Theory to Practice (Journal of Cleaner Production, 2013, vol. 38).

[2] Somewhat surprisingly, Daly (1991) approaches the policy problem from a market-based view, arguing that the questions of allocation, distribution, and size can be separated such that allocation can be left to the market and distribution and scale could be addressed through 'appropriate' instruments. See also the critical discussion on optimal scale and the inseparability of policy instruments in Lawn (2001).

[3] The common ground and 'visions' between economists of ecological and Post-Keynesian type have been long been argued for (Gowdy, 1991; Gowdy and Erickson, 2005; Spash and Schandl, 2009; Kronenberg, 2010). Concrete movements have only been undertaken more recently (Holt et al., 2009; Rezai et al, 2013). See also Fontana and Sawyer (2016), Jackson and Victor (2016), and Taylor et al. (2016) in this special issue.

[4] The work on the climate policy and the macroeconomy by Terry Barker and his associates from Cambridge Econometrics is the big exception and deserves special notice.