

Why do Environmental and Ecological Economics Diverge? Comparison of the Ideological, Institutional and Scientific Backgrounds of the Main Actors

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Abstract

Environmental economics and ecological economics became established scientific fields as a result of the growth and the success of the environmental movement in the 1960s and 1970s. Using the strong programme in the sociology of scientific knowledge and the general theory of scientific/intellectual movements, this article compares four pairs of scholars (two pairs of scholars appropriated for these fields and fields' founders during the emergence and establishment of the fields). The article depicts how their institutional, ideological and scientific backgrounds contributed to the divergence of these fields. Practitioners of environmental economics and ecological economics were influenced by different strands of the environmental movement. Environmental economics has epistemological and institutional links with environmentalism and ecological economics with ecologism. Different types of interdisciplinarity were used in these fields—a bridge building type of interdisciplinarity in the case of environmental economics and a restructuring and integrative in the case of ecological economics.

Keywords: environmental economics, ecological economics, environmental revolution, green ideology, interdisciplinarity, scientific fields

Introduction

When in the 1920s the Nobel laureate chemist Frederick Soddy made inroads into the study of economics, he was met with strong resistance from leading economists. Soddy's use of the laws of thermodynamics in the study of economics remained unknown to future economists who applied the laws of thermodynamics (Daly, 1996). After Nicholas Georgescu-Roegen in the early 1970s published his work emphasizing the significance of the second law of thermodynamics in understanding the place of the economy in the natural system, this became one of the starting

points for the emergence of a new field of ecological economics in the following decade and a half.

Also in the 1920s, another prominent scholar wrote about the need to tax the negative consequences of building a factory and of erecting buildings which tend to "injure the health and efficiency of the families living there" (Pigou, 1920: 162). Unlike Soddy, the author of this proposal was an influential economist, Arthur Cecil Pigou. His tax proposal, now known as the Pigouvian tax, is one of the founding tenets of environmental economics and it reached its institutional climax in



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1975 when it became the basis of the OECD's environmental policy (Pearce, 2002). This fifty-year time span demonstrates how ideas that had limited relevance at the time of their construction (i.e. in the early days of social interest in environmental problems and interdisciplinarity) became far more influential in another period. The relevance of these ideas grew with profound political and social changes, which were the consequence of the 1960s environmental revolution. Nevertheless, their initial placement in early 20th century economics influenced their different trajectories and distinct places in the realm of contemporary scientific knowledge. Soddy is analysed here as the harbinger of ecological economics and Pigou of environmental economics.

Environmental economics and ecological economics are two scientific fields with, at first glance, a rather similar basic goal of combining the study of environmental degradation with the analysis of economic systems. However, they are often at odds with each other as the different ideological backgrounds and scientific cultures of some of their protagonists have prompted them to analyse relations between the economy and environment through different perspectives and with different policy recommendations. Environmental economists are primarily involved in determining the value of nature, while ecological economists concentrate on placing the economic subsystem within the very limited ecological boundaries of the Earth. The core of environmental economics are negative externalities and "the environmental problem is cast in terms of an interaction between people (economic agents), that is, nature and environment are only implicitly described" (van den Bergh, 2001: 15). On the other hand, ecological economics "generally assumes a longer time horizon (...) and (...) pays more attention to cause-effect chains, interactions and feedback between natural and human-economic system" (van den Bergh, 2001: 15).

It is argued here that environmental economics and ecological economics both became established scientific fields as the result of the growth and the success of the environmental movement, although they were influenced by different strands of this movement. Despite considerable differences, both fields developed out of the same historical context of the 1960s environ-

mental revolution and the subsequent greening of socio-political, scientific and economic spheres. At first there was a good deal of cooperation and common ground among scholars of the emerging fields during the end of the 1960s and beginning of the 1970s. However, as both fields became established and institutionalized, scholars, who were influenced by disparate ideological and epistemological backgrounds, became more involved in drawing boundaries between the fields. The establishment of two separate scientific fields gives evidence to the importance of environmental revolution, its diversity and the new scientific landscape.

The developments of these two fields have rarely been compared without taking sides in their debates. When they have been compared, it is usually by protagonists of one or the other field, which usually implies a critique of the opposing field. Turner (2002) rather neutrally compared both perspectives; regarding their ideological backgrounds, he noted a collectivistic perspective in ecological economics and an individualistic one in environmental economics. Turner (2002: 1001), moreover, called for a joint pluralistic approach which could lead to interdisciplinary insights. Historical comparisons encompassing ideological positions and institutional and epistemological contexts in which some of the most prominent predecessors and founders of these fields worked are missing.

Theoretical framework

The emergence of new ideas in economics and the outline of the history of ecological and environmental economics are analysed here from the perspectives of science and technology studies (STS) and ideology studies (for a combination of these two perspectives see Bud, 2017). Ecological economists invoked some of the central concepts of STS such as the Kuhnian scientific revolution (Daly, 1980, 1996) and Funtowicz and Ravetz's post-normal science (Munda, 1997) when arguing for their field. While defending their field's dominant position, environmental economists have argued for a different, less radical, understanding of science.

A comprehensive analysis relying on STS theories was given by Røpke (2004, 2005)

who analysed the development of ecological economics using Whitley's theories of research fields and concluded that ecological economics is a fragmented adhocracy. Pearce (2002), on the other hand, wrote about the intellectual history of environmental economics in which he analysed the history of major concepts of that field and the influence of different economics fields on its emergence. Røpke's and Pearce's different approaches to the analysis of knowledge creation also imply different roads to the establishment of each field and the present article draws on these texts. To present the establishment of ecological economics, Røpke demonstrated how a small number of very loosely connected economics mavericks and ecologists devoted to systems thinking formed a completely new field. To understand the establishment of environmental economics, one has to understand how a growing concern for environmental issues popularized the concept of externalities and expanded the scope of already, more or less, established economic fields such as welfare economics and natural resource economics.

It is argued here that the scholars' social and ideological backgrounds contributed to the emergence of new ideas that form the bases of both fields' theories. Social causes of the emergence of both fields are analysed through external and internal causes. External causes relate to ideological, political and economic changes that played out in a broader social setting, namely the environmental revolution. Internal causes were profound changes affecting the organization of science during the last hundred years.

The individual scientific endeavours of actors who created both fields happened in social contexts and had strong political and ideological backgrounds that steered the development and reception of new theories. Bloor's (1991) tenets of the strong programme in the sociology of scientific knowledge are followed in order to analyse how new ideas that form the bases of the two fields emerged. The analysis is causal and explores social causes that brought about new states of knowledge in the field of economics.¹ Also, the analysis is impartial as equal weight is given to both fields since both of them require explanation. Neither is considered to be true or false, rational

or irrational, not least while economics is a multi-paradigmatic science. Bloor (1991: 53) claimed that "ideologies rather than the totality of our real social experience (...) control and structure our theories of knowledge".

Ideological discourses of some of the most influential authors of both fields are therefore analysed here. Ideologies are treated here as an indispensable element of political but also of social and scientific life as they enable a coherent understanding of the world, and they also guide social actors towards action (Freeden, 1996). The latter feature was important in the development of environmental and ecological economics as scholars from both fields gave strong policy recommendations. The emphasis in this research is on the analysis of concepts of green ideology that steered the development of new fields. Freeden (1996: 527) argues that variants of green ideological discourse have common core concepts such as nature becoming "an overriding factor in guiding human conduct" or "the *valued preservation* of the integrity of nature and of forms of life (...) usually associated with a recognition of the finiteness of resources and the irreversibility of some kinds of intervention in nature". Freeden also mentions adjacent concepts of green ideology such as community, decentralization and direct democracy, and equality regarding equal access of the South or future generations to global resources. However, Freeden sees green ideology as a thin ideology, i.e. it does not offer answers to all of the questions of social and political life and can be incorporated in other ideologies. On the contrary, Humphrey (2013) emphasizes more policy oriented core concepts, such as radical democratization, ecological law (which can be contrary to conventional laws) and non-violence, in order to claim that green ideology is more than just a thin ideology and that it has the potential of being a thick ideology, i.e. an ideology that can provide most of the guidance for social and political life.

Especially useful here is Dobson's (2016) differentiation of ecologism and environmentalism, because it coincides with the differences between ecological and environmental economics. Dobson states that "*environmentalism* argues for a managerial approach to environmental problems,

secure in the belief that they can be solved without fundamental changes in present values or patterns of production and consumption". On the other hand, "ecologism holds that a sustainable and fulfilling existence presupposes radical changes in our relationship with the non-human natural world, and in our mode of social and political life". Dobson argues further that "environmentalism is more easily incorporated into other ideologies. So we can imagine a 'liberal environmentalism' or a 'socialist environmentalism', but it is harder to imagine a liberal or a socialist *ecologism*" (Dobson, 2016: 37). Thus, environmentalism is a thin ideology and ecologism is a thick ideology that radically challenges other ideologies. Moreover, the scope of both fields' engagement with broader social challenges is quite different. The breadth of ecological economics' policy proposals by some protagonists resembles the morphology of thick ideologies.

Methodology

Group and personal ideologies are reflected in the ideas and actions of scholars, but these ideas are also under the influence of changing social and institutional contexts in which scholars act. It is in these complex interactions that new ideas emerge, so similar ideologies and similar institutional and social contexts are not mechanistically translated into similar ideas. Different social, political and institutional contexts in which both fields developed will therefore be presented.

Social causes are analysed through the cases of individual scholars compared with their counterparts (see Table 1). Pairs of scholars represent two fields in the same development phase and in a similar historical period, but each scholar belonged to different milieus that influenced their ideas. The comparison of scholars appropriated for fields (i.e. identified as significant predecessors) can indicate the ideological preferences of the authors of fields' prehistories. These authors were interested in drawing boundaries between the two fields through narrating communities (Hodgson, 2006). Boundary-work "imprints the formation and institutionalization of disciplines, specialties, and theoretical orientations within science" (Lamont and Molnár, 2002: 179). The

works of Martinez-Alier (1987) and Sandmo (2015) are used as prehistories of ecological economics and environmental economics, respectively. Sergei Podolinsky and Soddy received the most coverage in the history of the roots of ecological economics written by Joan Martinez-Alier, one of the leading ecological economists. Sandmo linked Pigou with the foundations of environmental economics and Dupuit is the earliest scholar mentioned by Pearce (2002). These four scholars are accordingly analysed here. These prehistories projected the self-image of these fields to earlier scholars (Hodgson, 2006: 175), as often authors of canonical histories fuse "their own perspectives with those of their subjects" (Fuller, 1991: 309). These examples from prehistories helped draw boundaries between the fields as none of these scholars are appropriated for the other field.² Comparing pairs of scholars during the emergence (John Krutilla and Georgescu-Roegen) and foundation (Pearce and Herman Daly) of fields can help explain divergences between the fields, as both pairs exemplify the influence of different ideological and epistemological backgrounds on the emergence and institutionalization of ideas.

Certainly both fields have many more examples of influential scholars, but the ones presented here are chosen as some of the most typical representatives of their fields, celebrated by their heirs. The scientific practices and discourses of some of the most influential authors of both fields are examined in order to discern why studying the nature-economy nexus has produced two distinct fields. The methods of comparative intellectual history are used here as they focus on "how ideas became meaningful in a particular cultural milieu" (Christie, 1989: 90) and "differentiate cases (...) capturing similarities and differences across a limited number of instances in order to understand the cases under discussion" (Pollock, 2010: 191).

The growing trend of interdisciplinarity influenced the scientific practices of the scholars analysed. Bloor (2011) has demonstrated that belonging to subculture either of science or engineering can influence the development of rival theories. Different versions of interdisciplinarity interacted with the different ideological backgrounds of the scholars and thus contributed to

the divergence of the two fields. Calls for interdisciplinarity have been on the rise since the 1970s. The 1970s also saw the formulation of two types of interdisciplinarity:

The first, 'bridge building', takes place between complete and firm disciplines. The second, 'restructuring', involves changing parts of several disciplines ... is more radical and often embodies a criticism of not only the state of the disciplines being restructured but, either implicitly or explicitly, the prevailing structure of knowledge. (Thompson-Klein, 1990: 27)

Also, the third type of interdisciplinarity, integration of knowledge, is important here, as it was the goal of Kenneth Boulding and other proponents of general systems theory, who were influential for the emergence of ecological economics. Integration of knowledge is a search for a new overarching theory, close to transdisciplinarity, which had the ambition of "comprehensive unity of knowledge" (Thompson-Klein, 1990: 28).

Frickel's and Gross' general theory of scientific/intellectual movements (SIMs) is particularly useful for understanding interdisciplinarity and making of interdisciplines of which ecological economics is a good example (Jacobs and Frickel, 2009; Frickel, 2004).³ Frickel (2004: 273) studied the emergence and establishment of genetic toxicology and concluded that for "interdisciplines, key boundary problems involve perforating existing boundaries and/or inventing porous ones". However, with a competitor in sight (i.e. environmental economics), ecological economics' boundary-work was more complicated. Frickel's and Gross' general theory is likewise instrumental in understanding the divergence between these fields, as it analyses the presence of grievances and opportunity structures, which were quite different in each case. Grievances against

dominant intellectual approaches are taken as "a necessary condition for the emergence of a SIM" (Frickel and Gross, 2005: 210). The first proposition of the general theory is that "a SIM is more likely to emerge when high-status intellectual actors harbor complaints against what they understand to be the central intellectual tendencies of the day" (Frickel and Gross, 2005: 209). In the case of ecological economics, a small number of prominent economists developed grievances towards the dominance of neoclassical economics and towards its inadequacy when dealing with environmental issues. The strength of grievances depended on the ideological backgrounds of scholars. Those that understood and practiced green ideology as a thick ideology were more likely to have stronger grievances.

However, once the key ideas of scientific/intellectual movements "are formulated, they must be orchestrated, coordinated, and collectively produced. For this to occur, opportunities for gaining access to resources are imperative" (Frickel and Gross, 2005: 214). The process of the use of opportunity structures will be described in the section on the establishment of both fields. Although the theory of SIM also deals with micro-mobilization contexts, primary interest here is in the emergence and establishment of ideas in a broader social context.

First, key representatives of more or less constructed roots of both fields are presented. The emphasis is on those authors that contemporary environmental and ecological economists see as the ones who created milestones for economic thought and their respective fields, and why they are perceived as such. Second, the links between the emergence of the environmental movement and the emergence of both fields are analysed through portraits of two economists and of the institutional and social contexts in which they worked. Both Krutilla and Georgescu-

Table 1. Compared scholars during different development phases of environmental and ecological economics

Development phase	Environmental economics	Ecological economics
Appropriated 19th and early 20th century scholars	Jules Dupuit (1804-1866) Arthur Cecil Pigou (1877-1959)	Sergei Podolinsky (1850-1891) Frederick Soddy (1877-1956)
Emergence of the field	John Vasil Krutilla (1921-2003)	Nicholas Georgescu-Roegen (1906-1994)
Establishment of the field	David Pearce (1941-2005)	Herman Daly (1938)

Roegen were established economists as the environmental revolution erupted and subsequently changed the emphasis of their work. Their influence on the emergence of a particular field is still referenced and celebrated (for Krutilla see Smith, 2015; Banzhaf, 2019; for Georgescu-Roegen see Bonaiuti, 2011; Kallis, 2011). Third, using the examples of two economists prominent in establishing these fields, the rising influences of environmental and ecological economics' actors and theories on international organisations and political movements are discussed. Pearce and Daly were initiated into the emerging fields during the environmental revolution and became prominent economists as environmental issues were internationalized. With concepts of market-based incentives and steady-state economy they further established their fields.

Appropriated 19th and early 20th century scholars

Environmental and ecological economists often search for unsung heroes who provided these fields with their epistemological and methodological tools and, not less importantly, possessed similar ideological and scholarly profiles to the authors who appropriated them for their fields. Dupuit and Pigou were early contributors to concepts crucial for environmental economics: cost-benefit analysis and externalities, respectively. Podolinsky and Soddy both used the second law of thermodynamics in their understanding of the economic world. They were also all inspired by proto-ideologies that resembled environmentalism and ecologism.

Jules Dupuit (1804-1866) and Sergei Podolinsky (1850-1891)

Neither Dupuit nor Podolinsky are mentioned in Kula's (2003) comprehensive history of environmental economic thought. It could be argued that Pearce (2002) and Martinez-Alier (1982, 1990), two important establishers of environmental and ecological economics, while writing about lesser-known 19th century scholars tried to construct deeper historical roots of their fields.

The practitioners of environmental economics in the formative years of their field and thereafter

traced the roots of environmental economics to a French engineer (Kneese, 1986; Pearce, 2002). Jules Dupuit was an inspector general of bridges and highways. In 1844 Dupuit introduced the concept of cost-benefit analysis. Ekelund and Hébert (1999: 39) argue that the specific French national context and "the ideology of the state engineering corps served to justify a strong educational focus on mathematics". State engineers' views of economics were influenced by their liberal professors, and the engineers combined liberal ideas with a belief in state intervention. Dupuit was a strong believer in markets and he went on a mission to expand the realm of economic thought. As an engineer he saw the influence of new technologies on the market and institutional change (Ekelund and Hébert, 1999). In this context, Dupuit created microeconomic concepts, which resembled those of future neoclassical economics, and contributed to the mathematization of economics.

The strong influence of proto-interdisciplinarity and ideology emanating from the national context also shaped Podolinsky who arises as ecological economists search for their roots in the 19th century. A Ukrainian socialist educated in the natural sciences and medicine, Podolinsky is strongly promoted by Martinez-Alier as a "Marxist-Narodnik Precursor of Ecological Economics" (Martinez-Alier, 1997: 231). In his 1883 article, Podolinsky mentioned both the second law of thermodynamics and "the danger that we will suffer one day a scarcity of transformable forces on the surface of the Earth" (cited in Martinez-Alier and Naredo, 1982: 211), although he saw this as a very distant danger. Podolinsky's attempt was criticised by Engels, who thought that there was no need for calculating energy values and that expressing economic relations in physical measures is impossible (Martinez-Alier and Naredo, 1982). Engels' criticism of Podolinsky's ideas at the beginning of the 1880s meant that Podolinsky's name was relegated to the fringe of the Marxist movement and was incorporated in the history of economic thought only in the 1980s during the establishment of ecological economics.

Indicative in Podolinsky's biography are his heterodox ideological motivation and his broad interdisciplinary knowledge, characteristics that were present in many ecological economics

pioneers. The *Narodniki* movement, which originated in the 1860s Russia and promoted the ideals of self-governed peasant communities, influenced Podolinsky's thought. In his 1883 article, Podolinsky was writing from an agricultural perspective and was using examples from agricultural statistics to show how solar energy is transformed by the work of humans and animals. His idiosyncratic leftist position, different to that of scientific socialism in already industrialised countries, is something that could have shaped Podolinsky's new perspective on relations between the economy and nature. Thus, in Podolinsky's last writings, he was less optimistic regarding nature's capacities than Marx and Engels who were also interested in the natural sciences but tended to see the peasantry as mostly a counter-revolutionary force.

Apart from their ideological differences, the main difference between Dupuit and Podolinsky was the way they used their interdisciplinary knowledge. Dupuit applied knowledge from two disciplines in order to solve practical problems and expand economic theory. Podolinsky, on the other hand, sought a holistic understanding of social and economic processes, with crucial insights from the natural sciences, with the goal of creating a just society.

Their diverging perspectives, the natural sciences perspective in the case of Podolinsky and the engineering perspective in the case of Dupuit, are still present in some of the debates between the two fields, so it is not surprising that these two scholars are invoked in the search for fields' roots. The engineering perspective is connected with problem solving and improving on prior knowledge that is not deemed as wrong, but as no longer useful (Aslaksen, 2013). The natural sciences perspective involves trying to give answers to ultimate questions and rejecting old theories and paradigms.

Another difference between these two scholars is that one can find relative continuity in the expansion of Dupuit's ideas during the marginalist revolution of the 1860s, while Podolinsky's ideas remained on the margin of social thought. This could be explained by their respective social positions which shaped the institutionalisation of their ideas, as Dupuit's endeavours were backed

by the French state and Podolinsky's ideas had little influence even on socialist authors. Although Dupuit's attempt to mathematise economics were not an outright success, his ideas survived and later became part of the neoclassical economics, which became prominent after the marginalist revolution (Ingrao and Israel, 2015).

Arthur Cecil Pigou (1877-1959) and Frederick Soddy (1877-1956)

Pigou, one of the heirs of the marginalist revolution, succeeded Marshall in the position of professor of Political Economy at Cambridge. Apart from Marshall, Pigou was strongly influenced by another of his Cambridge teachers, a universalistic utilitarian philosopher, Henry Sidgwick. What is most significant here is Sidgwick's discussion of various divergences between private and social interests (Aslanbeigui and Oakes, 2015). Pigou was a devout follower of Marshall's neoclassical economics, although he "was ready to refine or innovate if the results promised to strengthen economic analysis" (Aslanbeigui and Oakes, 2015: 101). Pigou had a negative stance towards scientific revolutions, especially towards the Keynesian revolution which was the most threatening to his own and neoclassical economics' legacy. His position is interpreted as the opinion that "economics progresses not by (...) destroying or demeaning the work of others, but by building on past knowledge" (Aslanbeigui and Oakes, 2015: 102).

Pigou's view of economics was that it should be value-neutral and analyse the consequences of economic policy proposals coming from different ideological camps. Nevertheless, he espoused liberal views as he argued for the benefits of free trade on the prosperity of all British people. Another topic that concerned him were the negative consequences of the 19th century urbanization in Britain and his influential proposal to tax the negative consequences of new buildings is a logical consequence of this interest. Pigou remains important for environmental economics because he developed and promoted the concept of externality or "a detrimental (...) effect to a third party for which no price is exacted" (Pearce, 2002: 58).

Soddy, Pigou's ecological economics counterpart, received a Nobel Prize in chemistry for 1921

for his contribution to the chemistry of radioactive substances. Already in 1912 he expressed concern about the limits of major energy sources of that time, but he saw hope in the development of atomic energy (Soddy, 1912). After the First World War Soddy began to doubt that political development could follow advances in science and he turned to writing primarily on economic problems. This transition happened during a public backlash against science. Science was already in the course of the war blamed for “contributing to the horrific character of modern industrialized warfare” (Agar, 2012: 117). Soddy was one of the pioneers of introducing the second law of thermodynamics into the study of economics. This can be traced to his 1921 speech where he gave the following warning: “You cannot permanently pit an absurd human convention, such as the spontaneous increment of debt, against the natural law of the spontaneous decrement of wealth” (Soddy, 1921). As a natural scientist involved in the study of economics, Soddy was developing a view on interdisciplinarity that could be labelled as the restructuring of economics.

Soddy’s contributions to economic thought were strongly influenced by his ideological profile. Soddy was worried that atomic energy, to whose development he had contributed, under existing economic conditions could destroy civilisation. Soddy (1921) praised Marx’s understanding of natural processes. However, Soddy was not a socialist, although his criticism of contemporary science coincided with ideas of the socialist-oriented scientific humanists around John Desmond Bernal with whom he collaborated. Contrary to them, Soddy did not see socialism or communism as the solution and saw the battle between socialism and capitalism as one that misses the real target. He criticised the monetary system led by private bankers and called for more democracy (Trenn, 1986). Soddy emphasized that he had a different perspective than most other economists and politicians. He espoused a rather independent ideological position, emphasizing an agricultural perspective (Soddy, 1921). Not belonging to established economics schools allowed him to pursue new ideas such as that true wealth is energy and not money.

As in the Dupuit-Podolinsky comparison, Pigou’s and Soddy’s ideas were characterized by the influence of different worldviews and different receptions. Soddy moved from his established discipline and became engaged in the quest for a new society, while Pigou was expanding neoclassical economics so it could respond to new social problems. Although Pigou’s role in the history of economics was overshadowed by the Keynesian revolution, his ideas were important in the already established fields of neoclassical economics and welfare economics in whose institutionalisation and promotion he was heavily involved. The theory of externalities, which he created, was reborn in the 1950s and particularly in the 1960s with the emergence of environmental economics (Medema, 2017).

Similar to Podolinsky, Soddy’s ideas, although far more visible than those of the Ukrainian *Narodnik*, remained on the fringe of social and economic thought. The questioning of the market as the main tool for understanding economic life and replacing them with energy was ideologically unpopular for free-marketeters and this was most pronounced in Hayek’s criticism of Soddy (1943). Already before the end of the Second World War, i.e. twenty years before the environmental revolution particular scientific ideas resembled ideological constellations that are still shaping the environmental debate: liberal environmentalism (in Pigou), anti-environmentalism of free-marketeters (in Hayek) and ecologism (in Soddy).

The emergence of environmental and ecological economics during the environmental revolution: John Vasil Krutilla (1921-2003) and Nicholas Georgescu-Roegen (1906-1994)

The Second World War, especially the use of the atomic bomb, had a profound influence on the rise of environmental and techno-pessimistic values, although it had a rather delayed effect on the creation of a strong environmental movement. The rise of this movement during the 1960s coincided with the transition of two major economists towards building environmental and ecological economics’ theoretical foundations.

However, the Second World War's more immediate impact on environmental economics was reflected in the concern of the United States' political elite about the availability of resources essential for the US to preserve its post-war global role. Hence, Resources for the Future (RFF), the first think-tank dedicated solely to resource and environmental issues, was founded in 1952. It became a key organization in the establishment and promotion of resource and later environmental economics with major figures such as Krutilla and Allen Kneese working there (De Steiguer, 2006).

The environmental revolution, which started with Rachel Carson's 1962 book *Silent Spring* and peaked with Earth Day demonstrations in 1970 (McCormick, 1995), gave a new significance to the inclusion of environmental issues in the science of economics. The debate that started in the second half of the 1960s was influential for the establishment of both fields, because it gave even more prominence to environmental issues but was also crucial for their divergence. Interdisciplinarity was paramount for this period that witnessed the emergence of ideas that were intensively questioning the concept of infinite economic growth (McCormick, 1995). The best-selling books were Paul Ehrlich's *The Population Bomb* (1968) and *The Limits to Growth* (Meadows et al., 1972), which featured scenarios of the coming collapse of human civilization and caused a big debate. Regarding the period before this sort of books, both environmental and ecological economics could claim that they have been influenced by Carson's book. Both Røpke (2004) and Pearce (2002) see *Silent Spring* as a watershed moment and eye-opening for economists in understanding the scope of environmental degradation and its connection to economic processes. However, the following years brought political polarisation as the radical countercultural movements of the 1960s began questioning the industrial capitalist foundations of Western society. These movements were particularly influential in the US, starting with the escalation of the Vietnam War in the mid-1960s, which also raised the issue of global North-South inequalities, and subsequently influenced the character of Western academia. The difference between the traditional approach of the conservation movement present in natural

resource economics and the newer emphasis on limits to growth and criticism of industrial society is visible with the two scholars analysed here.

Distinct institutional and ideological backgrounds

Krutilla, one of the founders of environmental economics, worked at RFF from 1955 until 1988. Prior to that, he worked for the Tennessee Valley Authority, the United States government agency dealing with the exploitation and natural-resource management of the Tennessee River and its surroundings. Both the Tennessee Valley Authority and RFF were products of the conservation movement. The conservation movement was oriented towards the rational use of natural resources and its influence was visible in Krutilla's first major works such as *Multiple Purpose River Development* (Krutilla and Eckstein, 1958). This book "was motivated by the Eisenhower administration's policy advocating a larger private-sector role in river basin development" (Smith, 2015: 4).

Another strand of the early American environmental movement, a more eccentrically oriented preservationist movement called for the protection of nature for its intrinsic value. The late 1960s were marked by the fight for "the rejection of multiple-purpose river structures in favor of free flowing rivers" (Hays, 1982: 17). It was, therefore, a defining moment for environmental economics when Krutilla (1967) in his seminal article *Conservation Reconsidered* took account of the perspectives of both conservationists and preservationists in giving value to nature. Krutilla opened the article with a quotation from Pigou, developed the notion of non-use value of nature, and introduced the concept of existence value, while arguing that "the existence of a grand scenic wonder or a unique and fragile ecosystem (...), its preservation and continued availability are a significant part of the real income of many individuals" (Krutilla, 1967: 779). In a footnote Krutilla specified these individuals as "the spiritual descendants of John Muir, the present members of the Sierra Club, the Wilderness Society, National Wildlife Federation, Audubon Society and others to whom the loss of a species or the disfigurement of a scenic area causes acute distress and a sense of genuine relative impoverishment"

(Krutilla, 1967: 779). Thus, Krutilla adopted one of the core concepts of green ideological discourse that Freeden described: the valued preservation of nature and the irreversibility of some interventions in nature. Krutilla's revision of conservation and acknowledgment of the preservationist perspective was happening during the 1960s environmental revolution, which was centred in the US. However, adjacent concepts of green ideology were not present in Krutilla's work, as he went on to develop his ideas on projects of limited scope regarding local and national regulation. He did not deal with broader global and political issues, which became prominent in new strands of the environmental movement and with ecological economics practitioners.

Georgescu-Roegen, one of the founders of ecological economics, was educated as a mathematical statistician in Paris and London. He was politically active in the Romanian National Peasant Party in the 1930s after he returned to his native Romania. Poporanism, a Romanian version of *Narodnik* ideology, influenced the National Peasant Party. Some of the party's ideologues argued that there was no need for a predominantly agrarian Romania to industrialise and resemble Western societies, and they favoured small peasant holdings (Daskalov, 2014). Vivien (1999) gives a comprehensive account of Romanian influences on Georgescu-Roegen's worldview, mentioning even the problem of exhaustion of Romanian oil resources since the late 1930s, but he does not mention these ideological links. Vivien deals solely with epistemological links, citing Chayanov, an influential Soviet agricultural economist, but fails to mention the Romanian National Peasants Party. Virgil Madgearu, an economist and one of the most prominent party ideologues, was influenced by Chayanov. But Madgearu took Chayanov's positive assessment of traditional peasant subsistence economy even further, while Chayanov was not able to promote it in the Bolshevik Soviet Union, at least not publicly. Madgearu argued in the 1920s that "the peasantist 'third way' between capitalism and socialism had to lean on this type of economy" (Daskalov, 2014: 317). Although in the 1930s this radical peasantist ideology was subdued in the National Peasant Party, Georgescu-Roegen was certainly aware of it.

Georgescu-Roegen wrote important contributions to econometrics and neoclassical economics during the first decade and a half of his stay in the US after his exile from communist Romania in 1948. However, in his 1960 article he began dealing with the problem of agrarian economics while using the example of interwar Romania to present the problem of agricultural overpopulation (Georgescu-Roegen, 1960a). He stated that neither Marxian nor neoclassical economics can help in understanding the problems of an overpopulated agricultural economy. Georgescu-Roegen (1960a: 10) invoked the *Narodniki* ideology which negated both capitalism and socialism. Georgescu-Roegen thought that there is a need for a different economics and different ideological perspectives when analysing the problems of the agrarian economy. His dismissal of capitalist and socialist worldviews was in accordance with Madgearu's peasantist ideology, but also with future green ideology positioning itself as an ideology beyond left and right.

In the same article there was a critique of Western social scientists that have contempt for the rural perspective, small-scale production and "any idea that is not presented through a mathematical model" (Georgescu-Roegen, 1960a: 10). The same year Georgescu-Roegen (1960b: 231) published another article where he mentioned entropy and wrote that the economic process "must obey the universal laws of matter and energy". However, he did not give it a central position in the article, nor did he sound any warnings about the Earth's limited resources. Tellingly, he did not develop its use in economic analysis into a full-fledged theory until the environmental revolution came into full swing (see Georgescu-Roegen, 1976: 20). His 1966 book *Analytical Economics* contained an epistemological preparation for his revision of economic knowledge and included both of his 1960 articles. Georgescu-Roegen (1966: 42) was discarding his neoclassical heritage and even the dominance of numbers in modern science, as he intended to study change.

Georgescu-Roegen's quest for a different analysis of economics resulted in the book *The Entropy Law and the Economic Process* (1971), which has a cult-like status in some ecological

economists' circles (Daly, 1980: 482; Bonaiuti, 2011: 27). In it, he stressed the irrevocability of the entropic process, an emphasis that was most probably the result of the environmental revolution. Favourable institutional context could have played a part in this new emphasis as Georgescu-Roegen enjoyed the "relative openness of US academia as compared to that of Europe" (Martinez-Alier, 1997: 226). Vanderbilt University, where he worked from 1949 until his retirement in 1976, was an organization that in the 1960s encouraged the voicing of contentious opinions (Heard, 1995). At the end of his official academic life, Georgescu-Roegen (1976: 33-34) added a list of policy proposals to his core concept of the irrevocability of the entropic process such as: "(1) the production of all instruments of war, not only of war itself, should be prohibited completely. ... (2) the underdeveloped nations must be aided to arrive as quickly as possible at a good (not luxurious) life (3) mankind should gradually lower its population to a level that could be adequately fed only by organic agriculture". He therefore introduced adjacent concepts of green ideology such as equality and non-violence to his core theoretical concept; thus, his scientific endeavour started to resemble the demands of countercultural movement and a thick ideology of ecologism, as defined by Humphrey.

Diverging scientific practices

Georgescu-Roegen (1976: 356) also formulated the fourth law of thermodynamics applying the second law of thermodynamics on macroscopic matter and concluding that "recycling cannot be complete". This provoked debates in which natural scientists were also involved, criticising Georgescu-Roegen's use of physical laws (Bianciardi et al., 1993). Georgescu-Roegen's texts indicate that in the foundations of ecological economics a restructuring interdisciplinary approach was strongly present and it aimed not just to restructure economics, but sometimes also the natural sciences.⁴

Environmental economics has a completely different approach to the natural sciences, as the roles of the sciences are well known, in accordance with bridge building interdisciplinarity. The strict division of labour between the natural sciences

and economics is evident in this quotation from Krutilla's *Conservation Reconsidered*:

Only after there is developed an adequate system of classification of aquatic communities will it be possible to identify distinct environments, recognize the needed reservations, and, then, estimate the opportunity costs. Classification and identification of aquatic environments demand early research attention by natural scientists. (Krutilla, 1967: 785)

As the environmental revolution came and began exerting stronger influence on national and global policies, environmental and ecological economists were in different positions. Welfare and natural resource economists were ready to apply their analysis of themes such as externalities and market failure to new societal demands (Cropper and Oates, 1992). On the other hand, heterodox economists had to first translate the new understanding of social and natural processes into full-fledged scientific theories. The environmental revolution created opportunities for the emergence of a scientific/intellectual movement in which high status thinkers (Georgescu-Roegen and Boulding) shared grievances towards dominant approaches in economics, articulated their program and did "the intellectual or scientific work that comes to be seen as the hallmark of the movement" (Frickel and Gross, 2005: 212).

A comparison of Krutilla and Georgescu-Roegen's bibliographies indicates the different levels of specialisation upon which scholars of emerging fields could build. Krutilla published one of his early contributions in *Land Economics* (Krutilla and Peterson, 1956), a journal which was founded in 1925 as the *Journal of Land and Public Utility Economics* but eventually became an outlet for environmental economists (Spash, 1999). Krutilla (1966) also published in the *Natural Resources Journal*, founded in 1961, a primarily environmental law journal, which during the 1960s "developed concerns about the political economy of environmental issues" (Spash, 1999: 266). Georgescu-Roegen had no such specialised outlets at his disposal and questioned throughout the 1960s neoclassical mainstream theories in general economics journals such as the *American Economic Review* or *Oxford Economic Papers*. These

different starting positions were reflected in the time lag of ecological economics' institutionalisation through journals and professional societies. The most important environmental economics journal, the *Journal of Environmental Economics and Management* (JEEM) published its first issue in 1974. The Association of Environmental and Resource Economists (AERE) was founded in 1979 in Atlanta with a strong institutional and financial backing from RFF, and the AERE started overseeing the JEEM (Spash, 1999). Ecological economics saw its first society, the International Society for Ecological Economics, and its major journal, *Ecological Economics*, founded synchronously in 1988 and 1989, respectively (Costanza, 2003).

The establishment of both fields was a result of two processes. First, the rise of the environmental movement put environmental issues high on the social agenda, prompting explanations of environmental crises from all sciences. Economics in particular was invited to provide answers as economic activities were singled out as the main cause of the crisis. In the case of environmental economics, this resulted in a prominent natural resource economist such as Krutilla and his younger colleagues at RFF such as V. Kerry Smith, Anthony C. Fisher and Charles Cicchetti, adopting preservationist ideas and applying them in real-life cases (Banzhaf, 2019). Ecological economists were, on the other hand, challenging well-established economic theories, primarily the benefits of economic growth.

Second, the growth of science after the Second World War opened possibilities for interdisciplinarity and the establishment of new fields, think-tanks, scientific societies and journals. Rapid growth in higher education was an especially important breeding ground for the establishment of ecological economics. The surge of radical student movements of the 1960s, especially influential in the US and France, provided both a public for the ideas questioning the workings of contemporary society and a contingent of radical students for future ecological economics practitioners. Georgescu-Roegen's ideas were well received by the French post-1968 non-communist left, which was looking for new ideas upon

which it could build its resistance to the capitalist economy.

The establishment of environmental and ecological economics after the internationalization of the environmental movement: David Pearce (1941-2005) and Herman Daly (1938)

Arguably, even more important than their starting positions for the current unequal prestige of the two fields was the way they were translated into public and economic policies. This is evident from the careers of two representative scholars, analysed here as important promoters of these fields.

Their agency should be put in the context of the emergence of international environmental organizations represented through the build-up to the 1972 Stockholm Conference (McCormick, 1995). The conference pushed governments to act and create various regional and global organizations such as the European Environmental Bureau or the United Nations Environment Programme. This sort of organization became the breeding ground for the institutionalization and promotion of environmental and ecological economics. Opportunity structures were created in forms of employment for SIM participants and "additional prestige above and beyond that which they currently possess" (Frickel and Gross, 2005: 215).

One of the contributions to the Stockholm Conference was the OECD's (1972) report on key aspects of environmental economics. A young British economist David Pearce was a member of the small group of economists that produced this report (Barde, 2007). Pearce devoted his whole scientific career to issues of environmental economics and wrote numerous important contributions to environmental economics theory and practice and also two of the early textbooks (1976; Pearce and Turner, 1990).

Diverging perspectives on solutions to environmental crises

Especially indicative of the rising influence of environmental economics is the policy scope of Pearce's work. Pearce's 1970s cost-benefit analy-

ses mostly dealt with British case-studies (1970). At the end of the 1980s he was the main author of the *Blueprint for a Green Economy* (Pearce et al., 1989), an environmentalist best-seller introduced as “a logical outcome of the UK government’s initial response to the Brundtland report” (Pearce et al., 1989: xv). More precisely, it was an outcome of the Thatcher government’s embrace of environmentalism in the late 1980s. The book argued that environmental problems should be tackled with an approach that would establish *market-based incentives* (Pearce et al., 1989: 155). Then came the *Blueprint 2: Greening the World Economy* (Pearce et al., 1991), which focused on global environmental policy and contributed to the Intergovernmental Panel on Climate Change report in 1996.

Pearce’s global solutions were also based on the use of markets and thus well suited for the ascent of neoliberal ideology that started in the end of the 1970s. Although Pearce contributed to the rising marketization of society, he was not a Tory and he even took part in the early meetings and the founding of the journal *Ecological Economics* during the process of ecological economics institutionalisation in the late 1980s (Barrett, 2005; Røpke, 2005). Pearce’s ideological and scientific position can be traced to his reaction to the early 1970s British debate on *The Limits to Growth*. The University of Sussex Science Policy Research Unit (SPRU) scholars attacked *The Limits to Growth* models as being too simplistic and ignorant of innovation and technology as variables that could diminish resource depletion (Cole et al., 1973). Pearce bypassed siding either with *The Limits to Growth* pessimism or with the techno-optimism of SPRU. The conclusion was that we are faced with uncertainty and there is a need for the optimal strategy in this situation (Pearce and Rose, 1975: 20).

This reflected debates at the OECD during the late 1960s and early 1970s between more ecologically oriented functionaries who founded the Club of Rome and economists promoting high economic growth, which was the main goal of the organization during the 1960s.⁵ Liberal environmentalism, which did not discard the concept of economic growth and tried to reconcile it with environmental protection, eventually took over the OECD after the 1973 economic crises

(Schmelzer, 2012). Throughout the 1980s and 1990s, liberal environmentalism became “a mainstay of how international organizations and states understand their role in promoting action” (Bernstein, 2001: 71). Pearce remained an important part of OECD’s environmental expertise throughout his career (Barde, 2007). His technocratic strategy included bridge building interdisciplinarity; i.e. he tried to find links between the disciplines of economics and ecology (Pearce, 1976: 31). It was also shaped by British scientific culture “producing skepticism about claims that appear to go beyond the observable facts of nature or society” (Jasanoff, 2005: 263).

Ecological economics promoter Daly, on the other hand, saw economics as in need of a new paradigm and he expressed this straightforwardly. When writing about discovering Soddy as the predecessor of ecological economics, Daly quoted (1986: 199) Kuhn’s characterization of scientific revolutionaries: “Almost always the men who achieve these fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change”. While Daly saw the emergence of ecological economics as a scientific revolution, Pearce and Turner (1990: 5) did not “view changing economic doctrines over time in terms of Kuhnian ‘scientific revolutions’. Rather it is more fruitful to think of clusters of interconnected theories or ‘scientific research programmes’ which compete against each other”. It was Lakatos who was the order of the day for environmental economists and this was followed by further discarding of revolutionary economics: “Rather than looking for some ‘different economics’, we are seeking to expand the horizons of economic thought” (Pearce and Turner, 1990: 31). Daly (1996: 191), on the other hand, classified Georgescu-Roegen’s contributions to economics “into two categories (...): normal science and revolutionary science”.

Daly was Georgescu-Roegen’s student at Vanderbilt University while he was doing his PhD. The importance of contingency is apparent in the story of the emergence of ecological economics. Daly did not know of Georgescu-Roegen before he arrived at Vanderbilt University to study economic development in Latin America. But he became influenced by Georgescu-Roegen’s

critique of neoclassical economics and he would later steadily promote his teacher's ideas. He was also much more open to cooperation with other scientists than Georgescu-Roegen was. Daly's collaboration with the ecologist Robert Costanza was especially formative for the institutionalisation of ecological economics (Røpke, 2004). That Daly was Georgescu-Roegen's student and Costanza a student of the prominent ecologist H. T. Odum confirms Frickel's and Gross' (2005: 211) conclusion that "older intellectuals who occupy prestigious positions (often in prestigious departments) as well as their younger protégés (...) will be in the best position to lead a SIM".

But there was more than just contingency in the forming of relations between the founders of ecological economics. A growing interest in developing countries during the 1960s at Western and especially US universities, combined with rising environmental concern, was an ideal breeding ground for a radical restructuring of economic thought. Similar to Georgescu-Roegen's interest in Romanian agricultural overpopulation, the issue that shaped Daly's economic thought was the problem of under-developed countries, his point of reference being overpopulated Northeast Brazil. This sort of global engagement and the inclusion of the perspectives of under-developed countries were missing during the emergence of environmental economics. This does not mean that environmental economics is a parochial discipline or even predominantly concerned about the West. But there was a difference in how the perspective of developing countries was used in developing new ideas. Pearce, for instance, had a broad knowledge of and significant concern for the environmental problems of developing countries. He co-authored a book chapter with Indian economist Ajit Kumar Dasgupta (1972) on flood control in the Damodar Valley in West Bengal. However, this was the application of a Western type of cost-benefit analysis on an Indian case-study and it was not epistemologically different from the one analysing the Tennessee Valley.

Daly (1970) used his knowledge of Northeast Brazil firstly, to emphasize that almost all of the economic growth was taking place in the upper-class per-capita income and that population

growth was taking place in the lower class, thus diminishing their per-capita income. Secondly, he concluded that neither the Brazilian oligarchy nor the Brazilian Marxists wanted population control for the lower class. The former because this provides them with a source of cheap labour and the latter because they see the pauperized and numerous lower class as the reservoir for future revolution. These kinds of problems implied that there was a need for a radical change of the social and economic system and for a new ideological and scientific paradigm that would go along with it. As in Georgescu-Roegen's case this change was neither Marxist nor capitalist-oriented and could be, thus, connected with the emerging ideology of ecologism. Daly soon envisaged a steady-state economy that could be achieved only through radical changes and he called for the creation of institutions that would be responsible for "stabilizing population", for "stabilizing physical wealth and keeping throughput below ecological limits", and for redistribution of wealth in order to decrease inequality (Daly, 1974: 19).

Adjacent concepts of future green ideology obviously influenced Daly: the equal access of the South to global resources. From an early age, Daly was appalled by poverty, especially in Mexico, which neighboured his home state of Texas, and later in the whole of Latin America (Daly and Kunkel, 2018). The issue of inequality became an important part of the global framing of environmental issues as developmental problems of the Global South featured prominently at the Stockholm conference. Since the late 1970s, traditional conservationist and preservationist American environmentalism had faced the rise of the environmental justice movement, which protested against the hazardous health and living conditions of the lower classes and minorities (Dowie, 1995). Thus, social equality became one of the core concepts of green ideology and some strands of ecological economics.

Daly tried to apply some of his ideas in the World Bank, where he worked from 1988 to 1994. However, contrary to Pearce, he was not successful in the implementation of ideas of ecological economics and ecologism in public policies as the World Bank's staff was predominantly educated in neoclassical economic theory (Daly, 2008).

The social impact of the fields and their positioning in the scientific landscape

The 1990s and early 2000s saw the growing need for interdisciplinary research in order to tackle the issue of climate change (Weszkalnys and Barry, 2013) making both fields more relevant, although during the 1990s neoclassical ideas dominated climate policy (Meckling and Allan, 2020). It could be argued that the presence of environmental and ecological economists in global institutions raised the stakes of belonging to one of the fields, because it meant that their ideas were no longer confined to academia, but had real-world implications. This created rifts between them, as they had different degrees of success regarding the application of their knowledge.⁶

The doyens of environmental economics Kneese and Ralph d'Arge, founding editors of JEEM, had a similar perspective on relations between the economy and nature as Daly in the early 1970s (Røpke, 2004). They were present in early ecological economics meetings, but eventually drifted away from ecological economics. This was also evident in Pearce's case who, after the success of his *Blueprints*, was less involved in ecological economics and became the target of criticism by some ecological economists (Røpke, 2005). Environmental economists contributed to widely used policy tools such as environmental taxes and emissions-trading schemes adopted by different national and global ideologies that had a liberal, social democratic or centre-right profile. These processes meant that environmentalism was incorporated into other ideologies. Ecological economics provided the theoretical basis for movements and political parties that espoused ecologism and, similar to the founders of ecological economics, wanted to overcome what they saw as the false dilemma between liberalism and socialism. Especially influential in the sphere of political movements were Georgescu-Roegen's ideas which helped establish the degrowth movement (Bonaiuti, 2011). The degrowth movement developed in France in the early 1970s and was resurrected again there in the early 1990s (D'Alisa et al., 2014). Environmental and ecological economics influenced institutions and political movements and this was a sign of both fields becoming fully established.

The divergence in the social influence of environmental and ecological economics was also reflected in their scientific developments. In 2007, the AERE launched the *Review of Environmental Economics and Policy*, a new journal for more popularly written and policy-oriented articles. On the other hand, the European Society for Ecological Economics provides for its members free access to the journal *Environmental Values*, founded by the environmental philosopher Allan Holland and now edited by the social ecological economist Clive Spash. *Ecological Economics* has often been a venue for debates on values and ideologies underlying this field (Söderbaum, 1999), the feasibility of the concept of degrowth (Kallis, 2011) or more recently for a special issue on the prospective alliance of environmental justice and degrowth movements (Akbulut et al., 2019).

The growing opportunities initiated a strong competition for intellectual prestige between the two fields. Opportunities of ecological economics' for amassing prestige were hindered by environmental economics' dominance in scientific and policy institutions. However, this does not automatically translate to failure or hindered scientific/intellectual movement (Frickel and Gross, 2005: 217). Under certain conditions, in this case the profound greening of academic and policy institutions, both movements can gain, although there are considerable differences in the levels of institutional stability of these fields. Environmental economics had origins in state administrative and research bureaucracies, therefore it belonged to "stealth SIMs", which pursue change while emphasizing continuity" (Frickel and Gross, 2005: 227). It soon became an established field within numerous economic departments. Ecological economics was more connected to environmental movements and its intellectual leaders (on different origins of SIMs see Jacobs and Frickel, 2009: 57). It used the opportunities created by the consequences of environmental revolution and of the popularity of interdisciplinarity to establish itself in interdisciplinary research institutes and non-economic departments (e.g. Institut de Ciència i Tecnologia Ambientals in Barcelona or Maryland International Institute for Ecological Economics) and to be involved in various networks comprising activists and scholars.

Conclusion

This outline of some of the main founders and ideas of both fields presents only a small segment of their corpuses of knowledge. Ecological economics, in particular, consists of several strands and positions and involves both social and natural scientists, as it cherishes methodological and ideological pluralism. Ecological economics as a fragmented adhococracy truly features “intellectual variety and fluidity” and does not “exhibit a stable configuration of specialized tasks or of problem areas, nor (...) strong co-ordinating mechanisms which systematically interrelate results and strategies” (Whitley, 2000: 168). Ecological economics encompasses social scientists, philosophers, and activists criticising market economy and imagining the future relations of humans with nature, but also approaches which are closer to mainstream economics. This roughly reflects differences between more radical European socio-economists and more mainstream US ecological economists around Costanza (Røpke, 2005). For example, an approach taken by Costanza, which included using a monetary valuation of the Earth’s ecosystem services, indicated a potential convergence with environmental economics (Costanza et al., 1997). This kind of reasoning prompted debates about whether economic valuation is appropriate for ecological economics (Norgaard and Bode, 1998).

Environmental economics became a different type of scientific field, as it could draw its methods and resources from already established fields. Its bridge building type of interdisciplinarity (sometimes more resembling multidisciplinary research practices than true interdisciplinarity), was in line with characteristics of neoclassical economics, which Whitley termed as being a partitioned bureaucracy. Environmental economics possessed “strong consciousness of the boundaries of economics and what are, and are not, economics problems, a highly rule-governed set of research practices (...) and a highly formal symbol system for communicating and co-ordinating task outcomes” (Whitley, 2000: 184).

The main goal of this analysis, however, was to compare several crucial actors and characteristics in the emergence and establishment of both fields, which could explain their divergence (see

Table 2). Both fields can draw upon a long history of particular framings of relations between the economy and the environment, which are similar to contemporary worldviews of these fields’ protagonists. However, institutional continuity and social relevance of these framings was quite different. This is reflected in the fact that concepts such as cost-benefit analysis and externalities, developed by economists incorporated in the history of environmental economics, became part of mainstream economics. Likewise, economics journals dealing with related topics were easily transformed into a venue for an emerging discipline of environmental economics.

Using the second law of thermodynamics in explaining economic processes, which became one of the key concepts of ecological economics, did recur among various authors in the 19th and early 20th century, as Martinez-Alier (1987) demonstrated. But it was rarely used by mainstream economists and certainly not as an integral part of an established school of economics. Only with social change i.e. the rise of the environmental movement did theories that underpin contemporary environmental and ecological economics become significant enough to provide the bases for established and independent fields. As demonstrated here, those narrating environmental and ecological communities interpreted concepts such as externalities and entropy as key concepts in the works of appropriated scholars such as Pigou and Podolinsky, respectively. On the other hand, prominent scholars experiencing environmental revolution made little use of concepts the focal points of their scholarly activities: entropy in Georgescu-Roegen’s case or non-use value of nature in Krutilla’s case.

Ecological economics was late to the game, as it lacked an organizational heritage and also possessed an ideological outlook that was more radical and included broader societal and political goals than environmental economics. This outlook was a product of an interaction between the emergence of radical environmental movements and the ideological backgrounds of some of the founders of ecological economics. For example, Georgescu-Roegen and Daly anticipated green ideology positioning itself as an ideology beyond left and right ideology and criticised both Marxist

Table 2. Outline of the main divergences between environmental and ecological economics

	Environmental economics	Ecological economics
Ideological predecessors	Universalistic utilitarianism, Conservationists	<i>Narodniki</i> , Preservationists
Ideological co-travellers	Environmentalism (liberal, social democratic)	Ecologism, Environmental justice movements, Degrowth movement
Adjacent concept of green ideology becoming core concept	-	Non-violence, Global North-South equality
Earlier journals becoming an outlet for the field	<i>Land Economics</i> (1925) <i>Natural Resources Journal</i> (1961)	-
Establishment of the eponymous journal	<i>Journal of Environmental Economics and Management</i> (1974)	<i>Ecological Economics</i> (1989)
Establishment of a major association	Association of Environmental and Resource Economists (1979)	The International Society for Ecological Economics (1988)
Type of scientific field	Partitioned Bureaucracy	Fragmented adhocacy
Types of interdisciplinarity	Bridge building	Restructuring, Integrative
Key concepts	Externalities, non-use value of nature	Energy, Entropy
Type of scientific/intellectual movement	Stealth SIM: low levels of grievances and high levels of institutional stability	Genuine SIM: high levels of grievances and low levels of institutional stability

and capitalist worldviews, aiming to produce a new economics paradigm. Subsequently, ecological economics' profile was then reinforced by the rising importance of radical environmental movements. Therefore, ecological economics was a scientific/intellectual movement in a true sense.

Environmental and ecological economics are, crudely speaking, results of but also contributors to two ideologies: environmentalism and ecologism. Similar to environmentalism, the analysed environmental economists perceived contemporary society as being able to adapt to ecological crises through piecemeal improvements, thus echoing liberal and social democratic approaches. The analysed ecological economists, on the other hand, saw the need for a radical transformation of industrial society as ecologism does, thus going beyond debates between established right and left ideologies and providing a new understanding of the world and new guidelines for action. Ecologism, being a far more radical ideology, prompted more radical types of interdisciplinarity and scientific/intellectual movements.

Restructuring and integrative types of interdisciplinarity present among ecological economics' founders meant that they strongly challenged the neoclassical paradigm. Ecological economics

as a genuine scientific/intellectual movement was more concerned with historical narratives (Frickel and Gross, 2005: 223), which allowed them to draw boundaries towards environmental economics. Scholars founding and establishing ecological economics perforated existing boundaries towards the natural sciences. However, as the competition with environmental economics became ever more important, more radical practitioners of ecological economics built firm boundaries towards environmental economics, while others opted for a more cooperative approach. This is in line with Lamont's and Molnár's (2002: 180) conclusion that boundary-work in science involves "the presence of relational (and often political) processes operating across institutions and contexts". Environmental economics was less concerned with boundary-work, because it could emphasize continuity with mainstream economics and thus gain access to resources.

The stories of environmental and ecological economics demonstrate how specific ideas such as the use of entropy in studying economic processes and treating pollution as an externality were recurring in the history of economic thought without being an inspiration for a school of thought or a scientific field. During the early years

of economics' professionalization, several scholars possessed appropriate combinations of ideological backgrounds and scientific practices that brought about the key concepts of both fields. But due to a lack of social demand and the insufficient proliferation of institutions of economic science, these theories were not developed and institutionalized. The impact of the environmental revolution on the establishment of environmental and ecological economics emphasizes the need for studying the effects of major social changes on the establishment of scientific fields, but also on their divergence.

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Notes

- 1 Social causes are not primarily causes of the emergence of new ideas. Natural causes in the form of environmental crises, although also caused by social causes such as industrialisation and globalisation, and internal developments in the scientific ability of tracking and analysing environmental deterioration were crucial for their emergence. However, the focus here is upon social causes, which can help explain the divergence of these fields.
- 2 This was not the case, for instance, for William Stanley Jevons who has a significant role in both fields' prehistories (on Jevons's importance for both environmental and ecological economics see Missemer, 2012).
- 3 Ecological economics is often deemed as a transdiscipline by its practitioners (Colander et al., 2004) and this also indicates boundary-work towards mainstream economics, which is often accused of being far less open to other disciplines.
- 4 Another crucial text for ecological economics was Boulding's essay on Earth as a spaceship i.e. as a closed system (1966). Boulding's venture into environmental issues can be interpreted as one stop on his journey towards creating a transdisciplinary and integrative system of knowledge. However, the integrative type of interdisciplinarity mostly embodied in general systems theory and the work of Odum did play an important role in the establishment of ecological economics (see Røpke, 2004).
- 5 The OECD was also highly instrumental in promoting interdisciplinarity (Thompson-Klein, 1990).
- 6 In the history of environmental thought and protection similar divergence happened at the end of the 19th century. Pinchot and Muir, at first allies in the fight against laissez-faire treatment of nature, argued acrimoniously how to practically proceed with the protection of wilderness (Banzhaf, 2019).