POPULATION GROWTH:

A COMPARISON OF EVOLUTIONARY VIEWS

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Abstract

Economists are divided about population growth: the pessimism of neo-Malthusians contrasts strongly with the optimism of cornucopians. Despite their differences, both schools of thought reject economic orthodoxy and prefer evolutionary forms of theory. Their interpretations of evolution are different: the neo-Malthusians appeal to the entropy law, whereas the cornucopians emphasise human creativity expressed through markets. This paper argues that both schools are right to adopt an evolutionary outlook, but that they are too restrictive in their conception of evolution. A more complete evolutionary view, which allows properly for social institutions, could give a more balanced account of population growth.

Keywords: population growth, neo-Malthusians, cornucopians, economic evolution, markets, institutions

Introduction

Population growth has been discussed by economists from Malthus onwards, and yet no consensus has been reached on its economic consequences. The disagreements about population growth are as comprehensive as ever, and the debate has often been ill-tempered and acrimonious. On one side are the neo-Malthusians, pessimists or 'doomsters'. For them, the unprecedented rate of population growth, combined with rapid economic development, has brought about humanity's first encounter with the global limits to growth. The current pressure on non-renewable resources and the natural environment may, if unabated, have disastrous consequences. Immediate policy responses are called for, including measures to slow down population growth. On the other side are the optimists, cornucopians or 'boomsters'. Far from being alarmed by population growth, the cornucopians welcome it. Population growth, according to them, goes hand in hand with economic development. In the short term, a growing population may cause temporary hardships, but in the longer term it provides the necessary stimulus for technical changes and the discovery of new resources. Markets are the means by which the changes will be made, so policy intervention is futile; measures to curb population growth and interfere with markets would only make things worse. The two schools of thought are diametrically opposed on all the major issues, and the chances of reconciliation seem to be slender.

The neo-Malthusian and cornucopian views do, however, have two features in common. The first is that they both claim to be evolutionary in character. In both schools of thought the word 'evolutionary' is used, albeit with different connotations. At least there is some shared terminology and the prospect that an elaboration of the idea of evolution might bring the two schools closer together. The second common feature is that both neo-Malthusians and cornucopians see themselves as iconoclastic; they contrast their own views with those of an 'orthodoxy' which is supposed to represent the conventional wisdom of economists. The orthodoxies posited by the two schools differ significantly. For the neo-Malthusians,

orthodoxy is a faith in the ability of markets to contend with and remove resource constraints; for the cornucopians, it is a belief in the permanence and immutability of resource constraints. Both schools of thought claim to hold a minority view and regard their opponents as defending the majority, orthodox position. The confusion about what constitutes orthodoxy demonstrates the low-key, non-committal treatment of population in mainstream economics.

This article compares the evolutionary views of the neo-Malthusians and cornucopians, and examines their relationship with mainstream and non-mainstream economics. The discussion first looks in greater detail at the neo-Malthusian and cornucopian accounts of population growth, and then considers how a more complete evolutionary view might be formulated.

The pessimists

Pessimism about population growth has a long pedigree in economics, dating back to the Malthusian population principle. Prior to Malthus, commentators on population growth had tended to adopt an optimistic or neutral view: this is true of most ancient, medieval and mercantilist writers (Overbeek, 1974). Although Malthus was not the first to make pessimistic arguments about population growth, his arguments had far greater impact than those of previous writers. The Malthusian stress on diminishing returns to labour and the role of population growth in keeping wages at subsistence level became a cornerstone of the Ricardian model and of classical political economy. Later, economists such as J.S. Mill questioned Malthus's policy conclusions (notably his refusal to endorse birth control as a way out of the Malthusian predicament), but they remained loyal to the Malthusian population principle. Malthusian pessimism was firmly entrenched among economists throughout the heyday of classical political economy.

The Malthusian outlook weakened slightly in the second half of the nineteenth century, when the economic mainstream converted from classical to neoclassical economics. No longer lying at the centre of the basic model of the economy, the Malthusian population principle was relegated to being a minor long-term issue. Neoclassical economists accepted the possibility of diminishing returns, but their static, individualistic theory drew attention away from population. Outside the economic mainstream, openly anti-Malthusian sentiments were expressed. Marxian economics, while built on Ricardian foundations, never incorporated the Malthusian population principle. Marx and Engels were hostile to Malthus, for a number of reasons: as a reputed plagiarist, as a reactionary critic of socialism, and as a proponent of universal, ahistorical theory that denied the historical character of economic arrangements (Meek, 1953). For Marx and Engels, surplus population is generated not through demographic change, but through the functioning of the capitalist system. Doubts about the Malthusian population principle were also apparent in early Keynesian writings. Keynes was an admirer of Malthus, but he showed concern about the deflationary consequences of a declining population, to be set alongside the Malthusian concern about a growing population (Keynes, 1937). The deflationary dangers of a declining population were a prominent theme of early Keynesian writers (Hansen, 1939; Reddaway, 1939), although the postwar period of economic growth and rising fertility diverted the interests of Keynesians away from demographic change. After the demise of classical economics the general position among economists was a half-hearted acceptance of Malthusian arguments by the neoclassical mainstream, qualified by some reservations from non-neoclassical economists about the relevance of Malthus for modern capitalism. This was the scene for the revival of Malthusian ideas in the 1960s.

An early and important neo-Malthusian text was Carlo Cipolla's account of world population history (Cipolla, 1962). According to Cipolla, world population growth has undergone two revolutions determined by major shifts in energy sources: the Agricultural Revolution around 10,000 BC, which saw a shift from hunting/gathering to agriculture (and

hence from unsystematic to systematic use of renewable energy sources), and the Industrial Revolution, starting in the late eighteenth century and still in progress, which has seen a shift from agriculture to industry (and hence from renewable to non-renewable energy sources). The recent rapid acceleration of world population growth has been heavily dependent on irreplaceable fossil fuels. It seems, therefore, that the current rate of population growth cannot be sustained indefinitely, and unless preventive action is taken the world may be heading for a Malthusian crisis. The fears about world population growth were dramatised in *The Population Bomb* by Paul Ehrlich, which predicted demographic disasters in the short term (Ehrlich, 1968). These predictions were contradicted by subsequent experience, but Ehrlich has since then extended and consolidated his ecological arguments (Ehrlich and Ehrlich, 1972). Although the time scale of neo-Malthusian predictions has had to be revised, their content is the same: without immediate preventive action, population growth will be suppressed by the Malthusian checks of famine, disease and war. The preventive action may need to be drastic, and neo-Malthusian ideas such as the 'triage doctrine' and the 'lifeboat ethics' of Hardin (1974) have aroused fierce controversy.

The initial neo-Malthusian arguments about population were not based explicitly on economic theory and not, in general, propounded by economists (Cipolla, for instance, was an economic historian, Ehrlich a biologist). Apart from a vague appeal to Malthus, there was little attempt to relate neo-Malthusianism to classical and neoclassical economic theory. It would have been straightforward to justify neo-Malthusian conclusions as the result of diminishing returns when population increases in the presence of fixed factors of production. Neo-Malthusianism is readily compatible with mainstream economics in either its classical or neoclassical guises. Instead of allying themselves with the economic mainstream, however, ecological writers have sought alternative theoretical underpinnings.

A prominent alternative has been Nicholas Georgescu-Roegen's entropy-based 'evolutionary' economics (Georgescu-Roegen, 1971). On this view, the evolutionary

character of economics stems from the one-way movement from low to high entropy, a process entailing evolutionary change that is missing from mainstream theory. Neoclassical economics rests on an analogy with classical mechanics and shares its timeless, ahistorical quality (Mirowski, 1989). Georgescu-Roegen went beyond classical mechanics to the later, more evolutionary theories of thermodynamics. If economic theory is to recognise thermodynamic principles, it cannot ignore the continuous loss of accessible energy sources over time. The finiteness of resources is restored to a pre-eminence in economic discussion unknown since the days of Malthus. Georgescu-Roegen bolstered his arguments for a more historically based economic theory with criticism of the positivistic aspirations of mainstream economists and with numerous observations on the humanistic and historical nature of the social sciences. All the same, the core of his evolutionary economics is an adherence to the principles of thermodynamics.

Neo-Malthusians are faced with a dilemma when choosing their theory. Their message could be delivered in the language of mainstream economics, merely by picking out some implications of classical and neoclassical theory that have been neglected in recent years. However, this would not provide a genuine theoretical alternative to the economic mainstream and would be a poor vehicle for the humanistic concerns of many ecological writers. The evolutionary economics of Georgescu-Roegen goes for a more historical, less mechanical view by drawing on post-Newtonian ideas that are more sensitive to time and history. Goergescu-Roegen's work is very broad in scope, with a strong awareness of the tensions between natural and social sciences, and it would be unfair to accuse him of overlooking historical and humanistic considerations. His arguments nevertheless originate in the natural sciences and retain some affinities with mainstream economics. Mirowski (1988) has questioned Georgescu-Roegen's desire to make a clean break from neoclassicism and pointed out his reluctance to formulate an alternative theoretical scheme (although Foster (1993) defends him on these issues). In its natural scientific background and its reliance on resource constraints, Georgescu-Roegen's evolutionary economics is

congenial to the outlook of mainstream economics, even if its more historical character is at odds with the details of neoclassical theorising.

The ambiguity of the neo-Malthusian position can be seen in its policy proposals. Herman Daly's notion of a steady-state economy is an example (Daly, 1992). As a neo-Malthusian, Daly is keen to distance himself from mainstream economists, with their approval of economic growth and their disregard for the scale of human activities. He distinguishes between 'absolute' (or Malthusian) scarcity, which refers to the finiteness of resources in general, and 'relative' (or Ricardian) scarcity, which refers to the scarcity of some resources relative to others and allows for unlimited opportunities for substituting between resources. Orthodox economists are depicted as being interested only in relative scarcity and losing sight of the absolute scarcity on which neo-Malthusian arguments depend. What is needed is a set of policies to cope with absolute resource constraints. Daly's policies are market-based: proposals include tradable depletion quotas for non-renewable resources, transferable birth licences to restrict population growth and a 'distributist institution' to equalise access to the market (Daly, 1992, Chapter 3). Such proposals are neoclassical in spirit; the market is fulfilling its neoclassical function of efficiently allocating given total quantities of real resources. Redistribution is accomplished by the standard neoclassical device of rearranging endowments. Policy intervention serves only to fix the total quantities to be allocated, thus attempting to make operative a simple neoclassical 'cake-dividing' model. In effect, Daly is criticising mainstream economists for not being neoclassical enough; they have not applied neoclassical principles with sufficient rigour to the allocation of scarce natural resources. To implement Daly's policies would be to try to create an economy that really was a static resource allocation mechanism and had all the mechanical qualities of neoclassical theory. This clashes with the holistic and humanistic pronouncements to be found elsewhere in neo-Malthusian writings. The theoretical and policy stances of neo-Malthusians are closer to mainstream economics than one might think from the tone of their discussion.

Neo-Malthusianism is essentially naturalistic in its placing of humanity within an external natural order. Ultimately, humanity will have to come to terms with the finiteness of the earth and the natural limits to economic growth. The corresponding concept of evolution is likewise naturalistic. Entropy gain is a one-way natural process governed by an evolutionary law. Human creativity is never going to evade the fundamental resource constraints imposed on the species, and all that humanity can do is influence the timing of entropy gain. Evolution has a known end point in the exhaustion of non-renewable resources. The one thing that cannot evolve is the finite extent of energy availability, so evolution becomes a process with a predictable outcome but unpredictable timing. In a closed system 'heat death' is unavoidable, but it should be deferred for as long as possible by measures to curb population growth and the waste of scarce resources. The pessimism is tempered only by humanity's ability to delay the final tragedy.

The optimists

Among economists, optimism about population growth has generally been a minority viewpoint confined to authors outside the mainstream. Few economists have gone as far as to argue directly for population growth: even the Marxian and Keynesian criticisms of the mainstream do not amount to this. The strongest advocacy of population growth has arisen in the last twenty years or so, as a response to neo-Malthusianism. It remains a minority viewpoint, but has gained ground on its neo-Malthusian opposition. The arch-cornucopian has been Julian Simon, who has put forward a wide-ranging and polemical case for the benefits of population growth (Simon, 1977, 1981). Simon's self-appointed task has been to confront what he sees as the orthodoxy of neo-Malthusianism and replace it with a more optimistic vision.

Markets are the linchpin of Simon's reasoning. He is highly critical of the neoclassical (and neo-Malthusian) stress on the allocation of given resources (Simon, 1992, Chapter 6). Markets, for Simon, are not a static resource-allocation mechanism: they are a means of removing resource constraints, rather than allocating within them. As a population grows, the rising resource requirements may create temporary scarcity and hardship, but this is the necessary spur to the functioning of markets. Any shortages caused by population growth will increase the prices of natural resources. Higher prices provide the incentive to find new resources and discover new means of satisfying the higher demand. Eventually either new supplies of existing resources will be found or, failing that, new substitutes for the scarce resources will be introduced. In the longer term the erstwhile shortages will be eliminated, resource prices will be lower than they were before, and humanity will have benefited from what appeared at first to be the adverse consequences of population growth. The temporary difficulties, although unfortunate, are necessary for change; without them, there would be no technical progress and few openings for improved living standards. Simon deploys the argument on a broad front: in LDCs, where markets are less prevalent than in the developed world, population growth can still be beneficial by encouraging the introduction of markets. A higher population density is a prerequisite for, and stimulus to, specialisation and trade, and along with new markets should come improvements in the infrastructure and education (Simon, 1992). Population growth, for Simon, is desirable in the longer term in both developed and less developed countries; there is no substance in the neo-Malthusian fears of a demographic crisis.

The arguments about population growth fostering technical change are not original to Simon; as he acknowledges, they date back as far as von Thunen writing in the early nineteenth century. Recent work in this vein is associated with Ester Boserup, who argues that population growth provokes social, cultural and technological changes (Boserup, 1965). The cornucopian view of markets has the flavour of Austrian economics. In Austrian theory, markets serve as an outlet for human creativity, rather than a resource-allocation mechanism. The discovery of new resources and the introduction of

new techniques are not just smooth, relative-price-induced substitutions between productive techniques in the neoclassical manner. They are acts of creativity, additions to knowledge, as opposed to selections from known alternatives. There is no identifiable absolute resource constraint on which resource-allocation decisions can be founded. Simon dismisses the entropy-based arguments of the neo-Malthusians as questionable scientifically and in any case irrelevant. Nor is enough known about relative scarcity to apply clear-cut neoclassical arguments about optimal resource substitution. The general outlook is that of the Austrian school, although Simon does not say so directly. He does, however, disown neoclassical theory and aligns his work with Hayek's related work on cultural evolution.

In his early writings, Hayek only hinted at the role of population growth in the development of capitalism (or the 'extended order' as he calls it), but in his later work this becomes much more explicit (Hayek, 1989, Chapter 8). Population growth, for Hayek, is not a problem as long as it is accompanied by the expansion of markets: population growth occurs always on the periphery of developed sectors of the economy, causing temporary hardships, but these are overcome when the new population takes advantage of the opportunities proffered by capitalism. Any temporary difficulties are regional, not global, and specific to particular areas. The risks of population outgrowing resources are negligible if population growth is matched with, and made possible by, growing productivity. Hayek is happy to quote Simon's empirical work, and Simon regards Hayek's views on population as a long-run version of his own population theories (Hayek, 1989, pp. 125-6; Simon, 1992, p. 448). It seems reasonable, therefore, to describe the views of Hayek and Simon as an Austrian account of the consequences of population growth.

Unlike the naturalism of ecological, neo-Malthusian writers, the Austrian account of population growth is anti-naturalistic and appeals to humanity's ability to transcend nature. The approach is more than humanistic: it is anthropocentric in that it focuses on human creativity and omits the possibility of humanity being thwarted by external, natural

constraints. This separation of humanity from nature derives from the more individualistic types of German romanticism: the creativity of the human individual is stretched to the point where humanity is thought to be unbounded (Berlin, 1991). Austrian subjectivism goes beyond human self-consciousness and perception of the external world to the reshaping of the external world itself. Individual self-interest and creativity can be foiled by the artificial restrictions of economic planning, but not by nature. We can be defeated only by ourselves. The only thing we have to fear is the failure to allow free markets to operate without interference and thereby realise humanity's potential. Simon rebukes the neo-Malthusians for being misanthropic in their underestimation of human capabilities and their reluctance to let the species multiply. Hayek rejects all planning and depicts unrestricted markets as the only way to maximise the stream of human lives. It is a 'fatal conceit' to think that we can plan the affairs of other human individuals, although not, apparently, to think that we can transcend nature. There is a hint of overconfidence in this. Its air of certainty jars with the Austrian emphasis on fundamental uncertainty and historical time. Simon is sceptical of current knowledge of resource availability and questions the eternal validity of the entropy law; this scepticism is inconsistent with his wilder statements about the absence of any resource constraints (Simon, 1981, pp. 5-6). Fundamental uncertainty can undermine the pronouncements of cornucopians as well as of neo-Malthusians. The ultimate limits to growth may perhaps be unknown, but this does not guarantee that they are non-existent.

The evolutionary arguments of the cornucopians differ from those of the neo-Malthusians. In accordance with Austrian ideas, evolution is assumed to be driven by human creativity and the selection of the most successful individuals and groups. The 'extended order' of capitalism emerges spontaneously as the system which permits the greatest differentiation of individuals and the widest opportunities for the acquisition of new skills, information and knowledge. Under capitalism, the conscious goals of social planning are replaced by market interactions resting on abstract general rules, with no anticipation of outcomes. The evolutionary process is complex and unpredictable, yielding

a system that is beyond human comprehension but well adapted to exploit human abilities to the full. The direction of evolution is deemed to be unknown, although the emergence and universal superiority of market systems are one prediction that is made. Optimists, like pessimists, have to make predictions of some sort, and the cornucopians predict that history will end in the triumph of the market.

Towards a more complete evolutionary view

The debate between neo-Malthusians and cornucopians has been unsusceptible to empirical resolution. In the short term the cornucopians have won most of the empirical arguments about resource prices, resource availability and the incidence of famines. As Simon has been quick to point out, commodity prices have been falling, whereas known reserves of primary commodities have been rising. World food production has so far been sufficient to meet total needs, and there is no aggregate food shortage, even if 'entitlement' problems have led to localised famines (Sen, 1981). The cornucopians have fairly solid empirical backing in the short run, although Simon's own empirical work is not in itself conclusive (Daly, 1992, Chapter 14). The inaccuracy of the more dramatic neo-Malthusian predictions and the apparent empirical success of the cornucopians are largely responsible for the increasing influence of cornucopian ideas. In the longer term the neo-Malthusians could still be proved right. The difficulty is that their views may be vindicated, if at all, only in the distant future and perhaps in tragic circumstances.

Without a conclusive empirical outcome, the population debate is likely to continue to be conducted on the basis of theoretical opinions and policy proposals. The extremity of the neo-Malthusian and cornucopian positions leaves plenty of middle ground for compromise views, which have come to the fore in recent policy discussions. After the initial neo-Malthusian scare of the late 1960s and early 1970s, the extreme neo-Malthusian views

have steadily receded. The usual illustration of this is the change in official attitudes to population growth between the UN World Population Conference in Bucharest in 1974 and those of ten and twenty years later in Mexico City and Cairo. The later conferences avoided alarmism and preferred a broader view which took into account the relationships between the developed and less developed world. Most of the use of scarce resources is by the developed countries, which have stable or slowly growing populations, so the effect of Third-World population growth on scarce resources is comparatively small. If the Third World were ever to complete the same demographic transition as the developed countries, the slowing down of population growth would coincide with an acceleration of economic growth that would increase the total demand for scarce resources. The links between world population growth and resource use are sufficiently complex for different policy conclusions to be drawn from them: neo-Malthusians regard a Third-World demographic transition as impossible, but not as any panacea even if it could occur; cornucopians regard it as the inevitable outcome of the evolutionary process that is spreading the benefits of the market system over the whole world. A compromise view is to give population growth its due place as a factor contributing to increased resource use, but to concede that it is intertwined with other influences that may be of equal or greater importance.

Another recent change of emphasis has been in the presumed nature of the shorter-term limits to growth. The first experiences of global limits have been environmental and climatic, and not from the depletion of exhaustible resources. Discussion of the shorter term has moved away from non-renewable resources towards those potentially renewable resources which are not currently being renewed: examples are the tropical rain forests, the atmosphere and the oceans. Because these resources are renewable, there is room for hope. In contrast with the unrelieved gloom of early neo-Malthusian writers, recent ecological writings on population have given more credence to optimistic views (Harrison, 1993). Discussion of the practicalities of population growth has shown a welcome tendency to combine neo-Malthusian and cornucopian arguments to produce a more balanced outlook.

Compromise has not been so evident at the theoretical level, yet an elaboration of the existing theoretical arguments may be able to offer a less restrictive account of reality. In looking for an elaboration, it is helpful to recall the observation made earlier about the two common features of neo-Malthusianism and cornucopianism: their evolutionary aspect and their rejection of orthodoxy. If a heterodox stance implies a rejection of neoclassical approaches, then it is a useful starting point; the static, mechanical, individualistic methods of neoclassical economics have little to contribute to the theoretical analysis of population growth. The two schools of thought are not, unfortunately, rejecting the same orthodoxy: the cornucopians clearly have a neoclassical orthodoxy in mind, but this is less obvious with the neo-Malthusians. In characterising all economists as pro-growth, they fail to distinguish between the neoclassical view of markets as a static resource-allocation mechanism and the Austrian view of markets as a dynamic source of creativity and growth. As can be seen from their policy proposals, it is uncertain that they have renounced neoclassical economics. Some neo-Malthusian writings read as if they are rejecting an Austrian 'orthodoxy' to return to the sound neoclassical principles of allocating scarce resources among alternative uses. A more thoroughgoing ecological approach would emphasise history, evolution and uncertainty, and distance itself from the mechanistic vision of neoclassical economics. This would mean resisting the temptation to draw up neat, neoclassically inspired policy proposals that do away with uncertainty and claim to be an efficient mechanism for allocating known quantities of scarce resources. For the neo-Malthusians to join the cornucopians in explicitly repudiating neoclassical orthodoxy would be a rare note of unity between them and a possible basis for reconciliation.

One way to steer clear of neoclassical theory is to invoke the idea of evolution. Both neo-Malthusians and cornucopians do this, but differently. The question is whether a more elaborate evolutionary framework could encompass both schools of thought. For neo-Malthusians, evolution unfolds within a holistic natural setting that is independent of human numbers and behaviour. Nothing can circumvent the entropy law. The natural setting within which people act never changes, and the laws of thermodynamics remain in

place. Humanity is a minor detail in a larger evolutionary process, in which neither energy nor matter is created or destroyed and entropy gain proceeds towards its inevitable final outcome. By conserving natural resources and slowing down population growth, humanity can delay the final outcome, but eventually it must arrive, even for so-called steady-state economies. What matters is the global constraint on the whole of humanity. The cornucopians, by contrast, are preoccupied with the diversity of local conditions. Evolution is an anthropocentric process that depends on human ingenuity in meeting challenges. As long as human individuals are given free rein to be creative, they will cope with all the local challenges to which they are subjected, as they always have done in the past. There is no known global constraint on this process, no challenge that cannot be overcome. The evolution of human societies will culminate in the universality of the market, which is the best of all possible worlds and serves to maximise human prosperity and adaptability to exogenous changes. Beyond that the cornucopians do not look.

These two notions of evolution are not entirely incompatible. They focus on different levels: the one physical and holistic, the other human and diverse. In Georgescu-Roegen's writings there is much that resembles the traditional concerns of Austrian economics: he touches frequently on history, uncertainty, free will, creativity, and so forth. One of the main contributions of the entropy approach is to turn economics away from the mechanistic theorising of neoclassicism towards the humanism that would be endorsed by Austrian writers. A more elaborate evolutionary perspective could combine holism and diversity, thus avoiding the oversimplified, extreme views that have disfigured the population debate.

Largely omitted from the debate is the role of social institutions. Because the object of contention is population, there is a tendency to neglect 'society' or at most to see it as an aggregation of individuals (a 'population'). The key variable is the total number of individuals: for the neo-Malthusians this pushes against the limits to growth and engenders a Malthusian crisis, and for the cornucopians it stimulates the market responses which lead to new resources being exploited. In practice, however, the knowledge of numbers alone is

insufficient for a proper explanation of social and economic changes; the structure of the social and economic system under discussion is also of vital importance. This harks back to the arguments made by Marx and Engels against Malthus. In their view, Malthus's claim to have discovered a truly general population principle was spurious, and any commentary on population should be specific to a given economic system. Although Malthusian ideas might be relevant to some conceivable forms of society, they were not thought to be relevant to capitalist economies which create a surplus population through unemployment irrespective of the rate of population growth. Similar arguments can be made against anti-Malthusian, Boserupian ideas about the benefits of population growth; population pressures might well provoke the introduction of markets, but other responses are possible depending on social institutions; nor is it clear why population pressures are the dominant cause of the introduction of markets in comparison with, say, social and institutional pressures (Nell, 1992). A full account of population growth should consider how population change affects institutions and, conversely, how social institutions affect population changes. Causality may be complex, and treating population as an autonomous influence on the economy may be an oversimplification.

The neglect of social institutions gives rise to a juxtaposition of nature and human individuals, with no social institutions as a mediating factor. Neo-Malthusians, despite the breadth of Georgescu-Roegen's approach, have concentrated quite narrowly on nature. Yet even the perceived natural limits to growth are socially mediated knowledge (that is, 'thought objects') and not purely physical. Science is an evolving social activity, which has not yielded a perfect understanding of humanity's natural setting. At present the entropy law seems to be watertight. Doubts remain, though, over the origins of the initial low entropy state and the assumption that the universe is a closed system (Boulding, 1981, Chapter 5). It would be prudent to admit that current science is provisional and may be superseded, and that what now appear to be insuperable physical limits may in fact not be. The earth, as an open system, permits some resources to be renewed. Many current resource constraints are at least conceivably surmountable (either by renewal or

substitution) and whether or not they are actually surmounted will depend on social conditions. The only unsocial, purely physical and insurmountable constraint is the last, most distant one, namely the running down of all available energy sources in the universe. Cornucopians have the opposite tendency to concentrate on human individuals. Their faith in individual abilities and human creativity leads them to think that all surmountable constraints will be surmounted. Challenges and temporary crises will have to be overcome before changes are made; 'optimism' could well embrace constraints which are surmounted only in the minimal sense that not everyone perished. To forget about the limits to growth until they are encountered means that environmental problems can only be cured, never prevented. The individualism of the Austrian vision plays down the value of conscious planning for the future; social institutions are construed negatively as undesirable constraints on individual activity. The cornucopians subordinate both the natural environment and social institutions to the behaviour of individual agents within markets, and in doing so present a unidimensional account of evolution.

A broader account of evolution can avoid reducing the population debate to the dominance of nature or humanity. If humanity is seen as part of nature, with powers that emerge from nature, then the nature/humanity division becomes redundant. Evolution has its naturalistic and individualistic facets, as well as others (such as the social and cultural) which are barely mentioned in the population debate. Through a less reductive stance, it should be possible to locate the concerns about population growth within a single, more open and complex evolutionary view. To the best of current knowledge the entropy law holds true and constitutes a constraint on evolution. The entropy law itself is open to doubt, however, and leaves enough leeway for humanity to escape imminent catastrophe. The most pressing practical considerations depend not on the ultimate constraint of the entropy law, but on the 'potentially-renewable-but-not-currently-being-renewed' class of resources. Economic evolution need not take the market-centred form ascribed to it by the cornucopians, and to insist on this form of evolution is an arbitrary assumption. A wider outlook would be less reliant on individual creativity and spontaneous order, and give

greater weight to collective human design and planning for the future. This would be better attuned to the activist views of ecological writers, and would allow a diversity of policy views to coexist within the same evolutionary framework.

Whatever the differences over theory and policy, there is tacit agreement between neo-Malthusians and cornucopians on the importance of evolution. To seek to deny evolution altogether by creating a steady-state society would be intrinsically undesirable and a sure way of minimising responsiveness to unforeseen challenges (Boulding, 1981). Georgescu-Roegen (1975) is critical of the concept of a steady state, while Daly's proposals for a steady-state economy are careful to give society freedom to evolve (Daly, 1993). The outcome of evolution is uncertain, notwithstanding the predictions made by the optimists and pessimists. Recent demographic work on world population has reflected this uncertainty and has become circumspect about the future (Livi-Bacci, 1992). For evolutionary theory to be equally circumspect, it should not embody the strong predictions made by neo-Malthusians and cornucopians. The relevant type of evolution has no predetermined, holistic pattern of development and no consummation in a final, known outcome: in the taxonomy of Hodgson (1993) it is genetic, population-based and non-consummatory. Neither the neo-Malthusians nor the cornucopians have appealed to this type of evolution and so, from the outset, they have restricted the range of conclusions that can be drawn. A sufficiently complex evolutionary framework would not in itself determine whether pessimism or optimism is warranted and would be capable of accommodating either.

Conclusion

Both sides of the population debate are right when they question the value of mainstream economics in discussing population growth and opt for a more evolutionary outlook.

Where they seem to go astray is in choosing restrictive, tendentious and one-sided accounts of evolution that have yielded extremes of pessimism and optimism. Neo-Malthusians dwell too much on the ultimate, long-run constraints on economic activity, and underestimate the scope for dealing with the shorter-term problems presented by population growth. Cornucopians, by contrast, are unwilling to contemplate any binding constraints on humanity and take it for granted that the problems presented by population growth will be dealt with easily and without conscious planning. Reality is likely to fall between the extremes. The future is sufficiently uncertain to make it difficult to take a strictly pessimistic or optimistic line. In these circumstances, an appropriate evolutionary framework will be more complex than the ones envisaged by the neo-Malthusians and cornucopians. Natural and human evolution are inseparable, and to ask whether nature or humanity dominates is meaningless. Humanity will evolve within nature, apply powers which emerge from nature to challenges posed by nature, and multiply or diminish according to its success or failure in meeting these challenges.

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