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the Case for an Economic  
Analysis based on  
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# The Current Crisis in Neoclassical Economics and the Case for an Economic Analysis based on Sustainable Development\*

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## ABSTRACT

This paper reflects on the current crisis that confronts neo-classical economics in the wake of declining enrolments in academic economics programmes around the world, the emergence of a popular ‘post-autistic’ economics network following the revolt of economics students at a number of leading universities and, most importantly, the apparent inability of the neoclassical paradigm to bridge the gap between theory and reality. There is a saying that ‘the more things change, the more they stay the same’, but in this paper, the authors contend that the economics profession is now on the brink of a scientific revolution, or what Thomas Kuhn referred to as a ‘paradigm shift’. As Herman Daly has observed, if the theory is not good enough, the real world does not stop to wait. Governments everywhere (and international organisations such as the OECD) are engaged in a big effort to develop indicators that focus on the sustainability of industrial activities. Meanwhile, businesses are waking up to the fact that without careful attention to sustainability issues, they face considerable insurance risks. The paper employs the concepts developed by Thomas Kuhn to assist in the analysis of the current crisis. In the process, it assesses the readiness of national and international political economies to embrace sustainable development and reject neoclassical economics. The paper critically examines, and roundly rejects, key postulates of the theory offered by neoclassical economists to support their arguments that production and consumption can be sustained forever and that the natural environment is not an important constraint on growth. The authors conclude that the theoretical work of ecological economics and its counterpart in the business world, ‘natural capitalism’ is a far more sensible paradigm for business.

## INTRODUCTION

*‘An important scientific innovation rarely makes its way rapidly winning over and converting its opponents; it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out and that the growing generation is familiarised with the idea from the beginning.’*

— Max Planck, *The Philosophy of Physics*, 1936

It is significant that this paper is written by two middle-aged, mid-career, PhD-qualified economists. It is significant, not because the arguments presented here have occurred to us only recently, rather it is only now that it has become possible to write a piece like this for a mainstream audience and stand a chance of being published. Our

dissatisfaction with the explanatory power and logical consistency of neo-classical economics has exercised our minds for the best part of two decades, and the discourse that follows has been refined over countless morning tea discussions, dinner conversations and email exchanges. There is no question that this paper is long overdue, and we have had to nurse our consciences having not attempted, before now, to fulfil our social responsibility as academics to persuade others in their scientific community of our views. The simple fact of the matter, however, is that a range of obstacles have been in existence that would have rendered ineffective any attempt to proffer alternative views in any case. Now things are different, and one of the objectives of this article is to elaborate on this theme, and explain why circumstances have contrived to make this paper a reality.

The main goal of this paper, however, is to present the case for an economic analysis based on the notion of sustainable development. We believe that only an analytical framework that combines well understood economic concepts with basic ecological concepts has the capacity to deal with the problems that currently beset the international political economy. In this regard, we conclude that the theoretical work of the ecological economists, and its counterpart in the business world, 'natural capitalism', offer a coherent integration of ecology and economics and a message that should have wide appeal, not just to theoreticians, but to practitioners in government circles and the business community who, most importantly, are those in a position to bring about change.

The first section of the paper after this introduction begins with a brief commentary on the burgeoning critical literature on the neo-classical paradigm, and how this has coincided with a 'popular uprising' among students of economics around the world who are deserting academic economics in their droves. There are a number of explanations for this phenomenon, but at the heart of it is the apparent inability of the neoclassical paradigm to bridge the gap between theory and reality. This state of affairs has prevailed since the 1970s and steadily worsened to the point where the economics discipline is now in serious crisis and on the brink of what Kuhn (1962) describes as 'scientific revolution'. The second section of the paper provides a broad overview of the nature of the criticisms that are currently being levelled at neoclassical economics, before the ecological economics critique of neoclassical economics is examined in more detail. The third section of the paper presents the case as to why we believe the ecological economics viewpoint will win the day. We argue this point largely on the basis that the real world does not wait for theory to catch up; that is, faced with a real world problem not addressed by the theoreticians, policy makers simply proceed to formulate responses (Daly and Townsend 1993:1). In this regard we point to the many instances where acknowledged problems in the real world are simply ignored or 'assumed away' within the neo-classical analytical framework. The final section of the paper notes the close parallels between ecological economics theory and 'natural capitalism', as advocated in the business best seller written by Hawken, Lovins & Lovins (1999) and draws conclusions about the implications of these approaches for business.

## **THE PROBLEM OF ECONOMICS**

In the first lecture of the semester it is common practice to talk about 'the economic problem'. In the majority of universities around the world these days it more

a case of ‘the problem with economics’ as students are not opting for economics classes, deserting the discipline in droves. Several years ago, the lead article in *The Economist* once famously asked the question: ‘Why has economics not done better?’ One reason, according to the article was that economists ‘tend to blame others for being too lazy or too stupid to understand their text-books.’ This, the article continues, is quite feasible because economics is ‘hard to teach well’ and for ‘the *uninitiated* [emphasis added] its basic principles often seem surprising or odd’ (Anon. 1997). Sadly, it is not just those unversed in the ways of neo-classical economics that find it such a mystery.

After completing the compulsory introductory economics component of their degrees, very few students are electing to pursue economics any further. As a result, numbers enrolled in intermediate level and post-graduate level units have dwindled to the point where many of these courses have become economically unviable at many institutions (see, for example, Siegfried 1995; Millmow 1995, 1997; Lewis & Norris 1997; Devlin 1998). But even those students who have kept faith with the neo-classical theoretical framework are now protesting loudly about its esotericism and increasing irrelevance.

An important watershed in this respect was the birth of the ‘post-autistic economics’ (PAE) movement in 2000 when a group of French economics students, under the banner ‘*autisme-économie*’, published a petition on the web protesting, *inter alia*, against the uncontrolled use of mathematics in economics as ‘an end in itself’, and the resulting ‘autistic science’. This was quickly followed up by a similar protest at Cambridge University in the UK, where the so-called ‘Cambridge-27’, a group of economics PhD students at the Cambridge University, published their own petition campaigning for the ‘opening up’ of economics rather than have research done in economics based on only one approach. Petitions in other countries have followed and there is now a robust global post-autistic economics network with nearly 8000 members in around 150 countries (PAE 2005).

The PAE critique is being accompanied by a striking increase in the number of books and journal articles with titles such as ‘Debunking economics’, ‘Disturbing currents in modern economics’, ‘The crises of vision in modern economic thought’, ‘The death of economics’, ‘Against economics’, ‘The end of economics’, ‘Growth fetish’, ‘The growth illusion’, ‘Where on earth are we going?’, ‘A guide to what’s wrong with economics?’, and ‘More heat than light’.<sup>1</sup> Many of the criticisms of the PAE network and those of the recent literature appear to be increasingly supported by daily events and common sense. That they have not yet brought down the ‘Berlin Wall’ erected by the neo-classicalists may well be because, as is recognised in the literature, those in positions of power, and who have invested a working life-time in the current paradigm, will be the most reluctant to part with that paradigm. As Fullbrook (2004) has commented, neoclassical economists have managed to block the employment of non-neoclassical economists for decades, narrowing the economics curriculum offered by

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<sup>1</sup> See Keen, S. (2001) *Debunking economics*, Sydney: Pluto Press; Blaug, M. (1998). *Disturbing currents in modern economics*, *Challenge*, 41(3), 11-34; Heilbroner, R. & Milberg, W. (1995) *The crisis of vision in modern economic thought*, Cambridge UK: Cambridge University Press; Ormerod, P. (1994). *The death of economics*, London: Faber and Faber; Kanth, R. (1996). *Against economics*, Aldershot UK: Ashgate; Perelman, M. (1996). *The end of economics*, London: Routledge; Hamilton, C. (2003) *Growth fetish*, Sydney: Allen and Unwin; Douthwaite, R. (1992) *The growth illusion*, Tulsa: Council Oaks Books; Strong, M. (2001) *Where on earth are we going?* London: Texere Publishing Ltd; Fullbrook, E. (ed) (2004). *A guide to what’s wrong with economics*, London: Anthem Press; and Mirowski, P. (1989) *More heat than light*, Cambridge UK: Cambridge University Press.

universities to students, and making their theory increasingly irrelevant to understanding economic reality.

### **The theory of scientific revolution**

There is an old English adage that ‘the more things change, the more they stay the same’. This phrase encapsulates rather nicely, the concept of ‘paradigm shift’, and the difficulty sometimes experienced in making the transition from the ‘old way of thinking’ to the ‘new way of thinking’. This phenomenon, as it applies to science, is superbly articulated in the classic work, *The Structure of Scientific Revolutions*, by Thomas Kuhn (1962). In this book, Kuhn attempts to explain how changes and revolutions occur in the physical sciences. A specialist in the history and philosophy of science, he did not intend for his ideas to be necessarily applicable to the social sciences, but his work has had a great impact, and many commentators see it as an explanation of how changes have occurred in the past, and of the forces currently working either to promote further change or, indeed, to prevent change. The concepts developed by Kuhn certainly assist us in the analysis of the science of economics in terms of its readiness to embrace sustainable development as one of the pillars of its theoretical framework and thereafter become thoroughly integrated with mainstream thinking.

Kuhn describes a ‘scientific community’ as a group of scientists having a similar education and being acquainted with the same scientific literature. There is usually a professional journal and a professional society to which they belong, and they attend special conferences devoted to their particular branch of science. There are also informal communication networks between the members, they circulate drafts and proofs of their articles to one another, they correspond on matters of professional interest, and they frequently cite one another in a complex network of citation linkages. Accordingly, the scientific community are the ‘the producers and validators of scientific knowledge’; it becomes the judge of the research of its members, and the members accept the ideas and the solutions currently adopted by the community (Kuhn 1962: 178).

The ‘paradigm’ is Kuhn’s central concept, and it is integral to concept of the scientific community.<sup>2</sup> A paradigm is defined by Kuhn as a ‘disciplinary matrix’; that is, a set of ideas, models, values and attitudes accepted by members of the scientific community. According to Kuhn, a paradigm exercises a number of important functions, some of which can be seen as advantageous to the progress of the discipline, and some disadvantageous.

The main advantage of the paradigm is that its acceptance by the members of the scientific community means that they can devote their energies to further developments of the paradigm, and protect themselves against time-wasting distractions. In other words, they do not need to investigate the fundamentals of their science once these fundamentals have been expressed in the form of the paradigm, and have become a starting point for further research. The paradigm sets the research direction of that particular community; it becomes the criterion for the selection of topics to be

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<sup>2</sup> Kuhn, of course, did not invent the term paradigm. It is defined in the Oxford English Dictionary as an exemplar, or an accepted model or pattern. Kuhn took this standard definition and extended it by saying that a paradigm is capable of development and further articulation.

researched. The paradigm also enables members to distinguish themselves from competing communities who adhere to different paradigms. According to Kuhn, the existence of a paradigm is a sign of maturity in the discipline. In pre-scientific times, or when a science is in an immature stage of development, there is an abundance of unrelated ideas and attitudes, but no consensus (no paradigm).

However, paradigms also have a number of serious disadvantages. Those who adhere to one paradigm will accept innovation within the context of that paradigm, but they strongly resist changes that threaten the fundamentals of the paradigm. To this end, it is not uncommon to find obstacles in the path of new paradigms; some purely intellectual, others financial. For example, those who are in a position to influence the appointment of staff in teaching and research institutions will tend to appoint new staff who will share the same paradigm, excluding any known dissidents. As leaders of their own community, they will also have a tendency not to support applications for research funds that lead to the promotion of competing paradigms, or tend to undermine their own paradigms. In short, the forces of the paradigm act as 'unofficial censors'. The paradigm and its supporters tend to sanitise the science, and to insulate it from newly-emerging real world problems. They become a reactionary, conservative force, intolerant of new theories. In many cases, these new and important problems are 'defined away'; that is, the issues are declared to be outside the realm of interest of the scientific community.

Kuhn uses the term 'normal science' to describe the day-to-day activity of a scientific community. The members are involved in the fine-tuning of an existing paradigm and in applying the existing paradigm to a variety of problems. They are not concerned with questioning the paradigm or inventing new paradigms. In pursuing normal science, the scientists are concerned with 'puzzle-solving' which, in this context, is a category of problems that test the ingenuity and skill of the scientists, but they are problems that can be solved with the application of the current paradigm. If the paradigm continues to solve the puzzles, and if there are no serious problems that cannot be explained by the paradigm, then there is no impetus for change. However, if the scientists come to realise that some important aspects of reality cannot be solved by the paradigm, then Kuhn says that the science has entered into a phase of 'anomaly and crisis'. This phase is characterised by a sense of malfunction, and by pronounced professional insecurity and tension. The first reaction of the scientists to this state of anomaly is not to abandon the paradigm, but to try harder to make it work.

### **Paradigm shift**

Scientific revolution, or 'paradigm shift', is the transition from one paradigm to another. Kuhn chose the term 'revolution' in order to make a deliberate comparison with political revolution. Unlike a political revolution, a scientific revolution does not normally involve bloodshed and violence, but both kinds are the result of profound discontent. After the revolution, the new paradigm does not necessarily replace the old one completely, and some parts of the old paradigm are often absorbed into the new, but most parts of the old paradigm – which are incompatible with the new – have to be dropped. This causes intellectual and psychological difficulties for those who adhered strongly to the incompatible parts of the old paradigm. Some will be persuaded and converted to the new paradigm, but some will resist. After spending many years of study and research to develop their competence in the previous paradigm, and having

achieved personal status and fortune through promoting the old paradigm in teaching and research, they will obviously be reluctant to admit that, to some extent, their efforts have been misdirected, and that their books, articles and lecture notes are now redundant. Over the years they will have defended their paradigm against attack from dissidents, by the exercise of scholarly virtues such as intellectual rigour and singleness of purpose, but now, these very virtues prevent their easy conversion to the new paradigm.

Of course, in many instances, no conversion will be possible and the old paradigm will survive until its supporters die (see the Max Planck quote in the introduction to this paper!). This leads Kuhn to stress the importance of the contributions of young scientists, or of scientists who have recently joined the discipline, in creating or promoting new paradigms. For reasons explained above, however, the intellectual and financial obstacles placed before these young researchers can be formidable, and it is only when these individuals have reached a stage in their career where they have nothing to lose, that they can challenge the paradigm without fear of reprisal.

### **The current crisis in neo-classical economics**

Kuhn's ideas on the function of paradigms seem to be very applicable to mainstream economics. One can see how in the case of the theory of the firm in microeconomics, for example, or in the theory that underpins the IS-LM model in macroeconomics; economists have indulged in abstract and esoteric articulations of paradigms without any real concern for their practical relevance. The great irony is that these theories have withstood the test of time, long after their originators disowned them. In the 1930s, for example, Joan Robinson wrote a book on imperfect competition which stimulated the development of research in this area and a proliferation of models of increasing sophistication and complexity. But Robinson argued that this early work of hers had been misdirected, and that she wished to disown it.<sup>3</sup> This recantation notwithstanding, research into the theory of the firm has continued along the lines she initially instigated. Similarly, John Hicks, who was responsible for the development of IS-LM analysis as a means of explaining Keynesian economics, also recanted his earlier views (Hicks 1980), expressing amazement over the extent to which it had come to dominate the teaching of economics.

One can also clearly see how certain sections of the economics profession close ranks against new problems by defining them as beyond the realm of economics. The leading representatives of the discipline, and the leading journals that publish their articles, are often reluctant to extend the boundaries of economics into areas that border on politics, sociology, or environmental ethics. As a result, important economic issues such as those associated with gender, race, or environmental degradation are rarely taught in mainstream economics courses, and are viewed as fringe areas and not truly 'scientific'.

Kuhn's remarks on the censorship role of the current paradigm and its supporters may also be seen to be relevant to economics. Articles or books that radically challenge the existing paradigm have great difficulty in getting past the

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<sup>3</sup> See: <http://www.cooperativeindividualism.org/robinsonbio.html> (Accessed 07 March 2005).

referees appointed by publishers and journals, because these referees are invariably leading exponents of the existing paradigm. Likewise, applicants for jobs as economists in government departments or universities reduce their chances of success if they are seen to be harbour unorthodox views. Kuhn's ideas in this respect reflect the famous comment made by Keynes (1936: 383-84) on the last two pages of the *General Theory*:

*Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy, there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians, and even agitators apply to current events are not likely to be the newest.*

Put another way, economists in universities oblige students to study issues that appear to have little relevance to the real world, and economists who have gained positions of power in government departments devote their energies to persuading their overlords to implement policies that they studied in textbooks many years previous.

## **THE ECOLOGICAL ECONOMICS CRITIQUE OF NEOCLASSICAL ECONOMICS**

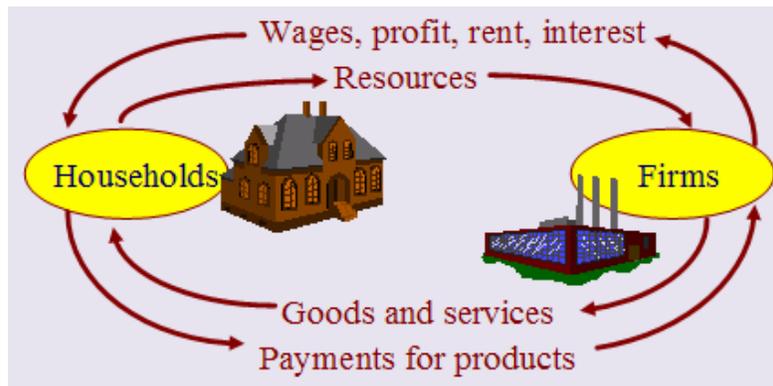
If one were to attempt to categorise the main criticisms currently being levelled at neoclassical economics, one might identify first, the excessive formality and low priority accorded to the need to check theories for real world relevance (as in a 'No Reality, Please. We're Economists' musical, as Blaug (1998:13) has quipped); second, a good deal of unease about the lack of 'plurality' in the views presented, that there is only one 'brand' of economics being taught, and this is being done as if there were one, and only one set of theories that a student needs to learn; and thirdly, a comprehensive critique coming from the ecological economists, particularly from Herman Daly (Daly & Townsend 1993; Daly 1996; and Daly & Farley 2004). Of the three categories, it is the third critique which may have the most far-reaching implications for business. Ecological economists point to what they term 'a changed pattern of scarcity' in modern economic systems. Economics, the discipline often defined as the study of how to manage scarcity has, for many years, considered man-made capital to be the resource of greatest relevance to the analysis of scarcity. This made sense at the time when the theory was being developed, when labour and natural resources were relatively plentiful, and the means of capturing and using these resources to meet basic human needs were quite primitive. As a result, human technical ingenuity has focused on better and better machines, and has improved the productivity of labour using those machines on an extraordinary scale. The work of two hundred workers in 1770 could be done by a single spinner in 1812 (Hawken *et al* 1999:7). One can scarcely guess by what order of magnitude modern technology has improved labour productivity since 1812.

Seeming so abundant over this period that it hardly rated a mention in economic theory was 'natural capital' – the natural resources such as fertile soils, supplies of timber, water, minerals and fossil fuels, and the capacity of the earth and its atmosphere to absorb wastes. These contributions from nature were certainly acknowledged during

the early development of economic theory, but somehow, as theoretical refinement proceeded and the focus remained on improving man-made capital, the production functions of the typical business began to be described as consisting of only two factors of production, labour (L) and man-made capital (K). Raw materials used as inputs in the production process, and any other services provided by the natural environment, were omitted from consideration altogether. Amazingly, they still are. First year economics students are still taught in almost all of the currently popular textbooks that businesses manufacture their products using only labour and machines!

Ecological economists, meanwhile, are at pains to point out that it is time to switch the focus from man-made capital to natural capital. It is now recognised that natural capital is becoming increasingly scarce, relative to man-made capital. It is no longer the ability to catch fish that is the limiting factor, it is the fish themselves. It is no longer our know-how and the means of irrigating crops that is constrained, but the amount of water available. It is not the power to pump, but the groundwater in the aquifers; not the number of chainsaws, but the available trees, and so on. Therefore, in the same way that the remarkable increase in productivity of labour has been achieved over the last 200 years, ecological economists argue that it is time to switch our ingenuity towards achieving increases in the productivity of natural resources. This means devising new technologies and redesigning existing techniques so that present levels of output can be achieved with much lower use of natural resources. That human ingenuity is capable of achieving this seems beyond any doubt.

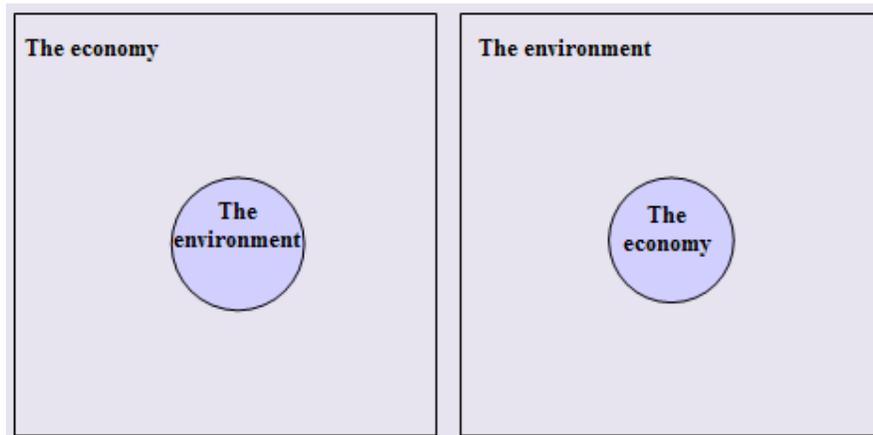
But if all this is possible, why is the ecological economics critique regarded as so subversive by the neoclassical economists? The answer takes a little explaining and has much to do with the way ecological economists see the world compared to the neoclassical economists.



**Figure 1: The neo-classical circular flow model**

In the physical sciences, paradigm shifts occur when the way in which a particular phenomenon is perceived changes fundamentally. The same is true of paradigm shifts in the social sciences. Ecological economists and neoclassical economists both observe the workings of the economic system as it is typically presented in the circular flow diagram (see Figure 1). However, because of a fundamental difference in their perception of the world and how the circular flow fits into it, *even before the analysis begins*, the two schools of thought come to very different conclusions regarding the desirability of economic growth.

For ecological economists, the economy is a subsystem of a finite, non-growing, materially closed (except for solar energy) environmental eco-system. As Figure 2B illustrates, the economy is firmly ensconced *within* the environment. Neoclassical economists, meanwhile, view things the other way round (see Figure 2A), where the ecosystem is a subset of the economy. According to this notion of the world, the economy extracts raw materials from the environment and then sends waste back into it. If one sees the world as in Figure 2B, on the other hand, then economic growth can only occur within the constraints imposed by the finite limits of the natural world. No such limitations apply to an economy which incorporates the environment as a sub-sector. This is especially so when it is also assumed, as it is by neoclassical economists, that man-made capital can make up for any shortages occurring in the natural resources sector. This last assumption is something we need to say a little more about.



**Figure 2A: The neo-classical economist's world view**

**Figure 2B: The ecological economist's world view**

In the 1970s, neoclassical economists developed a model that we term here the 'infinite growth' model (Solow 1974; Stiglitz 1979). The model purported to show how and why it is possible for production and consumption to grow forever. The idea that man-made capital will substitute for natural capital because 'well functioning markets' will signal the impending shortage of natural capital, stimulating technological progress to invent a substitute, is a key postulate of this model.

In the same way that we can grasp the idea that financial capital of \$10,000 can sustain consumption of \$1,000 a year at an interest rate of 10 per cent (ignoring taxes etc.), the basic idea of the infinite growth model is that an economy will sustain an amount of production or consumption indefinitely provided its productive capacity (which is a function of both man-made capital and natural capital) is not run down. One should be grateful perhaps, that at least this model recognises that there are such things as raw materials and natural resources in production functions. The problem with the model, though, is that its assumptions imply that the *composition* of capital retained in the economy does not really matter. Natural capital can be run down, but man-made capital (through technical progress) will make up for this deficiency. So long as the *total* amount of capital is preserved (natural capital + man-made capital), the economy can continue to grow indefinitely.

Four brief observations can be made about this model. First, the nature of the production function used in the model assumes that output can be maintained if raw materials are reduced, provided that man-made capital and labour are increased sufficiently to compensate. As Daly and Farley (2004:151) point out, the logic in this is tantamount to saying that if a cook is baking a five pound cake, he or she can increase it to a 1000 pound cake with no increase in ingredients but just by stirring harder and baking it longer in a bigger oven! In the real world, natural resources are actually necessary to maintain man-made capital in good working order. Not to put too fine a point on it, man-made capital is actually made out of the flow of resources and energy from natural capital.

Secondly, it can be observed that the neoclassical economics theoretical framework was conceived at a time when the ‘limits to growth’ debates of the 1970s identified ‘sources’ of raw materials as possible future constraints on economic growth, and less attention was given to (or known about) ‘sinks’ – the capacity of earth’s systems to absorb wastes. It was thought at the time that shortages of such resources as oil, coal, copper and other metals would become the limiting factors to growth. The model did not recognise any ecosystem services provided by nature. These were not, in any case, widely appreciated at the time. Nor did the model anticipate that, thirty to forty years later, it is the earth’s capacity to absorb the wastes of production into its atmosphere, ground water, oceans and rivers that is turning out to be more immediately limiting than future supply of minerals. It is difficult to see how even ‘well-functioning markets’ can signal threats to the earth’s sinks, thereby encouraging technical progress to find alternatives. Only more extreme weather events in the atmosphere, crop failures from salinity in groundwater, fish kills in the ocean, and the like, signal threats to the earth’s sinks – not market prices.

Market prices are a good *allocation* device for all those goods and services that go through markets, but markets cannot signal when the *scale* of an economic activity becomes uneconomic in terms of the environmental costs being imposed. For example, they do not indicate when the draw-down on a natural resource exceeds the capacity of the resource to regenerate. Markets did not indicate when fisheries were being exploited past the point of collapse off the coast of Newfoundland, for example (Harris 1998).

Thirdly, it is reasonable to assume, as do the neoclassical economic models, that technical progress will achieve a significant ‘dematerialisation’ or ‘decoupling’ of GDP from natural resources – not least because there is significant potential to conserve resources where old habits and methods of production have not taken into account the true scarcity of a resource. Efforts to conserve resources are being made successfully in industrialised countries (OECD 2002, 2004). However, while progress is impressive when decoupling is measured on a per capita or per unit of economic output basis, this success is much less apparent when resource use and waste flows are measured in absolute terms (WRI 2001). This is because in many instances, the rate of expansion as the economy grows simply outweighs the progress being made.

A final observation that will be made on the ‘infinite growth’ model of the neoclassical economists (although much more could be said) is that there is no apology, or even recognition, that an ethical judgement is being made when it is implied that future generations could live with a greatly depleted natural world, because they will be

grateful for the man-made capital that has replaced it. On the question of ethics, it can also be observed that other ethical considerations such as a right to a 'place in the sun' for other species (Daly 1996: 36) does not enter the neoclassical economics calculus.

It might be said, with some justification, that our criticisms of the infinite growth model take far too literally what was meant to be a simple mathematical exercise designed to see what assumptions and conditions would be necessary to ensure that economic growth is sustained indefinitely. Moreover, the exercise was undertaken thirty years ago before many of the recent environmental problems of economic growth had become apparent. If we accept this, however, then the question must be asked as to why the model has not been refined and updated. This model is the only theoretical justification the neoclassical economists can supply for a proposition that has become deeply ingrained in the minds of politicians and their advisors throughout the international political economy; namely, that economic growth should continue forever and there is no such thing as uneconomic growth where the environmental costs are greater than the benefits of material goods to humans. How can such a fundamental proposition have such a flimsy theoretical foundation? How is it possible that a *faith* in technical progress to avoid all crises is elevated in importance over any sense of precaution? What *justification* is there that infinite economic growth will be possible? Where are some of the natural resource shortages likely to emerge so that technical progress might be directed to anticipate them? A metaphor currently in use by the ecological economists is that the present path of the industrialised economies may be likened to that of a car without brakes, speeding faster and faster downhill. The assurance that is being given by the neoclassical economists is that we can keep putting our foot on the gas because someone will soon invent some brakes!

## **WHY THE REAL WORLD WILL NOT WAIT**

Paradigms collapse when pressing problems of the real world are either ignored or treated as unimportant by the theoreticians. In the light of so much evidence to the contrary, it is almost unconscionable that a group of economic theorists and the textbook hegemony they exert, can advocate unlimited economic growth on the basis that the environment is not a serious constraint. Media reports of the increased presence of greenhouse gases and climate change, river and groundwater pollution, deforestation, soil degradation, ozone depletion, deep ocean dumping, wetland draining, microbial resistance, bio-invasions, threatened species or fisheries collapse are an almost daily occurrence. Increasing population and economic growth have intensified pressures on the earth's systems on, below and above the earth's surface, and are said by scientists to constitute something of an evolutionary gamble with the planet (McNeill 2000). Surely there are rather too many 'externalities' to 'internalise' into the market?

*Business Week's* front-page story in August 2004 'Global warming: why business is taking it so seriously' did not seem to think the matter unimportant. Exactly how is man-made capital going to substitute for climate stability? Similarly, *National Geographic Magazine's* front page story on the same topic one month later (September 2004: 7) is not so surprising given that it is a scientific journal, but the poignancy of the editorial is telling, and worth quoting in full:

After a decade as Editor in Chief, I have a pretty good idea which articles will provoke a lot of angry letters. Whenever we publish stories that challenge widely held beliefs, some readers get mad, and they write to let us know.

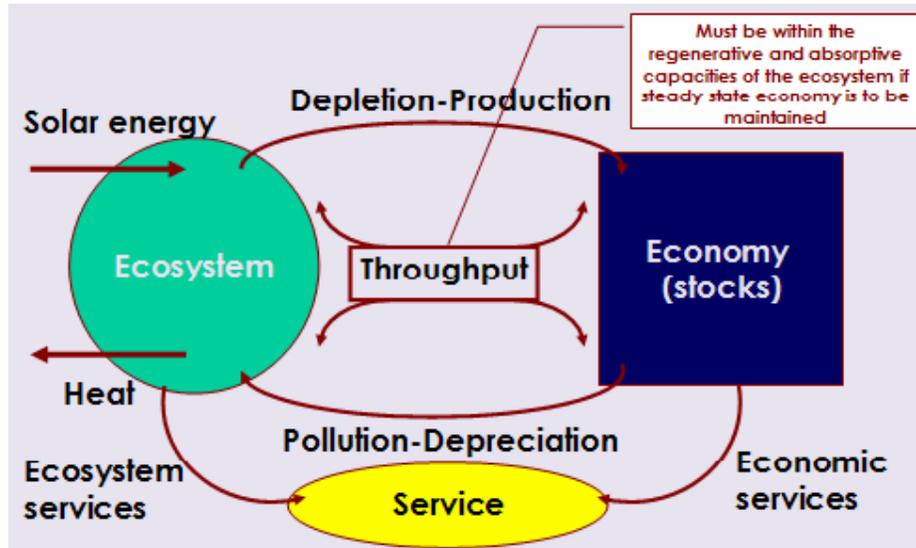
Well, we're about to do it again. We're devoting 74 pages of this issue to do a three-part series of stories on global climate change, and I'd be willing to bet that we'll get letters from readers who don't believe global climate change is real, and that humans contribute to the problem. Some readers will even terminate their memberships.

Why would I publish articles that make people angry enough to stop subscribing? That's easy. These three stories cover subjects that are too important to ignore. From Antarctica to Alaska to Bangladesh, a global warming trend is altering habitats, with devastating ecological and economic effects.

So I'm asking you – even those of you who don't believe the Earth is getting warmer and that human behaviour is a contributing factor – to turn to page 2. This isn't a science fiction or Hollywood movie. We're not going to show you waves swamping the Statue of Liberty. But we are going to take you all over the world to show you the hard truth as scientists see it. I can live with some cancelled memberships. I'd have a harder time looking at myself in the mirror if I didn't bring you the biggest story in geography today.

Daly (1993) has observed that real world policy, in responding to real world issues, cannot wait for the theoreticians to catch up. The use of tradeable pollution permits, for example, a policy widely endorsed by neoclassical economists, is an implicit recognition that the scale of economic growth in some areas can become uneconomic, so emission limits are imposed by policy-makers and trading in the right to pollute takes place below these limits. The *limits* set the *scale* for the amount of economic activity generating the pollution. Groundwater sharing plans and Regional Forest Agreements in Australia are further recognition of the scale of activities as a problem, and there are many similar examples in other countries. One might also ask why economists at the Organisation for Economic Co-operation and Development (OECD) are developing a 600 page Handbook (OECD 2003) on integrated environmental and economic indicators if ecological limits are unimportant. Or, looking at it from a different angle, why is the case against the United States signing the Kyoto Protocol typically presented in terms of the amount of GDP that will have to be foregone? Clearly, a problem of ecological limits threatening the scale of economic activity is manifest.

A changed pattern of scarcity appears indisputable. Ecological economic theory tells us that there will be an ultimate limit – the maximum amount of material and energy throughput in an economy that is consistent with the ability of the earth to absorb wastes and the capacity of renewable resources to regenerate (see Figure 3). Such a limit maintains the critical natural capital required for economic activity to be sustained in the long term. This notion captures the essence of the theoretical basis of 'sustainable development' as analysed by ecological economists. The scale of economic activity that can be accommodated within the requirement that critical natural capital be sustained will depend on the extent to which business can develop technologies that are able to make the natural resources used go further and further – in short, by increasing the *productivity* of natural resources, as we mentioned in the previous section.



**Figure 3: The ecological economist's circular flow model**

Increasing the productivity of natural resources is one of the four key strategies advocated in the business book best sellers, *Natural Capitalism* (Hawken *et al* 1999) and the *Ecology of Commerce* (Hawken 1993). The other three practical business strategies which are a component of the new 'natural capitalism' also fall squarely within the theoretical framework of sustainable development as analysed by ecological economists.<sup>4</sup>

A succinct overview of the 'four central strategies of natural capitalism' is found in the first chapter of *Natural Capitalism*. They are interrelated and interdependent, and generate numerous opportunities for businesses. The strategies may be summarised as follows:

**Radical resource productivity:** The use of scarce resources more effectively so as to slow resource depletion (at one end of the chain) and lower pollution (at other end of chain).

**Biomimicry:** The redesign of industrial systems along biological lines. This requires changes to material inputs and processes so that there is constant re-use of materials in continuous closed cycles. It implies zero 'waste', and the elimination of toxicity.

**Service and flow economy:** A fundamental shift in the relationship between producer and consumer. Quality of service and flow is valued above the quantity and acquisition of goods. Financial benefits accrue to those who can link resource productivity with closed-loop cycles of material use.

**Investing in natural capital:** Investment in processes that sustain, restore or expand stocks of natural capital, so that the biosphere can produce more abundant ecosystem services and natural resources.

Hawken *et al* (1999) are keen to make the point that for a business to examine how their product is being made, and make incremental improvements in materials used and environmental impact, may not be as economical as conducting a complete re-

<sup>4</sup> There is a close correspondence between the four strategies of natural capitalism (Hawken, Lovins & Lovins 1999) and the Comprehensive Efficiency Ratios of ecological economics (Daly and Farley 2004: 422-424).

assessment of the design of the production process (see also Weizacker *et al* 1997). They argue that marginal improvements and trade-offs, rather than complete system redesign, may even be detrimental to the environment (Hawken *et al* 1999: x):

...eco-efficiency [incremental improvements to existing production methods] could be a disaster for the environment by overwhelming resource savings with even larger growth in the production of the wrong products, produced by the wrong processes, from the wrong materials, in the wrong place, at the wrong scale, and delivered using the wrong business models.

The authors conclude that the world stands on the threshold of fundamental changes in the conditions of business. Companies ignoring the message are at risk (Hawken *et al* 1999: xiii).

A number of observations might be made at this juncture. First and foremost, as we have noted in the preceding discussion, significant change is unlikely in any society so long as the people in the seats of power (and their advisors) continue to be the products of the mainstream paradigm. A second observation is that, generally, human behaviour is such that it only responds to incentives, and so long as the incentive to embrace paradigm shift remains weak (or non-existent), the prospects of change are remote. A 'command-and-control' approach on the part of the state, for example, might provide a useful legislative framework for change, but unless there are tangible benefits to be gained from operating within this framework, change is likely to be piece-meal. Rapid change is far more likely to occur if it is voluntary.

Given the right incentive, the business community can lead the charge (WBCSD 2001), and be the catalyst for change (Gladwin *et al* 1995). Indeed, as Hawken (1993) has argued, business is the only institution within the national and international political economies powerful enough to foster the changes necessary for ecological and social sustainability. The profit motive has an important role to play (something largely absent within academe and state bureaucracies). For business to take up the challenge, sustainable behaviour must be a source of competitive advantage. The vital ingredient is education of business leaders. If it can be demonstrated that a business strategy based on sustainable development is capable of providing a competitive edge in the marketplace, then it is possible for positive feedback to prompt a logistic or 'S-shaped' pattern of adoption (see Figure 4), and for paradigm shift to be effected.

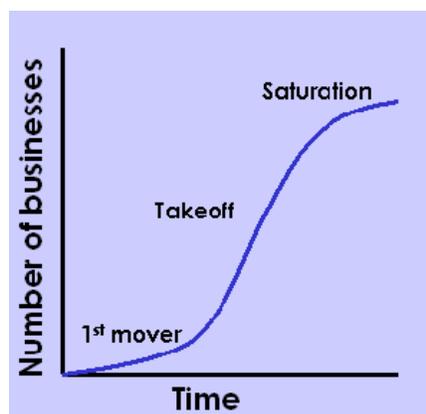


Figure 4: Sustainable development adoption dynamics

## SUMMARY AND CONCLUSIONS

The main objective of this paper was to present the case for an economic analysis founded on ecological economics. In the process we have highlighted the serious shortcomings of the neo-classical model and that, so long as this analytical framework continues to dominate mainstream thinking, the scale of economic activity will become increasingly threatened by ecological limits. We have also highlighted the various obstacles to a change and how, despite the overwhelming evidence that neo-classical economics is sadly lacking in its internal consistency and explanatory power, it is a paradigm that still wields influence largely because of the conservative and reactionary powers within the halls of academe. On a positive note, we do not believe academic economists will continue to hold sway for too much longer. The ranks of those protesting against the neo-classical orthodoxy continue to swell, but ultimately the business community is the body most likely to seal its fate. Generally, business does see something working effectively in practice and ask if it works in theory. It is the most powerful institution within the national and international political economies, and it is the vehicle most likely to bring about change. A number of forward looking companies are now embracing the principles of natural capitalism, and formulating strategies founded on sustainable development to their considerable commercial benefit.

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