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# Biodiversity and the Human Factor – The Need to Overcome Humankind's Addiction to Growth

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## 1. Introduction

It is often believed that biodiversity loss is principally due to poor environmental management or the failure to preserve critical ecosystems. Although these factors are critical, the greatest threat to biodiversity conservation is unquestionably humankind's addiction to growth. Economies are subsystems of the larger ecosphere and dissipative structures in the sense that they must continuously digest low-entropy resources and excrete high-entropy wastes to maintain their physical order (Georgescu-Roegen, 1971; Perrings, 1986; O'Connor, 1991; Daly, 1996; Common & Stagl, 2005). Because of thermodynamic limits to both materials recycling and the technical efficiency of production (Ayres & Miller, 1980), the continued growth of economic systems requires an ever-rising rate of resource throughput that must eventually exceed the ecosphere's regenerative and waste assimilative capacities. Whether we like it or not, all attempts to continuously grow our economic systems must inevitably deplete the natural capital that supports them as well as the critical ecosystems that contain much of the planet's biodiversity (Jansson et al., 1994; Lawn, 2000, 2007; Victor, 2008).

The increase in the rate of throughput, as the global economy expands, and its degenerative impact on natural capital and biodiversity can be represented by way of a comparison between the Earth's biocapacity and humankind's ecological footprint (see Figure 1). The global ecological footprint constitutes the area of land *required* to service humankind's production and consumption desires, whereas the Earth's biocapacity constitutes the area of land that is *available* to service them (Wackernagel et al., 1999). Between 1965 and 2005, humankind's ecological footprint continuously rose. Worse still, humankind's ecological footprint began to exceed the Earth's biocapacity in the mid-1980s (Global Footprint Network, 2008). That is, humankind's demands on the biosphere eventually surpassed the Earth's capacity to support them on a long-term sustainable basis. In effect, since the mid-1980s, humankind's ability to meet its production and consumption desires has only been possible by running down stocks of natural capital and, in the process, eroding the Earth's biodiversity.[1]

[1] Natural capital can still be depleted, even when humankind's ecological footprint is less than the Earth's biocapacity, if natural capital is exploited imprudently.

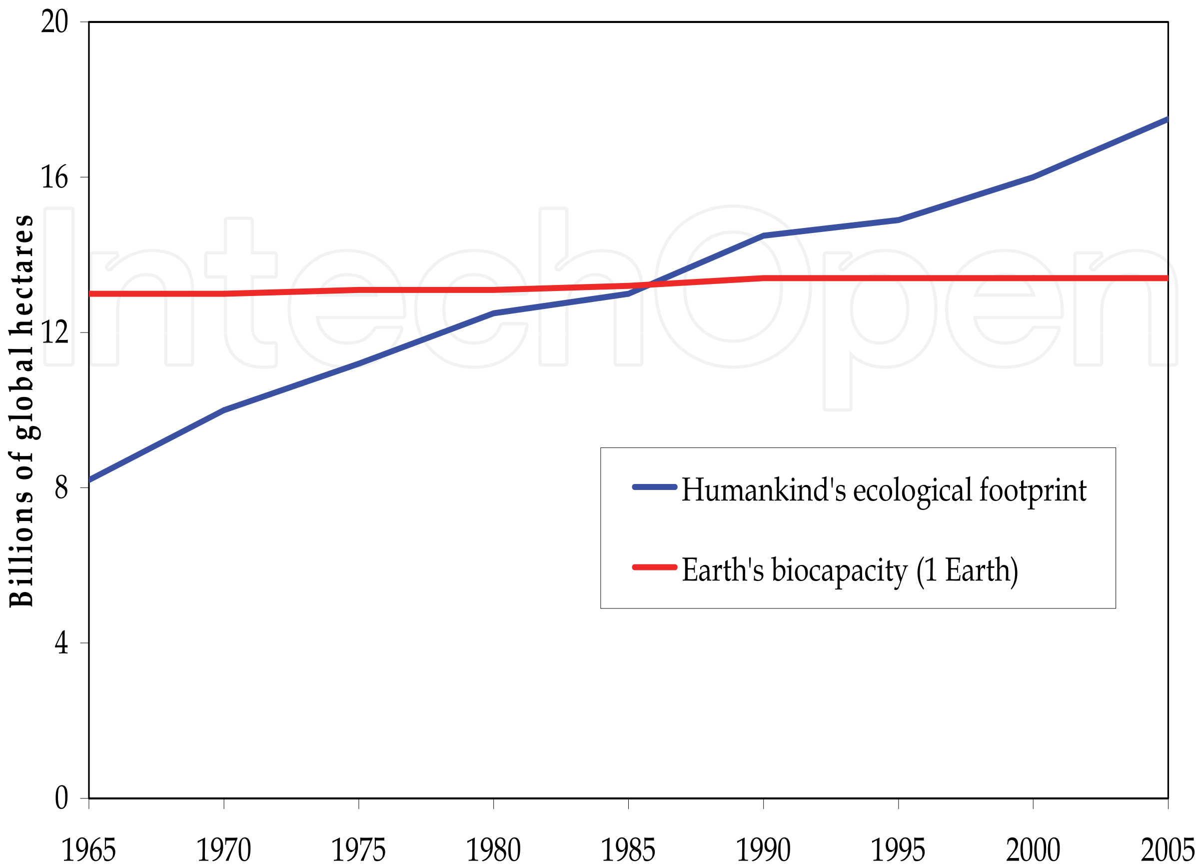


Fig. 1. Humankind’s ecological footprint versus the Earth’s biocapacity – 1965-2005 (Source: Global Footprint Network, 2008)

The important connection between growth of the global economy and biodiversity loss is reflected by the fact that the rise and trend change in humankind’s ecological footprint between 1965 and 2005 corresponds almost exactly with the rise in real Gross World Product over the same period. Indeed, the more temperate rate of increase in the ecological footprint in the early-1980s and early-1990s coincided with global output recessions when Gross World Product also increased at more modest rates.

Clearly, in spite of efficiency gains, conserving biodiversity will require all nations to eventually make the transition to a steady-state economy – that is, a physically non-growing economy maintained by an ecologically sustainable rate of resource throughput (Daly, 1991). Whilst, for many impoverished countries, some further growth is both possible and desirable, for wealthy nations, the need to make the transition to a steady-state economy is required immediately and likely to involve the physical shrinking of their economies (Latouche, 2007; Martinez-Alier, 2009; Kerschner 2010; Martinez-Alier et al. 2010). There is little doubt that the need to make such a transition will encounter considerable political and institutional barriers. However, this only highlights the urgency of the problem at hand and the extent to which humankind has failed miserably to deal with the problems of excessive growth.

Putting aside political realities for a moment, there are four critical questions that need to be answered in relation to macroeconomic policy and its connection with biodiversity:

- To what extent does contemporary macroeconomic policy contribute to the growth of economic systems and the subsequent loss of biodiversity?
- Can macroeconomic policy be implemented to ensure the scale of economic systems remain within the limits imposed by the regenerative and waste assimilative capacities of the ecosphere and the need to preserve critical ecosystems?
- If the answer to the above question is no, what basic policy instrument needs to be implemented to achieve the condition of ecological sustainability which is necessary to preserve the planet's biodiversity?
- Where does this leave the role of macroeconomic policy?

## 2. Contemporary macroeconomic policy and its relationship with growth

Before answering the first question, let me say a few things about contemporary macroeconomic policy.

Macroeconomic policy exists at two levels. The first level involves 'internal' fiscal and monetary policies, while the second level involves the 'external' policy area of international trade. Fiscal policy primarily relates to the expenditure decisions of central governments as well as the impact of taxation on private-sector spending. Monetary policy, which involves manipulatory intervention in money and bond markets, is decreasingly being conducted in terms of money-supply targets. It is now almost exclusively conducted by way of interest rate adjustments to either facilitate or dampen private-sector spending. In most countries, monetary policy is carried out by central banks acting independently of the central government. Central banks usually perform their monetary policy role with the aim of achieving a desired inflationary target band inscribed in the central bank's charter (Dornbusch & Fischer, 1990).

Whilst international trade policy can involve the central-government impositions of tariffs, import quotas, and foreign exchange regulations, contemporary international trade policy is increasingly characterised by minimal government intervention in global markets and the relatively fluid movement of international financial capital across international borders. As a consequence, international trade outcomes are determined primarily by private-sector agents engaged in international transactions. This is not to say that central governments do not implement policies to influence international trade outcomes. Central-government policy is often aimed at increasing the international competitiveness of domestic industries in order to boost net exports. Unfortunately, policies designed to increase competitiveness are not always desirable and invariably reflect the detrimental impact that globalisation forces are having on domestic policy (Daly, 1996). I shall return to this issue later in the chapter.

Whether it is internal fiscal and monetary policies or the external policy area of international trade, macroeconomic policy is essentially directed towards achieving the maximum 'inflation acceptable' growth rate of real GDP (Gross Domestic Product). By 'inflation acceptable' I mean a growth rate which does not lead to price-inflation exceeding the upper end of a desired target band (usually 3% per annum). Although central governments prefer a low unemployment rate, it is because of the desire to avoid an excessive rate of price-inflation that full employment ceased to be a major objective of macroeconomic policy in most countries during the 1970s. Thus, by stopping short of encouraging a rate of growth that leads to excessive inflation, most governments are content to accept a higher unemployment rate than what would generally be regarded as full employment.[2]

A minority of economists are critical of this 'fight inflation first' approach to macroeconomic policy insofar as it is results in a 'sacrificial' pool of unemployed labour (Forstater, 2000; Mitchell & Watts, 2002). Advocates of the mainstream position respond by asserting that macroeconomic policy aimed at achieving full employment leads to an unacceptably high inflation rate that, in turn, leads to macroeconomic instability and prolonged periods of even higher rates of unemployment. Hence they argue that the current approach is the lesser of two evils. Critics of the mainstream position disagree and believe that a non-inflationary full employment outcome can be achieved through the implementation of an appropriately designed and government-financed 'employer of last resort' programme (Wray, 1998; Mitchell & Watts, 2002; Mitchell & Muysken, 2008).[3]

You may well ask what the employment implications of macroeconomic policy have got to do with biodiversity conservation. I believe a great deal since, in the case of industrialised nations at least, economies organised to operate sustainably will need to be much smaller in scale than they are at present and this could lead to potential difficulties if associated with very high rates of unemployment. Should society regard the ensuing unemployment rate too repugnant to accept, it could inhibit the transition to ecological sustainability and thus undermine conservation efforts.

Irrespective of the economic debate surrounding employment and inflationary issues, the general flavour of all mainstream macroeconomic policy is essentially the same – it is unashamedly pro-growth. Given the link between growth and natural capital depletion, there is little doubt that contemporary macroeconomic policy contributes significantly to the growing pressure being exerted on the ecosphere and the subsequent loss of biodiversity. To make matters worse, the lack of efficient 'cost internalisation' policies – which is partly due to the globalisation forces arising from the international trade aspect of contemporary macroeconomic policy – is further increasing environmental pressure by allowing damaging activities to proceed without the perpetrators incurring a financial penalty commensurate with the spillover costs they impose on the rest of society.

I might also point out that ecological economists believe there is an 'economic' limit to growth that is likely to be arrived at prior to reaching any ecological limits. The reasoning for this is that the costs of growth – in particular, the costs associated with the depletion of natural capital and any accompanying loss of biodiversity – typically rise at an increasing rate (principle of increasing marginal costs). Conversely, the benefits of growth typically increase at a declining rate (principle of diminishing marginal benefits). Thus, well before the physical scale of the economy becomes ecologically unsustainable, a point is reached where the additional costs of growth exceed the additional benefits. As a consequence, growth beyond this point reduces a nation's economic welfare.

Studies using a Genuine Progress Indicator (GPI), which is a recently established indicator of economic welfare, appear to support this contention (Redefining Progress, 1995; Lawn & Clarke, 2006). The studies reveal that the economic welfare enjoyed by wealthy nations has

[2] A full-employment rate is not 0%. Because there are always people moving in and out of jobs, there is always some 'frictional' unemployment. Full employment is usually regarded as being somewhere near a 2% unemployment rate.

[3] A good example of an 'employer of last resort' programme is the Job Guarantee described in detail in Mitchell & Muysken (2008).

either plateaued or been in decline for some 30-40 years despite the almost continuous rise in GDP (Daly & Cobb, 1989; Max-Neef, 1995; Jackson & Stymne, 1996) (see Figure 2).

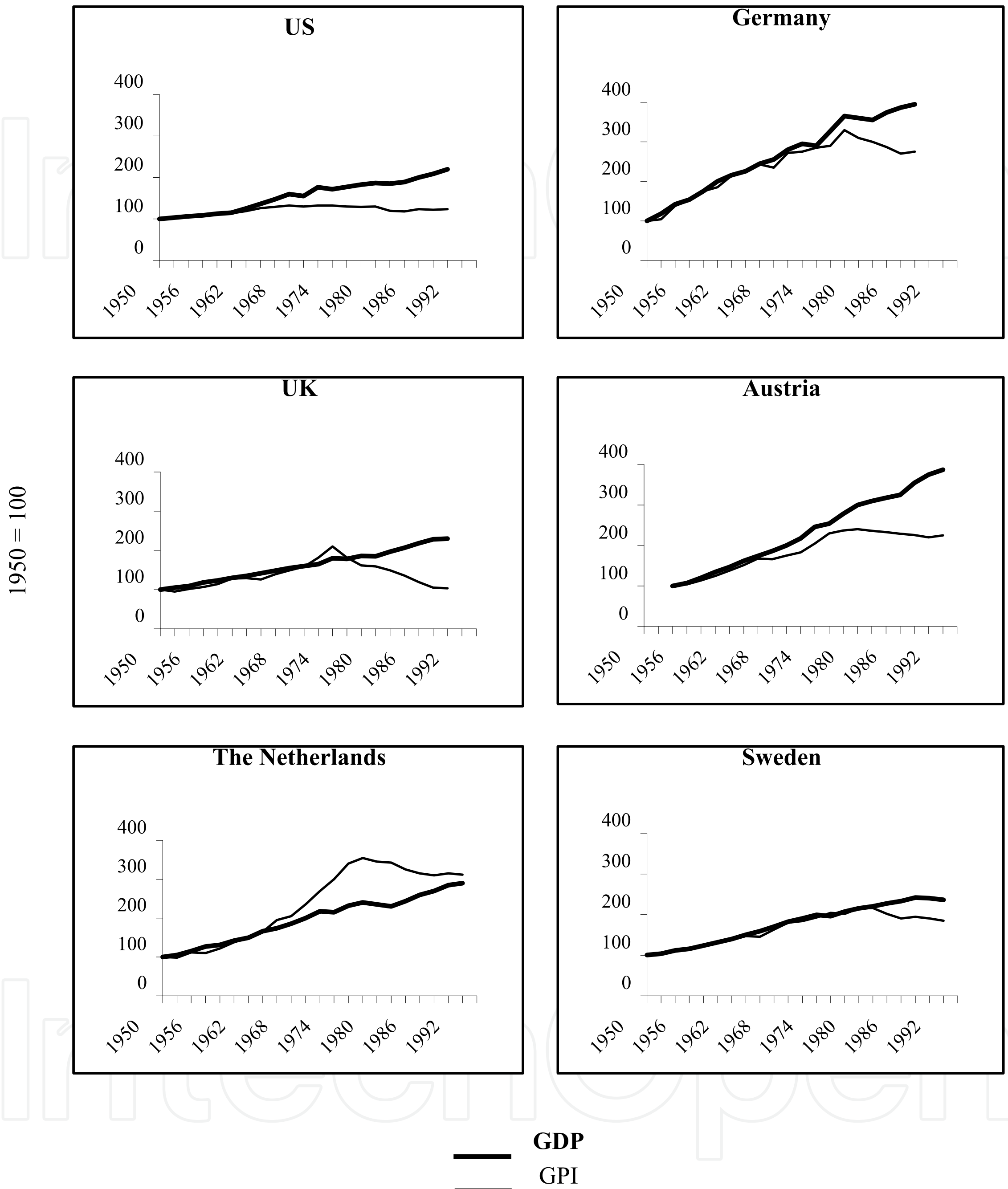


Fig. 2. A comparison of the per capita GDP and per capita GPI of six industrialised nations (Source: Jackson & Stymne, 1996)

Although the timing of the peak of the GPI varies from country to country, what doesn't change, but is not evident in Figure 2, is that the per capita GPI almost always starts declining when the per capita GDP of a nation reaches somewhere around US$20,000. When this trend was first recognised in the mid-1990s, it led Manfred Max-Neef (1995) to put forward a *threshold hypothesis* regarding the growth of a nation's economy and the economic welfare it generated. Max-Neef argued that a per capita GDP of approximately US$20,000 constituted a threshold income level at which point continued growth of a nation's economy would reduce the economic welfare enjoyed by the average citizen.

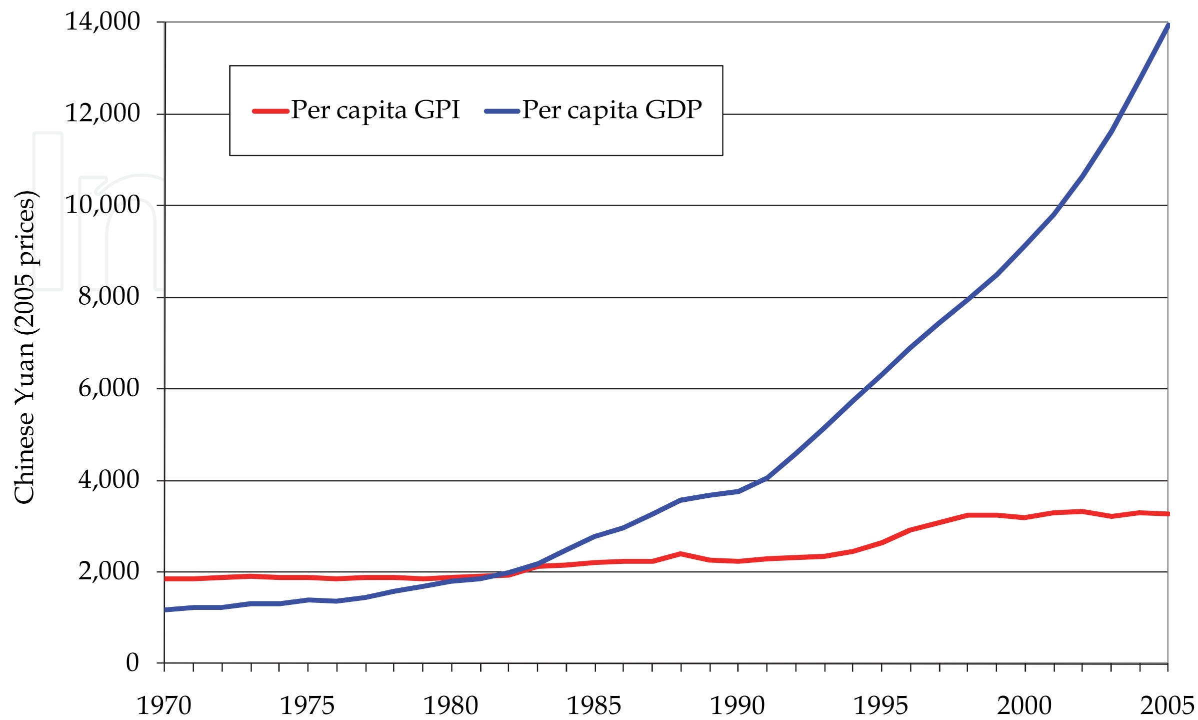


Fig. 3. Per capita GPI versus per capita GDP – China, 1970-2005 (Source: Wen et al., 2008).

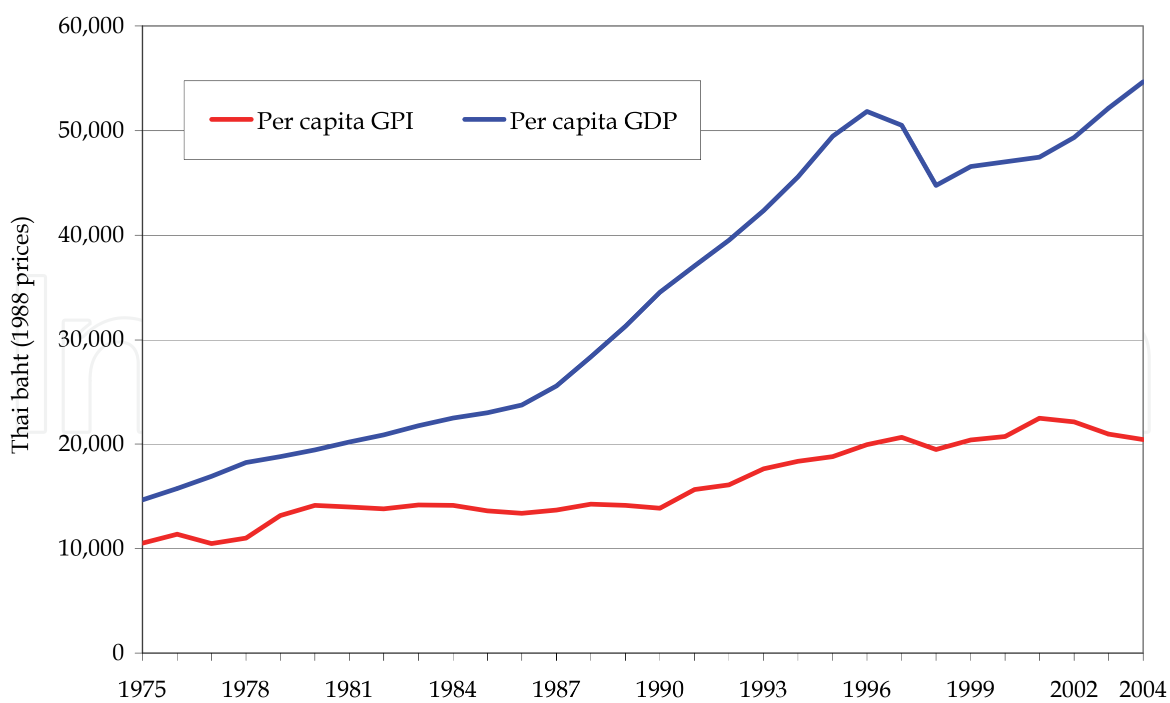


Fig. 4. Per capita GPI versus per capita GDP – Thailand, 1975-2004 (Source: Clarke & Shaw, 2008).

As disconcerting as the threshold hypothesis seemed for the rich countries at or beyond the threshold income level, it appeared to offer great comfort to the world's poorer nations. Since all poor countries had a per capita GDP well below US$20,000, the threshold hypothesis suggested that the growth of their per capita GDP would increase the economic welfare of its citizens for some considerable time. Distressingly, a recent GPI study of seven countries in the Asia-Pacific region – four of which are relatively poor nations – casts doubt over this prognostication. Consider Figures 3 and 4, which show that the per capita GPIs of China and Thailand have begun to fall despite the per capita GDP levels of both countries being well short of the US$20,000 envisaged by the proponents of the threshold hypothesis. Indeed, China's per capita GPI peaked when its per capita GDP was around US$5,000. For Thailand, its per capita GPI peaked at a per capita GDP of around US$7,500.

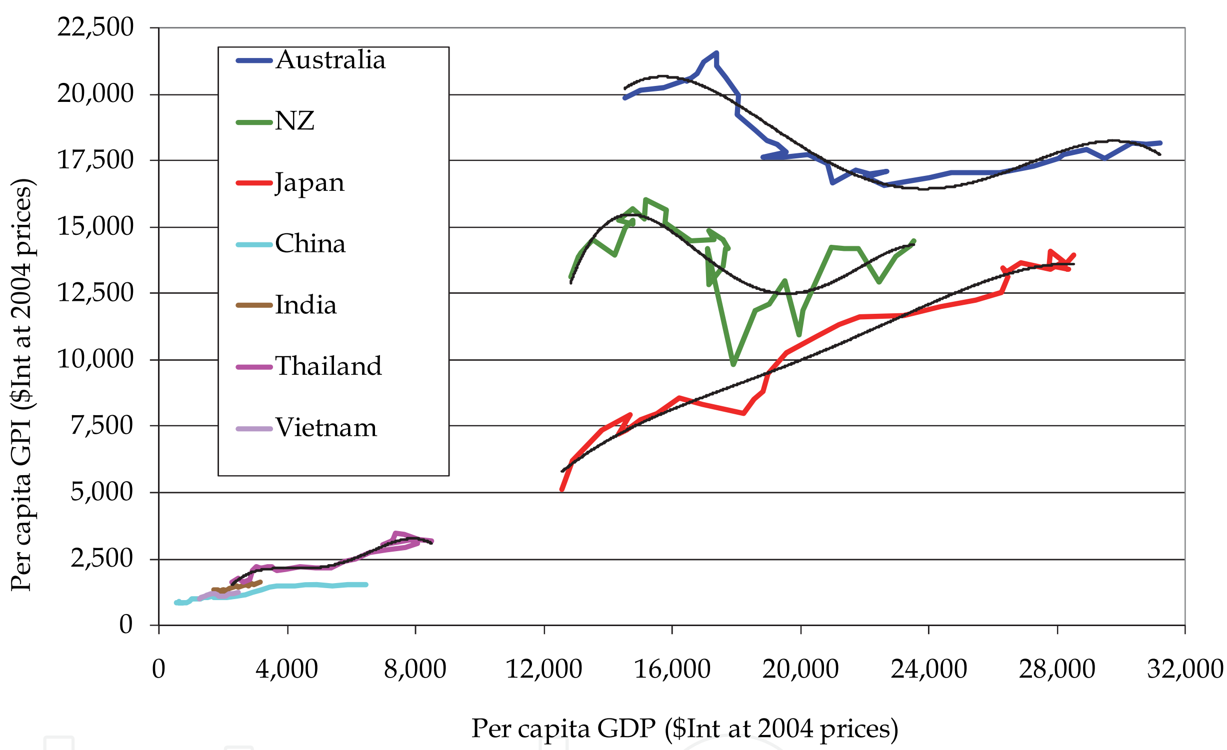


Fig. 5. Per capita GPI versus per capita GDP of seven Asia-Pacific countries (Source: Lawn and Clarke, 2008)

Now consider Figure 5, where the annual per capita GPI values of the seven countries included in the Asia-Pacific study have been plotted against their corresponding per capita GDP values. The figure reveals that the three wealthy countries of the region – Australia, New Zealand, and Japan – along with China and Thailand, have all reached a threshold level of per capita GDP. Although India and Vietnam, with a per capita GDP of around US$3,000 and US$2,500 respectively, have yet to reach a threshold point (i.e., their per capita GPI is still rising), both countries are experiencing substantial increases in environmental and social costs (Lawn, 2008; Nguyet Hong et al., 2008). It is not unreasonable to assume that both countries are likely to cross a threshold point at a lower per capita GDP than Thailand and China. From the results of this GPI study at least, there is little doubt that the later a nation experiences an initial expansion phase of its economy, the lower is its per capita GDP when its per capita GPI begins to decline. This is no better exemplified than by the tunnelling of each country's per capita GPI-GDP curve below that of their growth predecessor.

Lawn and Clarke (2008) believe that the phenomenon revealed in Figure 5 can be mostly explained by: (a) low consumption levels in poor nations relative to their domestic production – a consequence of their large net exports of goods and services; (b) the migration of manufacturing operations to poor countries where wages are low and environmental regulations are weak; and (c) growth late-comers having to contend with GDP expansion in a world full of human beings and human-made capital, yet one with much less natural capital and many fewer ecosystems. Whereas (a) reduces the marginal benefits enjoyed by poor countries and (c) increases the marginal cost of an increment of GDP growth, (b) results in poor nations having to bear a disproportionately large share of the world's social and environmental costs.

It is because of the above factors that Lawn and Clarke (2008) have proposed a new *contracting threshold hypothesis*. The hypothesis is essentially this: as the economies of the world collectively expand in a globalised economic environment, there is a contraction over time in the threshold level of per capita GDP. As such, growth late-comers (poor nations) face the prospect of never attaining the level of economic welfare enjoyed by the early growth-movers (rich nations).

Despite this new hypothesis, Lawn and Clarke still believe it is possible for poor nations in the Asia-Pacific region and the world generally to experience higher levels of economic welfare. However, they argue that progress will only occur if an extension can be made to the threshold point at which the per capita GPI of poor countries begins to decline. This, according to Lawn and Clarke, will necessitate dramatic policy changes on the part of poor nations. Just as importantly, it will require rich nations to cease growing their economies (i.e., make the transition to a steady-state economy) in order to provide the 'ecological space' that poor nations need to enjoy a phase of welfare-increasing growth.

All in all, apart from having to make the transition to a steady-state economy to achieve ecological sustainability, it is becoming increasing apparent that wealthy nations must stabilise their economies at a much smaller physical scale in order to maximise the economic welfare enjoyed by their citizens. Once this scale has been attained – referred to by ecological economists as the optimal macroeconomic scale – the emphasis of economic activities should shift from quantitative expansion (growth) to qualitative improvement (development), where the latter would involve improvements in the stock of physical goods, a more equitable distribution of income and wealth, minimisation of the rate of resource throughput via increases in the rate of recycling and the technical efficiency of production, and reorganisation of the production process to increase job satisfaction and reduce the cost of unemployment, crime, and family breakdown. All such advances would enable economic welfare to increase without the need for further growth. What's more, they would allow businesses to increase profits without the need for continuous businesses expansion, thus allaying any concerns that a steady-state economy is incompatible with capitalism (Lawn, 2011a).

## 3. Achieving ecological sustainability and biodiversity conservation

If contemporary macroeconomic policy can be largely blamed for the growth that threatens biodiversity conservation, it ought to follow that growth can be slowed or halted via a radical alteration of the fiscal, monetary, and international trade policy stances of central governments. Although international trading arrangements warrant a serious overhaul, a radical redirection of fiscal and monetary policy stances is not the solution. Certainly, the growth process could be reversed by implementing macroeconomic policy in such a way as to totally destabilise the economy. But sabotaging a growth economy is hardly the appropriate means of dealing with the dilemma that humankind confronts.

Why, then, is macroeconomic policy unable to halt the biodiversity-eroding growth of economic systems? It has already been argued that the scale of economic systems must remain within the limits imposed by the need to preserve critical ecosystems and the regenerative and waste assimilative capacities of the ecosphere. These limits are determined by biophysical criteria, yet macroeconomic policy is designed to meet economic criteria and thus has no capacity to achieve biophysically-based targets. Macroeconomic policy cannot, therefore, directly solve the biodiversity erosion crisis.

Mainstream economists will be the first to admit that macroeconomic policy cannot satisfy biophysical criteria. However, they will usually respond by arguing that there is no need to align macroeconomic policy with ecological constraints because an alignment of this nature is automatically achieved at the microeconomic level. According to mainstream economists, if there is any possibility that the growth of the economy may lead to an excessive rate of resource throughput, it will be adequately registered in individual resource markets and will induce appropriate remedial action. That is, if we value ecological sustainability and the biodiversity conservation that comes with it, the increased scarcity of natural resources will cast a shadow in the form of higher natural resource prices. This will induce greater resource use efficiency and lessen our demands on the stock of natural capital per unit of economic activity. In doing so, the rise in natural resource prices accompanying any increase in natural resource scarcity will automatically ensure that the necessary stock of natural capital is maintained, including the critical ecosystems containing a great deal of the planet's biodiversity. Hence, regardless of the macroeconomic policy being undertaken, it will only end up being expansionary if the increase in efficiency induced by rising natural resource prices permits the production of a larger quantity of goods and services from what the market will always ensure is a sustainable rate of resource throughput.

It is at this point that mainstream economists come unstuck. The belief that increased resource scarcity will immediately result in a rise in all resource prices is erroneous (Hall & Hall, 1984; Reynolds, 1999; Lawn, 2007, 2010). Resource prices are very good at reflecting the *relative* scarcity of resources (i.e., how scarce a particular resource is relative to a substitute resource). But resource prices are woefully inadequate at reflecting the *absolute* scarcity of each resource type (i.e., how much remains of each particular resource) and are even worse at reflecting the services provided by nature's waste sinks and life-supporting ecosystems. This is because ecological sustainability is based on the need to meet ecological criteria and markets are only capable of satisfying economic criteria (i.e., the efficiency criteria). What's more, even if resource prices do eventually rise and induce greater efficiency, there is nothing inherent in markets to prevent the percentage increase in efficiency from being overwhelmed by the percentage increase in economic output – a phenomenon known more widely as the 'Jevons' Paradox' (Jevons, 1865; Blake, 2005). Hence, there is nothing to prevent the rate of throughput from rising and therefore nothing to prevent the stock of natural capital from subsequently declining. Finally, market decisions are made by currently existing people who have a natural tendency to discount the future ramifications of their present actions. This leaves future generations – the people who will suffer most in a resource-poor world – unable to partake in the current resource bidding process. Thus, market decisions are always biased against future generations.

Put simply, markets have no ears, noses, and eyes to sense an ecologically sustainable rate of resource throughput just as they cannot sense an equitable distribution of income and wealth. As such, no economic forces exist to ensure economic systems operate sustainably.

There are, of course, many actions that need to be taken to ensure economic activity is ecologically sustainable and the need for sound environmental management, ecosystem preservation, and the preclusion of human-beings from the direct use of a relevant portion of the total ecosphere have already been mentioned as important requirements. As I have argued, all will prove futile unless the rate of resource throughput is kept within the limits imposed by the ecosphere's regenerative and waste assimilative capacities. Since markets and economic instruments cannot satisfy ecological criteria, the policy instrument required to resolve the resource-limiting aspect of sustainability dilemma must exist in the form of society-imposed restrictions on the annual rate of resource throughput.

A policy instrument of this nature would be more complex than first imagined. To begin with, it would require a unique resource extraction regime for each resource type. Furthermore, the extraction regime for each resource would need to differ from one geographical location to another (e.g., tree species 'X' could thrive in both dry and moist environments but regenerate more slowly in the former). As for many non-renewable resources, restrictions would need to be determined by the rate at which renewable resource substitutes can be cultivated to keep intact a combined stock of resource-providing natural capital. In other instances, limits on the incoming resource flow would be dictated by a paucity of environmental sink capacity.

Although the imposition of throughput constraints involves the establishment of a policy instrument external to the market domain, there is no reason why it cannot be combined with the policy instrument of relative prices to maximise efficiency. This can be achieved by introducing a system of tradeable resource use permits, or what is often referred to as a 'cap-auction-trade' system. There is insufficient space to outline the full details of such a system except to say that the cap on the number of permits sets a throughput constraint on economic activity (see Lawn, 2007, Chapters 11 & 13). This ensures the economy at all times operates sustainably. Meanwhile, the initial auctioning and subsequent trading of the permits by a government authority ensures that permit prices, by reflecting ecological limits, serve as an absolute scarcity tax. The tax-like feature of the permit prices enables a central government to achieve two things. Firstly, it provides a central government with an opportunity to reduce the marginal tax rate on low incomes, which not only shields low-income citizens from the impact of higher resource and energy prices, but also narrows the income gap between rich and poor. Secondly, it encourages the efficient allocation of the capped (sustainable) resource flow under existing technology while also facilitating the development of new resource-saving technology.

I should also point out that a cap-auction-trade system can also be extended to various forms of pollution to ensure certain types of waste do not exceed the ecosphere's capacity to absorb them. Generally speaking, the system need not be applied to all forms of pollution because, in keeping with the first law of thermodynamics (the law of conservation of matter and energy), limits imposed on the input of low-entropy resources automatically imposes limits on the output of high-entropy wastes. However, a cap-auction-trade system is ideally suited to certain types of waste that are more difficult to regulate via caps on resource inputs. A good example of this are greenhouse gas emissions, where not only can a cap prevent emissions from exceeding dangerous levels – unlike a carbon tax – the price paid for emissions permits can encourage the development and uptake of pollution-reducing technology. Permit prices can also facilitate the gradual shift from non-renewable resources to renewable resources.

## 4. The role of macroeconomic policy in a throughput-constrained economy

One of the major ramifications of imposing throughput constraints on the economy is its impact on expansionary macroeconomic policy. Let's assume that the central government is of the view that the prevailing unemployment rate is too high. Believing that an economic stimulus would not lead to an excessive rate of price-inflation, it implements an expansionary monetary policy. Such a policy would immediately bring about a rise in the demand for low-entropy resources. However, with a cap-and-trade system in place, there would be no corresponding increase in the low-entropy resources supplied in resource markets. The resultant excess demand for low-entropy resources would almost certainly drive up the price of resource permits and raise the cost of resource use in production. This, in turn, would increase the general price level of all goods and services and therefore reduce real income. To cut a long story short, it is possible, as a consequence of implementing an expansionary monetary policy in a throughput-constrained economy, for real GDP to decline and for unemployment to rise – the opposite outcome to the one intended (see Heyes, 2000; Lawn, 2007, Chapters 13 & 14).

The altered dynamics surrounding the eventual fall-out of macroeconomic policies implemented in a throughput-constrained economy is not something to be taken lightly. I alluded earlier to the idea that bad macroeconomic policy can undermine conservation efforts if society rejects the ensuing deterioration of economic outcomes and reverts to the growth objective. It is therefore critical that we gain a greater understanding of the impact of macroeconomic policy in a throughput-constrained economy. To date, very few researchers have undertaken work in this area and this includes ecological economists who have long stressed the need for nations to make the transition to a steady-state economy.

From the small amount of work conducted on this issue, there are three things worthy of note. Firstly, except for impoverished nations that require a dose of efficient and equitably-distributed growth, fiscal and monetary policy should not be expansionary. Nor should it necessarily be contractionary since any economic contraction required to align the rate of resource throughput with the ecosphere's regenerative and waste assimilative capacities is best left to the introduction and gradual tightening of a cap-auction-trade system. In addition, healthy government expenditure levels are necessary to maintain public goods and critical infrastructure as well as to keep unemployment low during downturns of the business cycle, all of which are necessary to soften the social impact of transitioning to a steady-state economy.

Of course, if there is a gradual tightening of a cap-auction-trade system and a consequent reduction over time in the rate of resource throughput, there is no need to be concerned that the maintenance of strong expenditure levels would promote the undesirable growth of the economy. Indeed, all that healthy government expenditure levels would effectively do is alter the macro-allocation of resources towards the public sector (i.e., increase the public sector's share of real GDP relative to the private sector). Again, since public sector output tends to involve the provision of public goods and the redistribution of services towards the poor, this maybe necessary to ensure that the transition to a steady-state economy is socially acceptable. Overall, the importance of maintaining government expenditure indicates how potentially disastrous it could be to use contractionary macroeconomic policy as means of discouraging growth – even more so given that it does not guarantee ecological sustainability and biodiversity conservation.

Secondly, as a fiscal instrument, taxes are best used to alter the nature of consumer behaviour and economic activities rather than as a means of controlling the aggregate level of private-sector spending.[4] There are two reasons for this. In the first instance, the level of aggregate private-sector spending is best modified at the margin by the price-influencing impact of a cap-auction-trade system (i.e., as it alters the purchasing power of household disposable income). In the second instance, the tax burden should be redirected towards such 'bads' as resource depletion and pollution and away from such 'goods' as income and profit (a policy commonly referred to as *ecological tax reform*). Whilst the former discourages environmentally destructive activities, the latter rewards and thus facilitates increases in efficiency and value-adding in production (Gale et al., 1995; Daly, 1996; O'Riordan, 1997; Lawn, 2007). Incidentally, the imposition of a tax on depletion and pollution would be achieved to a large extent by the cap-auction-trade system given that resource permit prices are, as already mentioned, the equivalent of an absolute scarcity tax.

Thirdly, international trade policy should be focused on restricting the international mobility of financial capital. The massive increase over the past thirty-five years in the fluidity of financial capital movements has transformed the global economy from a federation of independent, trade-linked, national economies into one large economy devoid of national economic boundaries where production-location decisions are often determined by the desire of transnational corporations to avoid high wages and stringent environmental and workplace regulations. This globalisation phenomenon has emerged because the increase in financial capital mobility has shifted the principle governing international trade from 'comparative advantage' (which is based on the relative cost of production) to 'absolute advantage' (which is based on the absolute cost of production) (Daly and Cobb, 1989; Ekins et al., 1994; Daly, 1996; Lawn, 2007). In a world where comparative advantage is the dominant principle, lower absolute costs arising from lower standards confer little if any trade advantage because competing nations can continue to enjoy a relative cost advantage in the production and trading of most goods even if they suffer an absolute cost disadvantage in all goods. But in a world dominated by the principle of absolute advantage, lower absolute costs confer a significant trade advantage because the ability of corporations to take full advantage of a low-cost location is no longer impeded by a lack of international capital mobility.

Apart from the detrimental impact of global capital gravitating towards low-wage and environmentally damaging production locations, globalisation is increasing the pressure on governments in wealthy nations to lower environmental and workplace standards to prevent an exodus of capital and an associated loss of industries. It is for this reason that many ecological economists believe that globalisation forces are perhaps the most important to deal with since they severely undermine domestic attempts to introduce policies, such as cap-auction-trade systems, to achieve ecological sustainability, biodiversity conservation,

[4] This does not mean that taxes do not and should not be used to reduce private-sector spending power. Central-government taxation, by reducing private-sector spending power, plays an important role in nullifying most of the inflationary effect of a central government's own spending. Taxes should not, however, be used to control private-sector spending power at the margin in order to achieve an acceptable rate of price-inflation. I believe this is best left to variations in central-government spending via an 'employer of last resort' programme (see Lawn, 2011b).

and greater resource use efficiency. Ecological economists are therefore calling for urgent institutional reform at the international level – in particular, reform of the Bretton Woods institutions, such as the World Bank, International Monetary Fund, and World Trade Organisation (Daly, 2007).

## 5. Conclusion

Biodiversity conservation is threatened by many things but none more so than humankind's addiction to growth. Since contemporary macroeconomic policy is geared to maximise the growth rate of real GDP, it contributes significantly to the growing pressure being exerted on the ecosphere and the accelerating loss of biodiversity. However, turning macroeconomic policy on its head is not a viable solution to the dilemma we confront. This is because ecological sustainability, which is necessary to achieve biodiversity conservation, is a biophysical problem and macroeconomic policy involves the use of economic instruments which are designed to deal with economic problems. Macroeconomic policy settings cannot, therefore, be fine-tuned to directly solve the biodiversity erosion crisis.

To achieve ecological sustainability, it is necessary to impose resource throughput restrictions to ensure the rate of throughput does not exceed the ecosphere's regenerative and waste assimilative capacities. Given, also, the important role that efficiency plays in ensuring economic systems operate effectively within sustainable limits, cap-auction-trade systems should be widely introduced. However, cap-auction-trade systems will have major implications for macroeconomy policy setting. It is therefore important that more is known about the likely impacts of various macroeconomic policy stances in a throughput-constrained economy. Despite the lack of research in this area, it is safe to conclude that macroeconomic policy setting should cease to be expansionary, except in impoverished nations, where, for a limited period of time, a dose of efficient and equitable GDP growth would be clearly beneficial. Instead, macroeconomic policy should be directed towards: (a) maintaining public goods and critical infrastructure – necessary to ensure an appropriate macro-allocation of the sustainable incoming resource flow; (b) engaging in counter-cyclical increases in government expenditure to keep unemployment rates low; (c) ecological tax reform – necessary to discourage environmentally destructive activities and reward efforts to increase efficiency and value-adding in production; and (d) restoring comparative advantage as the principle governing international trade – necessary to promote a better international allocation of resources and to put a halt to standards-lowering competition at the international level.

Instituting policies of this nature would almost certainly reduce the real GDP of many wealthy countries, but it is our best chance of achieving sustainability and biodiversity conservation. Of course, as we have seen, and as I have been at pains to argue, there is no reason why appropriately designed and instituted policies that reduce the physical scale of wealthy economies should lead to a decline in human well-being. Indeed, if ecological sustainability is achieved in the manner outlined in this chapter, I believe that economic welfare, as reflected by the GPI, would rise. But if we sabotage the growth economy through the blunt use of contractionary macroeconomic policy, the GPI is almost certainly likely to decline along with real GDP. And that, I believe, would put at risk any genuine attempt to conserve the world's biodiversity.

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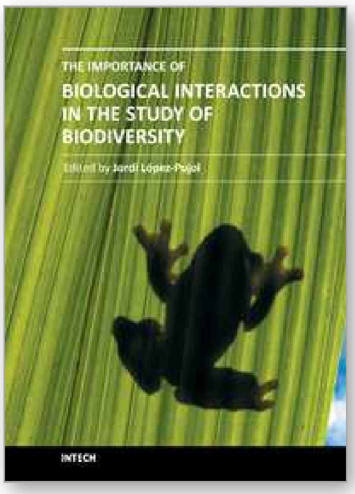


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The term biodiversity defines not only all the variety of life in the Earth but also their complex interactions. Under the current scenario of biodiversity loss, and in order to preserve it, it is essential to achieve a deep understanding on all the aspects related to the biological interactions, including their functioning and significance. This volume contains several contributions (nineteen in total) that illustrate the state of the art of the academic research in the field of biological interactions in its widest sense; that is, not only the interactions between living organisms are considered, but also those between living organisms and abiotic elements of the environment as well as those between living organisms and the humans.