ISSN 1444-8890

ECONOMIC THEORY, APPLICATIONS AND ISSUES

Working Paper No. 4

Globalisation, the Environment and Sustainability: EKC, Neo-Malthusian Concerns and the WTO

by

Clem Tisdell

March 2001

THE UNIVERSITY OF QUEENSLAND

ISSN 1444-8890
ECONOMIC THEORY, APPLICATIONS AND ISSUES
(Working Paper)

Working Paper No.4

Globalisation, the Environment and Sustainability: EKC, Neo-Malthusian Concerns and the WTO *

by

Clem Tisdell

March 2001

* This is a substantially revised version of C. Tisdell, *Economics, Ecology and The Environment* Working Paper No.39. It has been revised for consideration for inclusion in *Ecological Economics.*

WORKING PAPERS IN THE SERIES, *Economic Theory, Applications and Issues,* are published by the Department of Economics, University of Queensland, 4072, Australia.

For more information write to Professor Clem Tisdell, Department of Economics, University of Queensland, Brisbane 4072, Australia or email c.tisdell@economics.uq.edu.au

Abstract

GLOBALISATION, THE ENVIRONMENT AND SUSTAINABILITY: EKC, NEO-MALTHUSIAN CONCERNS AND THE WTO

Clem Tisdell, Department of Economics, The University of Queensland
Brisbane 4072, Australia, c.tisdell@economics.uq.edu.au

Economic globalisation is seen by many as a driving force for global economic growth. Yet opinion is divided about the benefits of this process as highlighted by the WTO meeting in Seattle in late 1999. Proponents of economic globalisation see it as a positive force for environmental improvement and, as a major factor increasing the likelihood of sustainable development through its likely boost to global investment. These proponents mostly appeal to analysis based on the environmental Kuznets curves (EKC) to support their views about environmental improvement. But EKC-analysis has significant deficiencies. Furthermore, it is impossible to be confident that the process of economic globalisation will result in sustainable development, if weak conditions only are satisfied. Strong conditions need to be satisfied in all probability to achieve sustainable development and given current global institutional arrangements these are likely to be violated by the current economic globalisation process. Global political action seems to be needed to avert a deterioration in the global environment and to prevent unsustainability of development.

This exposition demonstrates the limitations of EKC-analysis, identifies possible positive and negative effects of economic globalisation on pollution levels and highlights connections between globalisation and the debate about whether strong or weak conditions are required for sustainable development. The article concludes with a short discussion of the position of WTO in relation to trade and the environment and the seemingly *de facto* endorsement of WTO of weak conditions for sustainable development. It suggests that WTO's relative neglect of environmental concerns is no longer politically tenable and needs to be reassessed in the light of recent developments in economic analysis. The skew of economic growth e.g. in favour of developing countries is also shown to be extremely important from a global environmental perspective.

Keywords: China, environment, globalisation, environmental Kuznets curve, sustainable development, WTO.

Globalisation, the Environment and Sustainability: EKC, Neo-Malthusian Concerns and the WTO

1. Introduction

Controversy exists about the likely impacts of processes of economic globalisation in the environment and sustainable development and there is some dissatisfaction about WTO's policies regarding these matters. Some believe that economic globalisation is likely to be positive force for sustainable development (e.g. Sebastian and Alicbusan, 1989; Hansen, 1990) whereas others believe that it could have negative consequences for the environment and sustainable development (Daly, 1993; Lang and Hines, 1993; Anderson, 1998; Tisdell, 1999, Ch.6; Greenpeace, 1997; World Wide Fund for Nature, 1999). The purpose of this paper is to outline the basis of these differing views and briefly assess the position of WTO in relation to these matters.

The environmental/sustainability consequences of the economic globalisation process may be assessed from the point of view of an individual nation, such as China, or from a global perspective. Global environmental change may or may not be in the same direction for all nations (Copeland and Taylor, 1994; Neumayer, 2000, pp.139-141). Some countries may have an improving local environment as a result of the globalisation process whereas others experience a deteriorating one, and the global environment may deteriorate. Of course, the result which many would want is one in which the global environment improves and the local environments of all nations improve as well as the economic welfare of all nations. However, free trade is unlikely to result in simultaneous achievement of these objectives (cf. Cole *et al.*, 1998).

It should be noted that what is and what is not an improved environment is not always straightforward. The problem of evaluation is difficult when the environment improves in

some aspects and worsens in other respects, and this problem is not made easier by the use of environmental Kuznets curves.

2. Preliminary Analysis Using Environmental Kuznets Curves

In recent years, environmental Kuznets curves have been widely used to consider macro-changes in environmental quality as a result of economic growth, for example induced by trade liberalisation (e.g. Cole, 1999; Cole *et al.*, 1997; Grossman and Krueger, 1995, 1993), and to consider the environmental consequences of transition from a centrally planned economy to a market economy (Zylicz, 1994; Tisdell, 1997b). The method is, however, crude, can lead to faulty conclusions and ignores some factors relevant to sustainable development. Nevertheless, it is worthwhile noting the basic theory and relating it to the environment/globalisation debate.

The term "environmental Kuznets curve" (EKC) was coined by Selden and Song (1994). Its 'connection' with Simon Kuznets is at most indirect, Selden and Song (1994) hypothesized that the environment-income relationship might be similar to that suggested by Kuznets (1955) for income inequality in relation to economic development, namely of an 'inverted-U' shape. EKC has been subject to considerable attention and debate in recent years as highlighted by special issues of *Ecological Economics* (Rothman and De Bruyn, 1998) and *Environment and Development Economics* (Barbier, 1997), an article by Stern (1998) and by a very recent review of empirical studies of EKC by Cavlovic *et al.* (2000).

There are increasing grounds to be cautious about hypotheses based on the 'conventional' EKC. For example, Holtz-Eakin and Selden (1995) conclude that for some pollutants notably $C0_2$, the EKC-relationship does not hold in any meaningful way. More recently Harbaugh *et al.* (2000) found from their data that there is little empirical support for an inverted-U-shaped

relationship between several important air pollutants and national income. However, the subject is not closed and EKC-analysis continues to be widely used. Lopez and Mitra (2000), for example, have modified it to allow for differences in EKCs between countries due, for instance, to inter-country variations in the presence of corruption.

Based frequently, but not entirely as pointed out by Cavlovic *et al.* (2000), on observations from cross-sectional country analysis, the EKC-analysis suggests that pollution intensities, as indicated by pollution emissions per unit of gross product GP, decline with GP or GP per capita, after first rising (World Bank, 1992). This suggests that at low levels of GP per capita pollution intensities at first increase with economic growth and then decrease with further growth as income per head becomes high enough. To many, this suggests that economic growth is the key to solving environmental problems. They conclude: if economic globalisation provides a stimulus to economic growth, it will have a positive impact on the environment provided the economic growth is large enough. The simplest type of environmental Kuznets curve is shown in Figure 1 by the curve ABC. The unimodal nature of this curve is taken by many to imply that raising income above the level at which the curve peaks will reduce pollution levels.

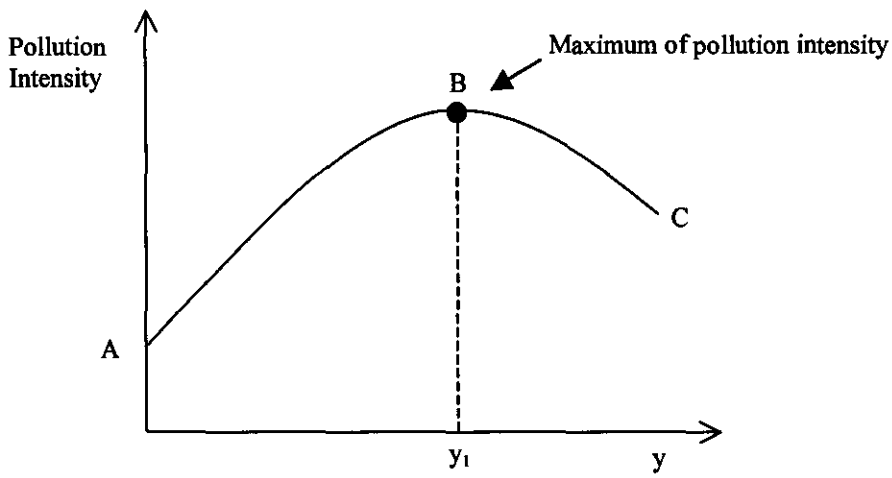

Figure 1: A 'normal' type of environmental Kuznets curve

For instance, in the case illustrated this curve may be taken to imply that provided world (national) GP or GP per capita or global gross product (depending on interpretation) is raised above y_1, economic growth will become favourable to the environment. But this is based upon the view that pollution is not cumulative or its impacts are reversible (cf. Arrow *et al.*, 1995; Tisdell, 1993). Some pollution is cumulative or virtually so because of the long life of the pollutants e.g. CO_2 emissions, some CFCs. Note also that the Kuznets curve fails to take account of biodiversity loss which is for all intents and purposes irreversible (cf. Tisdell, 1993). In addition, even after pollution intensity has reached its maximum level, total global pollution will continue to rise for at least a time, as illustrated in Figure 2. In this respect, the marginal net average curve needs to be taken into account because the pollution intensity curve is really an average curve not a marginal one (Tisdell, 1997b). Figure 2 illustrates this point. ABC represents an environmental Kuznets curve in relation to global gross product (GP) and curve DEBF is its corresponding marginal curve. Beyond a gross global product of y_1, pollution intensity is falling but total levels of pollution continue to rise in this case because marginal pollution levels remain positive. As global production increases beyond y_1, pollution intensity falls but global pollution rises until global production reaches y_1. Only after this point, will global pollution and global pollution intensities both declines This scenario is, therefore, not as rosy as one might deduce merely from a consideration of the EKC.

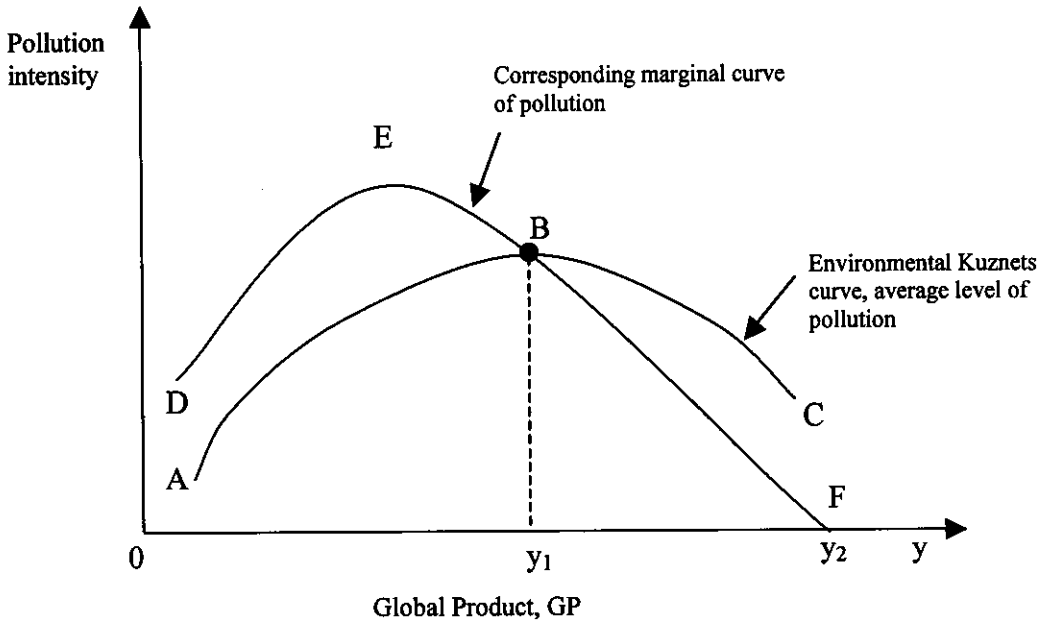

Figure 2: The environmental Kuznets curve is an average not a marginal curve

Although the EKC for some pollutants is likely to tend to zero or even become zero with sufficient economic growth once maximum intensities are exceeded, it is theoretically implausible that emissions of man-made pollutants as a whole will become zero with sufficient economic growth. Typically, the EKC-curve might after first declining from its maximum at an increasing rate do so at a decreasing rate but never become zero (see López and Mitra, 2000, p.144, curve AA in Fig. 1) Thus EKC can differ from a strict invested-U shape. In addition, the nature of the marginal pollution curve is little or hardly explored in the economic literature. While it might eventually become zero or negative for some pollutants as GP rises, this may not be so for pollution emissions as a whole. While the marginal pollution curve must be below the EKC when it is declining, it may or may not eventually reach zero or become negative depending on the pollutants being taken into account. However, the importance of the marginal pollution emission levels should not be ignored from a policy point of view as has largely been done to date. Pollution intensities (averages) provide a poor guide to social policy.

Furthermore, those who see economic growth as the eventual key to reduction of pollution have to face another significant issue. Pollution intensities or levels may not decline as economic growth proceeds until a critical pollution threshold is exceeded globally, or even nationally. Once this critical threshold is exceeded, the environmental change (such as might occur with rising greenhouse gas emissions) depresses incomes sharply and stymies economic growth. Such a threshold could be exceeded for flow pollutants but may be more probable for stock (cumulative) pollutants such as some greenhouse gases. The basic tenet, however, is the same, although optimal management of the different types of pollutants would differ. In addition, note that some flow pollutants become stock pollutants if environmental absorption capacities are exceeded, and various stock pollutants may have varying lengths of life. But these complications do not alter the substance of the matter.

In Figure 3, such a critical threshold is shown as OJ for flow pollutants, the only type allowed for in the Kuznets curve approach. In the absence of any pollution threshold constraint, the aggregate global pollution curve OABDF (corresponding to the EKC in Fig. 2) applies. But given this curve, production beyond y_0 cannot be achieve because once pollution exceeds the threshold OJ, gross global product (GGP) collapses substantially. This has analogies with the greenhouse gas case and the possibility of rising sea levels due to increases in greenhouse gas levels. In Figure 3, curve OABDF is the aggregate level of pollution as a function of GP in the absence of the critical constraints. Point B corresponds to the maximum of the Kuznets pollution intensity curve (EKC) in this case (Compare Fig. 2). The threshold OJ is breached before point B is reached. Consequently beneficial effects suggested EKC-analysis cannto be achieved.

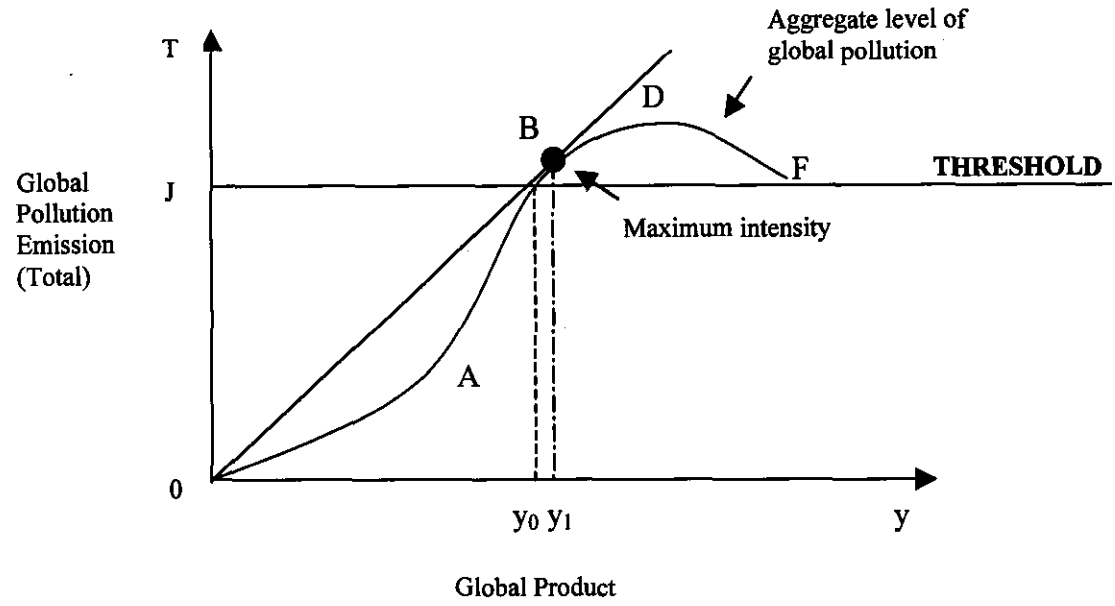

Figure 3: A case in which a global environmental Kuznets curve fails to decline before causing a pollution catastrophe.

3. IMPACT OF ECONOMIC GLOBALISATION ON ECONOMIC GROWTH, RESOURCE-USE AND CONSEQUENCES FOR POLLUTION LEVELS

Economic globalisation might be expected to have a positive impact on economic efficiency because the increased competition created by it is likely

(1) to improve allocative efficiency, and

(2) reduce X – inefficiency.

This ought to reduce input of materials per unit of output and lower wastage thereby reducing pollution emissions in relation to output. In effect this means a shift downward in the global environmental Kuznets curve as a result of globalisation. Thus a favourable environmental effect arises from this aspect.

This is, however, not the whole story. Input-saving and reduced pollution-intensities resulting from these two efficiency-factors may be offset or more than counteracted by the increased economic scale or economic growth stemming from globalisation.

Environmental 'pessimists' believe that the induced growth impact on resource-use of globalisation can be expected to more than offset efficiency gains in resource-use (Tisdell, 1999a, Ch.6; Daly, 1993). Consequently, total resource-use and pollution levels rise. Optimists suggest otherwise. The matter can be illustrated by reference to Figure 4. In a global system subject to limited competition, the relevant environmental Kuznets curve might be as shown by ABCD. But in an economically globalized competitive world, it might shift from ABCD to A'B'C'D' due to increased efficiency in resource-use. If this occurs, say when global production is y_0, total pollution emissions will fall by $y_0 \cdot BL$, and pollution intensity drops by BL if global GP is constant. But if sufficient growth in GP occurs, this may more than offset pollution benefits from increased resource efficiency. In the case shown in Figure 4, a rise in global GP from y_0 to y_2 as a consequence of globalisation results in an unchanged pollution intensity. However, the total pollution level rises by $BM \cdot (y_2 - y_0)$. So even with less growth in GP, the total global pollution level would rise. In this case, GP-values for which total pollution levels rise are easily found. To do so, we construct a rectangular hyperbole represented by curve HBK in Figure 4 based on the pre-globalisation pollution intensity. Any increase in GP above y_1 raises total pollution levels in the post-globalisation situation compared to the pre-globalisation one. Clearly the efficiency argument in itself does not imply reduced global pollution.

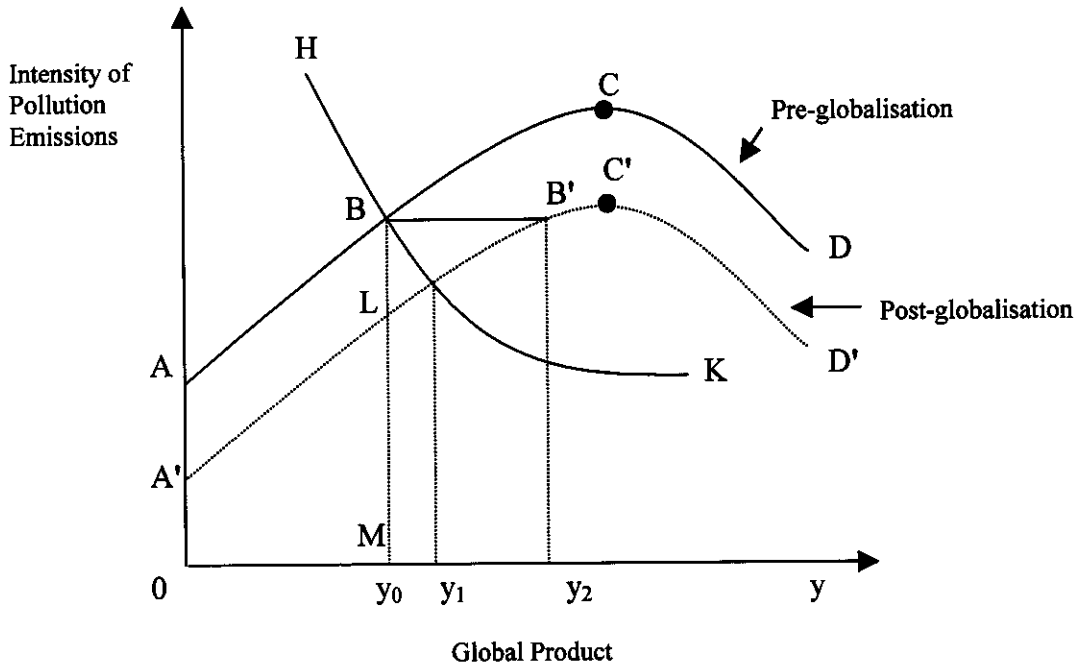

Figure 4: While EKC may decline because of increased efficiency as a result of globalisation, aggregate pollution levels may continue to rise due to economic growth.

Nevertheless, those who are quite optimistic about the beneficial environmental consequences of economic growth might argue that:

(1) economic growth is likely to stimulate the development of new resource-saving technologies;

(2) rising income may increase demand for a better environment, so environmental control improves (environmental income-effect);

(3) with economic growth, existing equipment may be replaced more quickly and in general, new equipment is likely to be more efficient in its resource-use and tends to be more environmental friendly (replacement effect) and

(4) with rising incomes, the nature of demand changes towards industries using fewer natural resources such as service industries (the composition effect) as suggested by the Clark-Fisher hypothesis.

Hence, pro-growth proponents may claim that the above environmental dilemmas are imaginary rather than real.

While all of the above effects should be taken into account, the empirical results indicate that material throughput has continued to rise even in countries which have had falling pollution intensities (Research by the Wuppertal Institute and World Resources Institute, see World Resources Institute *et al.*, 1997). Even if pollution intensities were to fall (or for that matter the level of total global pollution), economic growth might still be of concern to those who believe that strong conditions need to be imposed on conversion of natural resources to man-made goods in order to achieve sustainable economic development. Their concern is not based purely on pollution-effects. Let us consider its basis.

4. WEAK AND STRONG CONDITIONS FOR SUSTAINABILITY AND THE PROCESS OF ECONOMIC GLOBALISATION

Regarding sustainable development, one needs to know in what sense the term is being used and how sustainable development is to be achieved. One view of sustainable development is that it is development that ensures that the income of future generations is no less than that of current generations (e.g. Tietenberg, 1988).

Views differ about how that goal can be achieved. Some economists suggest that weak restrictions on the use of natural resources will suffice whereas others believe strong conditions must be imposed (Tisdell, 1999b). Traditionally economists have adopted weak conditions as a requirement for sustainable development. These imply that the appropriate way to achieve sustainable development is by accumulating man-made capital. Capital accumulation according to this approach is the key to taking care of future generations. This

approach assumes that man-made capital can continue to be substituted for natural capital (natural resource stock) without any adverse consequences for economic production.

In contrast, those who favour strong conditions for sustainable development argue that the continued conversion of natural resources to man-made capital will eventually reduce production. This group argues that man-made capital is not a substitute or a perfect substitute for natural resource capital. They argue that natural resources or environmental stock has an essential and irreplaceable role to play (Daly, 1997; Tisdell, 1997a, 1999a). Once natural capital is reduced beyond some point in relation to man-made capital, future production may fall. Where K represents man-made capital and N represents natural capital, the situation might be illustrated crudely by Figure 5. In this figure, the curve ABCD represents the level of income which can be sustained or more generally is an index of the level of income sustainable.

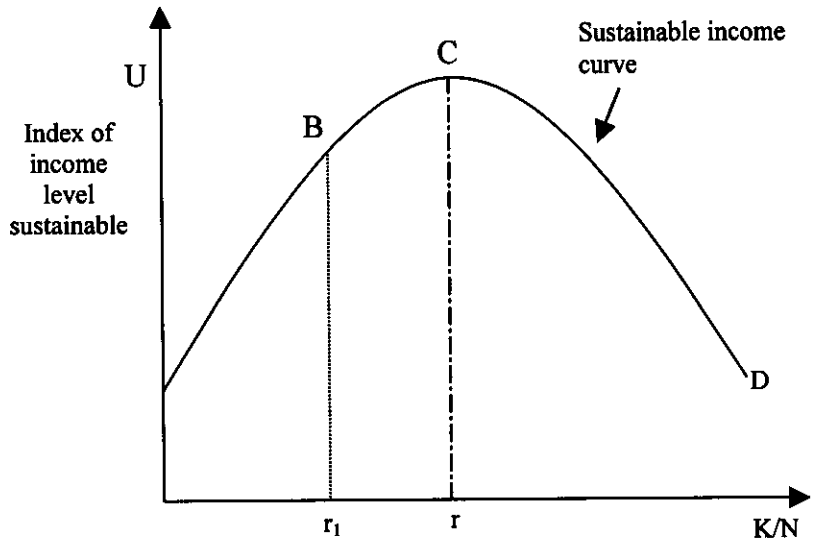

Figure 5: Likely relationship between the level of sustainable income and the ratio of man-made capital to natural capital.

From Figure 5, it can be deduced that if the world economy has a K/N ratio of r_1, further conversion of natural resources to man-made capital will raise the level of sustainable income. But if the world economy is at or gets into a situation corresponding to r_2, the level of sustainable income declines if further conversion of natural resources to man-made capital occurs.

If economic globalisation accelerates investment, as is likely, then it can be expected to push K/N upwards. Thus it could accelerate the onset of a decline in the level of sustainable income, or if a decline is underway in the level of sustainable income add to it. One of the reasons why economic globalisation may accelerate an increase in K/N is that foreign direct investment is facilitated, and multinational companies have increased scope for expansion. WTO (World Trade Organisation) rules are also designed to facilitate international investment.

In addition, there is the more optimistic possibility that globalisation could raise the level of K/N at which income can be sustained. It might do this, for example, by stimulating technical progress which saves on the use of natural resources in the investment process or raises productivity for at least some K/N combinations.

The situation can be illustrated by Figure 6. Let curve ABCD represent the sustainable income (SI) curve prior to globalisation. Suppose the world economy is then at B. The curve may shift as a result of globalisation up to $B'C'D'$. Sustainable income is now higher and loss of sustainability does not occur until the K/N ratio reaches r_3. Nevertheless, globalisation may stimulate investment to such an extent that despite the favourable shift in the

sustainability of income curve, income sustainability is increasingly threatened. In other words, the world economy may proceed well beyond r_3.

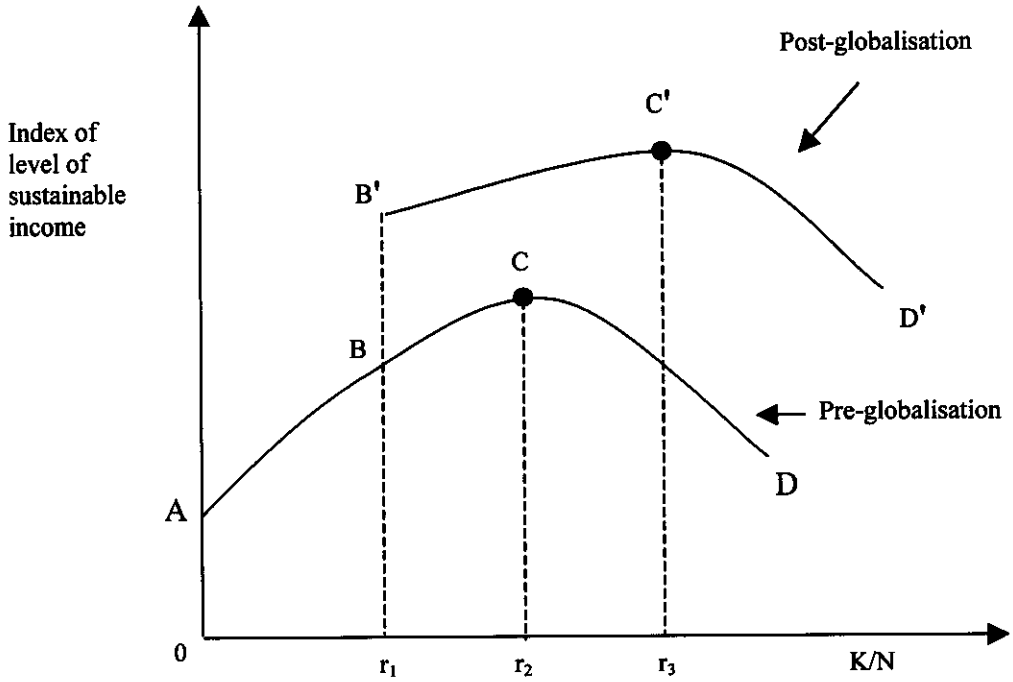

Figure 6: Increased technological progress following globalisation may raise the level of sustainable income and shift the sustainability curve.

5. Discussion of the Policy Relevance of the Analysis

There are strong reasons to be concerned that economic growth stimulated by globalisation as a consequence of international trade might have adverse consequences for the environment and for sustainable development. This article demonstrates that EKC-analyses provide no grounds for complacency nor does significant relaxation of natural resource stocks constraints in the context of strong requirements for sustainable development completely allay concerns.

Thus the pro-economic growth strategies promoted by Bretton Woods institutions and their progeny require careful scrutiny. While these policies may have drawn some support from

early EKC-analysis, this analysis has been shown to be wanting in several important respects some of which are mentioned here. In addition, these institutions do not appear to have come to terms with arguments in favour of strong conditions for sustainable development.

This applies especially to the World Trade Organisation (WTO) which has its origins in GATT (General Agreement on Tariffs and Trade). The stated objective of the GATT/WTO is to "provide a secure and predictable international trading environment for the business community and a continuing process of trade liberalisation in which investments, job creation and trade can thrive."

It is widely believed that the dispute settlement system of WTO favours trade expansion and economic growth to the neglect of environmental protection (Neumayer, 2000, p.139) and this can be interpreted as indicating that *de facto* it supports weak conditions for sustainable development, if it gives much attention in its policies to sustainable development at all. Although sustainable development is mentioned in the preamble to the agreement for the WTO, it has been observed that this is not binding (Halle, 2000). In any case, neither GATT nor WTO have approved trade restrictions which limit trade on the basis of adverse environmental effects when these occur externally to the country imposing sanctions. The only allowable basis for environmental trade discrimination is when environmental practices leave adverse identifiable signs on products. The technique adopted to produce the products cannot in itself provide a basis for trade discrimination, even if use of the technique seriously damages the environment. However, these principles appear to have been modified by a recent decision of the appellate body of the WTO about the import prohibition of the United States on certain shrimp and shrimp products (World Trade Organisation, 1998; cf. Stewart, 1998). Although this decision may open the way for unilateral extra-jurisdictional environmental protection, the appellate body strongly prefers a multilateral approach, and in

practice, a unilateral approach is unlikely to satisfy all the conditions imposed by the appellate body (Neumayer, 2000, p.150).

WTO has adopted the general position that policies on international trade and investment, especially national policies, should not be used to achieve extra-jurisdictional environmental objectives. WTO prefers that such matters be solved by international multilateral agreements. Concerning strong versus weak requirements for sustainable development and the conversion of natural resources into man-made commodities, the WTO appears not to have elaborated its position. Although it has formed an Environment and Trade Committee, this committee appears to have made little progress with policy (Cole, 2000) and so far it has not been instrumental in reconciling the views of many environmentalists with those of the WTO, as indicated by demonstrations at the WTO meeting in Seattle in late 1999.

Clearly the role of the WTO in relation to global environmental policies and the goal of sustainable development remains unsettled. In particular, there is considerable public debate about

a) the extent to which international trade policies should be used to achieve environmental and sustainability ends, and
b) the extent to which trade sanctions should be used to provide penalties for non-compliance with international environmental agreements.

It seems unlikely that the WTO will be able to avoid greater policy involvement in these areas in the future.

For some time, the International Institute of Sustainable Development, which was established following the United Nations Conference on the Environment and Development in Rio de Janeiro, has been calling for the WTO to integrate its trade policies with sustainable

development and has proposed the Winnipeg principles as a means to bring about this integration (International Institute for Sustainable Development, 1994; Shaw and Cosbey, 1995; von Moltke, 1999). However, its proposals appear to have had little effect on the WTO (cf. Halle, 1999, p.7). The reasons are unclear but could include the general reluctance of the WTO to extend its mandate to environmental issues, difficulties in putting the Winnipeg principles into actual operation, and the possibility that they are too idealistic to obtain the general political support of WTO members. An alternative might be to develop a set of less stringent conditions (minimum requirements) similar to those of the International Labor Organization covering labour standard. This could provide a platform for the evolution of international policy integrating trade and the environment. The above neo-Malthusian analysis, as well as public opinion, indicates the need to integrate policies for international trade and sustainable development.

While one can understand the reluctance of the WTO to allow international trade and investment policies to be used for enforcing environmental preferences or goals, it seems unreasonable to adopt a blanket position in this regard. Trade sanctions e.g. against Iraq, have been used for international political ends. Violation of environmental global agreements may require penalties and trade and investment sanctions should not be ruled out completely although they ought to be a last resort.

A further important matter should be considered in relation to the hypothesis that economic growth, stimulated by trade liberalisation, is in the end likely to be good for the environment and for sustainable development. For simplicity, the above analytical discussion proceeded on the basis that only the aggregate or global level of gross product is relevant for EKC-analysis. In practice, however, the geographic or international distribution of production is important in several respects, and one in particular is significant in the above context. Even

assuming that EKCs do not differ between countries, or do not do so significantly, if economic growth is concentrated on less developed countries, global pollution will increase by a greater amount then if the same amount of growth is concentrated on more developed countries, assuming that the latter are well beyond the maximum of their EKC and that developing countries are approaching or in the neighbourhood of the maximum of their EKC. The geographical distribution of global production does make a difference from a pollution point of view and it is possible to show mathematically using EKC analysis that the concentration of increased global production in less developed countries can raise global pollution by more than the same concentration in more developed countries[1]. Of course, this problem is exacerbated if, as suggested by López and Mitra (2000), problems of governance in less developed countries result in greater pollution per unit of output than in more developed countries and if there is a delayed turning point for EKC in less developed countries. But the argument does not rely on that assumption.

The above observations should not be taken to imply that economic growth ought to be stymied in less developed countries. This conclusion would be difficult to justify on welfare grounds. But it is clear that trade liberalisation which has stimulated economic growth both in less developed countries such as China and India, and further trade liberalisation for China with its entry to the WTO which is expected to prolong China's period of rapid economic growth, raises global environmental dilemmas. Skewing of economic growth in favour of less developed nations is likely to result in the type of environmental threshold(s) discussed in relation to Figure 3 being reached more quickly than otherwise. This is of particular concern in relation to the emission of greenhouse gases, and this seems to be so despite serious deficiencies in EKC-analysis.

6. Conclusion

Misgivings about the empirical basis of EKC-analysis, its theoretical limitations and faulty policy conclusions drawn from it, cast doubts upon the hypothesis that global economic growth stimulated by trade liberalisation and globalisation will (given current international institutional arrangements in which the WTO plays in important role) promote sustainable economic development. This sustainability concern is further reinforced by neo-Malthusian fears that global pollution thresholds may be exceeded and that excessive conversion of natural resources into man-made capital may occur as a consequence of uncoordinated global economic growth stimulated by trade liberalisation. The seriousness of these sustainability problems is likely to be exacerbated by the skew of economic growth in favour of major developing countries such as China and India. If the above analysis is correct urgent international cooperative action is needed to address these issues.

Acknowledgements

This article is based on a public lecture given at the University of International Business and Economics in Beijing and also given at the Institute of Business Management Calcutta, India. I wish to thank participants for their useful comments. I also thank reviewers for *Ecological Economics* for their valuable comments. The usual *caveat* applies.

Footnote

[1] To illustrate this, assume, that marginal pollution emissions as a function of national gross product is the same for all nations. Denote this function by $f(y)$ and assume that this function is unimodal and symmetric about its maximising value $\bar{y}$. Then for $y_0 < \bar{y}$ and for

$$\int_{y_0}^{\bar{y}} f(y)dy > \int_{y_r}^{y_r+(\bar{y}-y_0)} f(y)dy$$

Thus, in this case, the same degree of economic growth in the lower income country adds more to pollution emissions than in the higher income one. This may be of particular concern when the pollutant involved is a global one. This inequality does not however, apply in all cases. For instance, it need not if the income level of the poorer country is very low and that of the higher income country is not far beyond $\bar{y}$. However, with continued growth in both countries the inequality is likely to be satisfied.

References

Anderson, K., 1998. Agricultural Trade Reforms, Research Initiatives, and the Environment. In: Ernst Lutz (Editor) Agriculture and the Environment: Perspectives on Sustainable Rural Development, World Bank, Washington, pp.71-82.

Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Molling, C. S., Jansson, B-O., Levin, S., Mäler, K-G., Perrings, C. and Pimentel, D., 1995. Economic Growth, Carrying Capacity, and the Environment. Science, 268: 520-521.

Barbier, E. B., 1997. Special Issue: The Environmental Kuznets Curve. Environment and Development Economics, 2: 357-515.

Cavlovic, T., Baker, K. H., Berrens, R. P. and Gawande, K., 2000. A Meta-Analysis of Environmental Kuznets Studies. Agriculture and Resource Economics Review, 29(1).

Cole, M. A., 2000. Trade Liberalisation, Economic Growth and the Environment. Edward Elgar, Cheltenham, UK.

Cole, M. A., Rayner, A. J. and Bates, J. M., 1998. Trade Liberalisation and the Environment: The Case of the Uruguay Round. World Economy, 21(3), 755-787.

Cole, M. A., Rayner, A. J. and Bates, J. M., 1997. The Environmental Kuznets Curve: An Empirical Analysis. Environment and Development, 2(4): 401-416.

Cole, M. A., 1999. Limits to Growth, Sustainable Development and Environmental Kuznets Curves: An Examination of the Environmental Impact of Economic Development. Sustainable Development, 7(2): 87-97.

Copeland, B. R. and Taylor, M. S., 1994. North-South Trade and the Environment. Quarterly Journal of Economic, 109(3): 755-787.

Daly, H., 1997. Georgescu-Roegen versus Solow/Stiglitz. Ecological Economics, 22(3): 261-266.

Daly, H., 1993. The Perils of Free Trade. Scientific American, November, 24-29.

Greenpeace, 1997. WTO Against Sustainable Development. Greenpeace, Amsterdam.

Grossman, G. and Krueger, A., 1995. Economic Growth and the Environment. Quarterly Journal of Economics, 110(2): 358-377.

Grossman, G. and Krueger, A., 1993. Environmental Impacts of a North American Free Trade Agreement. In: P. Gamber (Editor) The US-Mexico Free Trade Agreement. MIT Press, Cambridge, MA.

Halle, M., 2000. Seattle and Sustainable Development. International Institute for Sustainable Development, Winnipeg. http://www.wcit.org/Halle_Seattle_and_sd.htm

Hansen, S., 1990, Macroeconomic Policies and Sustainable Development in the Third World. Journal of International Development, 2: 533-557.

Harbaugh, W., Levinson, A. and Wilson, D., 2000. Re-examining the Evidence for an Environmental Kuznets Curve. NBER Working Paper No.7711, National Bureau of Economic Research, Cambridge, MA.

Holtz-Eakin, D. and Selden, T., 1995. Stoking the Fires? CO_2 Emissions and Economic Growth. Journal of Public Economics, 57(1): 85-101.

International Institute for Sustainable Development, 1994. Trade and Sustainable Development Principles, IISD, Winnipeg, Canada.

Kuznets, S., 1955. Economic Growth and Income Inequality. American Economic Review, 45(1): 1-28.

Lang, H. and Hines, C., 1993. The New Protectionism: Protecting the Future Against Free Trade. Earthscan, London.

López, R. and Mitra, S., 2000. Corruption Pollution, and the Kuznets Environment Curve. Journal of Environmental Economics and Management, 40: 137-150.

von Moltke, K., 1999. Trade and Environment: The Linkages and the Politics. International Institute for Sustainable Development, Winnipeg, Canada.

Neumayer, E., 2000. Trade and the Environment: A Critical Assessment and Some Suggestions for Reconciliation. Journal of Environment and Development, 9(2): 138-159.

Rothman, D. and De Bruyn, S., 1998. Special Issue: The Environmental Kuznets Curve. Ecological Economics, 25(2): 143-232.

Sebastian, I. and Alicbusan, A., 1989. Sustainable Development: Issues in Adjustment Lending Policies. Environment Department Divisional Working Papers 1989-96, The World Bank, Washington D.C.

Selden, T. and Song, D., 1995. Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution Emissions? Journal of Environmental Economics and Management, 27: 147-162.

Shaw, N. and Cosbey, A., 1995. GATT, the WTO and Sustainable Development: Positioning the Work Programme on Trade and Sustainable Development. International Institute for Sustainable Development, Winnipeg, Canada.

Stern, D. I., 1998. Progress on the Environmental Kuznets Curve? Environment and Development Economics, 3: 173-196.

Stewart, T., 1998. The United States Embargo on Shrimp Imports: Legal and Economic Considerations. Environment and Development Economics, 3: 197-219.

Tietenberg, T., 1988. Environmental and Natural Resource Economics, 2nd Edition. Scott Foresman and Company, Glenview, Illinois.

Tisdell, C.A., 1999a. Biodiversity, Conservation and Sustainable Development. Edward Elgar, Cheltenham, UK.

Tisdell, C.A., 1999b. Conditions for Sustainable Development: Weak and Strong. In: Andrew K. Dragun and Clem Tisdell (Editors) Sustainable Agriculture and Environment: Globalisation and the Impact of Trade Liberalisation. Edward Elgar, Cheltenham, UK, pp.23-36.

Tisdell, C.A., 1997a. Capital/Natural Resource Substitution: The Debate of Georgesu-Roegen (through Daly) with Solow/Stiglitz. Ecological Economics, 22: 289-291

Tisdell C.A., 1997b. Protection of the Environment in Transitional Economics. Regional Development Dialogue, 18(1): 32-49.

Tisdell C.A., 1993. Combining Biological Conservation, Sustainability and Economic Growth: Can We Overcome Potential Conflict? Discussion Paper No.125, Department of Economics, The University of Queensland, Brisbane.

World Bank, 1992. World Development Report 1992: Development and the Environment, Oxford University Press, New York.

World Resources Institute, Wuppertal Institute, Netherlands Ministry of Housing, Spatial Planning and Environment, National Institute of Environmental Studies, 1997.

Resource Flows: The Material Basis of Industrial Economics. World Resources Institute, Washington D.C.

World Trade Organisation. 1998. United States – Import Prohibition of Certain Shrimp and Shrimp Products. (Appellate body report, adopted on October 12, 1998; WT/DS 58/AB/R) WTO, Geneva.

World Wide Fund for Nature International (WWF), 1999. Initiating an Environmental Assessment of Trade Liberalisation in the WTO. WWF, Amsterdam.

Zylicz, T., 1994. Environmental Policy Reform in Poland. In T. Steiner (Editor) Economic Policies for Sustainable Development. Kluwer Academic Publishers, Dordrecht pp.82-112.

ISSN 1444-8890

PREVIOUS WORKING PAPERS IN THE SERIES

ECONOMIC THEORY, APPLICATIONS AND ISSUES

1. Externalities, Thresholds and the Marketing of New Aquacultural Products: Theory and Examples by Clem Tisdell, January 2001.

2. Concepts of Competition in Theory and Practice by Serge Svizzero and Clem Tisdell, February 2001.

3. Diversity, Globalisation and Market Stability by Laurence Laselle, Serge Svizzero and Clem Tisdell, February 2001.