Is Economic Growth the Environment's Best Friend?[1]

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Summary

Whether economic growth is good or bad for the environment has since long been a matter of fierce debate. Recently, it has become quite popular among neoclassical economists and policy makers to praise economic growth as the best way to reach a decent environment. This study investigates the link between economic growth and the environment and presents the theoretical case for both 'environmental optimism' and 'environmental pessimism'. It shows that, theoretically, economic growth can be either good or bad for the environment. The author therefore analyses existing empirical studies finding that the available evidence does not allow to draw any general conclusions. There is no scientific answer on the consequences of economic growth on the environment. Whether one believes in environmental optimism or pessimism is ultimately just that: a matter of belief.

1. Introduction

It has long been believed that modern civilisation and especially economic growth leads to environmental degradation. In the early 1960s, when Carson (1962) expressed her fear about a 'silent spring' due to the death of birds being exposed to DDT, the public

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awakened to the detrimental side-effects of economic growth on the environment. The book became very popular and so, albeit slowly, became the environmental movement. It was not before the ozone layer depletion, global warming, and biodiversity loss became a big issue in the eighties, however, that environmental degradation was perceived as a constraint to economic growth as such. Interest by that time shifted away from natural resource availability towards the environment as a medium for assimilating wastes (from 'source' to 'sink'). Indicative of this trend is that the second 'Club of Rome'-report by Meadows et al. (1992) was much more concerned with the detrimental side-effects of economic growth than the first report (Meadows et al. 1972) which was mainly about the scarcity of natural resources[2]. I call the position which holds that economic growth leads to increased environmental degradation 'environmental pessimism'. Neoclassical economists, on the contrary, believe that economic growth and a decent environment are complements rather than foes (see Ravaioli 1995). They argue that environmental pollution is higher in poor countries than it is in rich countries. Hence, in order to become clean one has to grow rich. While it might be true that economic growth produces some ills along the way it also provides the means to cure these ills and to do even better. As Beckerman (1992b, p. 482) has put it: „In richer countries (...) by the end of the 1960s almost all of the most important components of the physical environment - notably air quality in cities - in the more advanced countries were also improving."[3] The World Bank as the predominant institution in the international development business - while realising that environmental improvements have to be achieved by active policy and cannot simply be waited for - also subscribes to the view that in the end economic growth will be good for the environment (World Bank 1992). I call such

[2] Another important contribution was Daly (1977) who stood a bit against the trend in emphasising environmental degradation as a consequence of economic growth already back in the 1970s. Daly became later on one of the best known economist critics of economic growth and a co-founder of the International Society for Ecological Economics. For a good overview of his recent work see Daly (1996).

a position 'environmental optimism'. This is arguably also the common view among policy makers which explains a good deal of their apparent inactivity and refusal to combat environmental problems.

This study investigates what theory and empirical evidence can tell us about the linkage between economic growth and environmental degradation. I define environmental degradation as a reduction in renewable resources that provide humans with environmental amenities such as forests, fish grounds, wildlife etc. and with waste-assimilating functions that reduce the impact of human-induced pollution.

Why is it that the economy and especially economic growth pose a problem for the environment? The first law of thermodynamics, that is the law of the conservation of mass, implies that no material can be destroyed, it can only be transformed into other goods (bound to become waste some time), and into waste, pollution etc. That is, all other things equal, economic activity and the more so economic growth „is inevitably an entropic process that increases the amount of unavailable (i.e. dissipated or high entropy) resources at the expense of available (i.e. ordered or low entropy) resources: the stock of wastes increases and environmental quality decreases."[4] (Smulders 1995, p. 165). Of course, it is the environmental optimists' argument that all other things are *not* equal.

Section 2 presents the theoretical case for environmental optimism. The opposite case of environmental pessimism is put forward in section 3. As these two sections will make clear there is no clear-cut theoretical answer on the environmental consequences of economic growth. Theory alone is not able to decide whether environmental optimism or pessimism is closer to the 'truth'. Section 4 therefore reviews existing empirical studies

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[3] For an eloquent several-hundred-pages defence of this view see also Simon (1996).

[4] Strictly speaking, this argument does not apply since the earth is not a closed system, but one that absorbs a steady, constant energy influx from outside exceeding the current total world energy

and assesses whether evidence is able to decide between the opposite claims. It will turn out that, at least so far, the empirical evidence is too clumsy, contradictory, and too little reliable for general conclusions to be drawn - especially for predicting future as opposed to past environmental consequences of economic growth. Section 5 concludes therefore that whether one sides with environmental optimism or pessimism is ultimately a matter of 'belief'. There is no scientific answer on the consequences of economic growth on environmental degradation in the long run.

2. The theoretical case for environmental optimism

There are several reasons suggesting that economic growth might be beneficial for the environment in spite of the first law of thermodynamics:

1) One that is often cited (e.g. Beckerman 1992a,b, Baldwin 1995) is that demand for environmental quality is a superior good as economists call it, that is a good with an income elasticity greater than one: as incomes grow environmental concern rises more than proportionally. In a political system that is responsive to the preferences of its people environmental protection rises more than proportionally with economic growth if demand for environmental quality is a superior good. There is some evidence suggesting that, in general, the political systems in rich countries are more responsive than in poor countries (Rueschemeyer, Stephens and Stephens 1991, Barro 1996). Given that past environmental destruction is not infinitely persistent and irreversible, the rising share of environmental protection in relation to total expenditure implies that environmental quality increases.

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demand at about three orders of magnitude. It does apply approximately, however, when most of this influx is — as at present — not used.

A similar argument is that with rising incomes people become better educated and better able to express their desires and defend their interests. It becomes more difficult with rising incomes to externalise environmental costs upon others, because the latter are better able to fight this degradation of their welfare. Also, richer people are more likely to be aware of environmental hazards due to better education and information. Hence in rich countries more environmental costs are internalised than in poor countries implying that pollution in poor countries is higher.

2) The second reason buttresses the first one in that it suggests that rich countries might not only have the higher demand for environmental protection, but also have the better means for satisfying this higher demand. If you are rich you can better afford spending money on the environment and you have the technical equipment for environmental protection. But it is more than that: Rich countries also „have the advanced social, legal and fiscal infrastructures that are essential to enforcing environmental regulations and promoting 'green awareness'" (Baldwin 1995, p. 61).

3) The third reason is that with economic growth it becomes more likely that more modern capital is newly installed or replaces old capital and Grossman (1995, p. 21) claims that later vintage capital by and large tends to be less pollution intensive. There is some weak support for this claim which is confined to case studies, however - see e.g. Wheeler and Stengren (1992). Systematic evidence on this claim is still missing.

4) The fourth reason is that at higher levels of income the share of industry goes down while the share of services goes up and it is often presumed that services are less pollution-intensive than industry manufacturing. Even within industries the share of heavy-polluting manufacturing (like chemistry, steel and cement production) decreases in fa-

vour of less-polluting high-tech manufacturing. For some weakly supporting evidence see Jänicke, Mönch and Binder (1992).

5) The fifth reason puts forward a similar, more fundamental argument: Economic growth is not logically equivalent to rising output in material terms but to rising output in value terms. That is, economic growth means a rise in total net value. Resource depletion and environmental destruction as such are not objectives of economic activity, rather they are 'unwanted' side-products of adding value to the inputs of production. Where this value comes from and how pollution-intensive it is are logically separate questions from the growth in value. The economic value per unit of pollution can rise or, vice versa, the pollution intensity per unit of economic value can fall. The same argument applies to resource use and resource intensity. Note that this decoupling of economic value from resource input and pollution can stem either from technical improvements or from the changing pattern of output away from resource- and pollution-intensive towards less intensive goods. It can also stem from re-use of goods, recovery and recycling of materials. There is „no definite upper limit" on the „service output of a given material" (Ayres 1997, p. 286).

6) The sixth reason takes a closer look at the environmental consequences of poverty. As Beckerman (1992a,b, 1993) and Barbier (1994) observe, poor people are often locked into a poverty-environmental degradation-poverty trap. That is: because you are poor you are forced to exploit your environment which in turn makes you poorer which in turn raises the pressure on the environment and so on. As Markandya and Pearce (1988, p. 35) observe, the very high time preference rates of poor people which is due to their poverty makes it completely rational for them to destroy the resource their living is dependent upon. Deforestation for the collection of fuelwood seems a good example for

this conjecture. Beckerman (1992a, p. 482) concludes that „in the end the best — and probably the only — way to attain a decent environment in most countries is to become rich“.

7) A seventh reason is that with rising incomes the pressure on the environment due to tremendous population growth goes down since population growth tends to go down. Figure 1 plots the average annual growth rates between 1990 and 1993 of almost all countries against their 1993 nominal per capita income in current US$. There is a weak tendency for lower population growth rates being correlated with higher per capita incomes shown by the linear trend line.

<<<<< **INSERT Figure 1 here** >>>>>

Source: World Bank (1995) dataset

Figure 1. Population growth and per capita income.

3. The theoretical case for environmental pessimism

There are several objections to the proposition that economic growth might be beneficial to the environment, however:

1) The first objects to the supposition that the rich care more about the environment than the poor do (see e.g. Martinez-Alier 1995). The available systematic evidence on this point is far from conclusive (see Kriström and Riera 1996). There is some casual evidence, however, suggesting that some societies with very low incomes place a high value on the conservation of species and amenities that are often characterised by common property (Bromley 1989, Kanbur 1992, Broad 1994).

A similar argument is that although environmental concern might rise more than proportional, rising incomes lead to an inflation in demands for all kinds of things. More and more goods and more and more new goods need to be produced to satisfy the rich consumer's desire which in itself means higher pressure on the environment. Poor people do not travel by plane very much and do not drive a Porsche.

2) The second objection is that while pollution per unit of output might decrease, total pollution might still increase if the rate of growth in output is higher than the rate of decrease in pollution per unit of output. As Lopez (1992, p. 154) observes for technical change, its effect on pollution is in principle ambiguous: „Technical change has two effects: (i) it increases the efficiency of conventional factors of production, and (ii) it may generate biases toward more or toward less environment-intensive technologies. Insofar as (i) is effectively equivalent to conventional factor accumulation, its effect on the environment is negative. The effect of (ii) is to decrease environmental degradation if technical change is environment saving. Given that environmental R&D efforts by the private sector are still oriented more toward the development of conventional factors saving techniques rather than to environmental saving techniques. Hence, it is likely that the effect (i) of technical change dominates the effect (ii), implying that growth, even if generated by technical change only, will lead to increased pollution."

Ausubel (1995) suggests that technical progress will vastly reduce the emission of carbon-dioxide in the beginning and middle of the next century, thus drastically reducing any need to cut down emissions artificially by introducing taxes. Clavendish and Anderson (1994, p. 774) cite evidence that „in a large number of cases pollution per unit of output can be, and often historically has been, reduced by factors of 10, 100, and sometimes 1000 or more (depending on the case) once the process of substitution is complete." But there are also limits to this trend of substitution — first physical limits,

but second, and much more important, economic limits, because often the marginal costs of reducing pollution per unit of output is rising steeply as pollution is tending towards zero. Not everything that is physically possible in theory will ever be put into practice because doing so would be prohibitively costly.

3) A third objection is this: Insofar as pollution is decreasing because the pattern of output is changing, there are limits as well. This time, however, the limits are not determined by technology or economic cost, but rather by people's preferences and social conventions. While it might be possible to substitute recreational and cultural activities which tend to be rather low pollution-intensive for the consumption of pollution-intensive material goods, this substitution cannot go on forever. As far as we can judge from people's revealed preferences, material goods are rather highly appreciated.

4) The fourth objection acknowledges that structural changes in the economy impact upon environmental quality. That does not work unambiguously in favour of the environment, however. At low levels, with rising incomes the share of agriculture goes down while the share of industry goes up with possibly detrimental effects on the environment, especially if not accompanied by a tighter environmental policy. Also, at low levels the share of heavy-polluting manufacturing (like chemistry, steel and cement production, heavy engineering) is usually quite high.

5) The fifth objection suspects that one important reason why high income countries could become cleaner was that they exported their most polluting industries to lower income countries. In importing goods that are highly resource- or pollution-intensive but produced elsewhere, developed countries can make their environmental record look cleaner than it actually is if one took account of the international trade linkages and at-

tributed resource use and environmental pollution to the final consumption. Of course, when everybody wants to become rich, there are no poor countries to take on the dirty industries anymore. Hence becoming 'cleaner' as a consequence of becoming rich is not possible anymore. The available evidence for this argument is rather inconclusive. See Hettige, Lucas and Wheeler (1992a,b) for some weak support, see Leonard (1988), Tobey (1990), Grossman and Krueger (1993) and the contributions to Low (1992) for contrary evidence.

6) The sixth objection contests that economic growth is a necessary and sufficient condition for reducing population growth. It is argued that investing in female education and providing retirement insurance schemes are the best ways to reduce population growth. While these might correlate often with economic growth, the latter is neither necessary nor sufficient to achieve the goal: There are poor countries like Uruguay with an income of 2,640 US$ and low population growth with an average annual growth rate of 0.59%, there are rich countries like the United Arab Emirates with an income of 21,610 US$ and high population growth with an average annual growth rate of 2.71% (data from World Bank (1995)). Quite clearly, population growth is determined by many other factors beside the level of a country's income. This can also be seen in referring back to figure 1: while there is a linear trend detectable, there is also considerable variance around the trend.

4. Empirical Evidence

From theory alone no definite answer can therefore be found. What does the evidence tell us? Available econometric studies, some time-series, but mostly cross-sectional, paint a complex picture depending on which indicator for which aspect of environ-

mental quality you are focusing on (Shafik and Bandyopadhyay 1992, Binswanger 1993, Panayotou 1993, Grossman and Krueger 1994, 1995, Grossman 1995, Cropper and Griffiths 1994, Shafik 1994, Selden and Song 1994, Holtz-Eakin and Selden 1995, Baldwin 1995). One has to be rather cautious in interpreting the generated results: First, the quality of data they rely on is very poor indeed; second, so far only very simple econometric techniques have been used and, third, different studies have come up with different relationships for the same indicator depending on the modelling technique. Nevertheless it seems possible to come to the rather robust conclusion that there are three qualitative cases to distinguish:

I. indicators showing an unambiguous improvement as incomes rise. Examples would be access to clean water and adequate sanitation.
II. indicators showing a deterioration first until a certain level of income is reached after which an improvement takes place. That is, on a graph with the environmental quality on the ordinate and income on the abscise the graph would show a U-curve. Often in the literature, however, the level of pollution is put on the ordinate so that the graph shows an inverted U-curve. This curve is called an 'Environmental Kuznets Curve' after Kuznets (1955) who hypothesised that income distribution would become more unequal first and more equal later on as development started off in a country. Examples would be the emission of suspended particulate matter, sulphur oxides, faecal coliforms, the quality of ambient air and the rate of (tropical) deforestation. This case has gained the most attention for reasons I will discuss further below.
III. indicators showing an unambiguous deterioration in this specific aspect of environmental quality as incomes rise. Examples would be municipal waste and the emission of carbon dioxide per capita. Strictly speaking the data suggest that at very,

very high levels of income there will be a turning point. But this level is much higher than any of the income levels of present countries (Holtz-Eakin and Selden 1995).

It follows that one has to carefully look at concrete environmental indicators to gauge the environmental consequences of economic growth. Precaution in making conclusions is additionally warranted since many aspects of the environment have not been examined yet, mainly due to lack of data - e.g. acidification, biodiversity loss, land degradation and loss of soil fertility, traffic congestion, water and other renewable resource depletion. Hence no general conclusions can be drawn from the existing evidence so far.

Why are there (at least) three different qualitative cases to distinguish? One possible explanation for the observed variance is that those environmental aspects that are most important in everyday life and that are rather difficult to externalise on others improve already at quite low income levels, whereas those that can be easily externalised on others, as for example with carbon dioxide emissions, worsen steadily with economic growth (Shafik 1994, p. 768). Another possible explanation is that some by-products of economic activity such as sulphur- and nitrogen-oxides (SO_x and NO_x) can rather easily be eliminated - whereas central components of the economy, like carbon dioxide and solid waste, cannot easily be disposed.

These are more or less speculations since the reduced-form econometric studies are not able to discriminate between varying theoretical hypotheses we looked at further above for explaining the observed data. It is, for example, not possible to clearly tell which part of the effect came about via quasi-automatic changes during the course of development (e.g. by substituting cleaner technologies for dirtier ones or by a change in the structure of the economy) or from deliberate environmental policy efforts (Grossman and Krueger 1995, p. 372). Recently, Selden, Forrest and Lockhart (1996) have tried,

however, to decompose changes in U.S. emissions of particulate matter, sulphur oxides, nitrogen oxides, non-methane volatile organic compounds, carbon monoxide and lead over the time period 1970 to 1990 into a scale, composition of the economy and various technique effects. They find that the non-energy-efficiency technique effect had the largest impact on the reduction of these emissions over time, both absolutely and per capita. What this finding tentatively suggests is that governmental regulation of emissions and emission abatement technology played a significant role in bringing about these improvements in environmental quality (ibid. p. 28).

Barrett and Graddy (1997) have tested the hypothesis that improvements in environmental quality partly come about via induced policy responses. They find that countries that exhibit high political and civil liberties tend to have lower air pollution[5] than countries with low liberties[6]. Barrett and Graddy (1997, p. 2) suggest that „a low-freedom country, with an income level near the peak of the inverted-U, can reduce its pollution at least as much by increasing its freedoms as it can by increasing its income per head". Torras and Boyce (1997) come to similar findings, using the same data as Barrett and Graddy (1997) on political and civil liberties. In addition, they find that increased literacy rates tend to reduce pollution levels[7]. Since they define higher political and civil liberties and increased literacy rates as constituting a more „equitable power distribution", they conclude that „a more equal distribution of power (...) can positively affect environmental quality" (Torras and Boyce 1997, p. 26).

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[5] For water pollution the impact of political and civil liberties is statistically insignificant.

[6] Data on political and civil liberties are based on an index published by Freedom House (Finn 1996). Political liberties reflect the existence and fairness of elections, the existence of a real opposition etc. Civil liberties reflect individual civil rights of free speech, demonstration, organizational freedom and the extent of the freedom of the press.

[7] Torras and Boyce (1997, p. 9) find that, contrary to their expectation, higher income inequality sometimes tends to worsen environmental quality. They reject their own findings on grounds of the „questionable quality of the income-distribution data". Somewhat astonishingly and inconsistently, however, they advocate a „more equitable income distribution" later on in their paper (p. 26).

An important caveat to keep in mind in interpreting the evidence and especially as concerns those indicators which appear to follow an 'Environmental Kuznets Curve' is the following: First, most low income countries are just about to enter the level of income where many emissions are still rising and doing so rapidly. Second, the mentioned econometric studies often use indicators on a 'per capita' or 'per unit of output' basis, but total pollution can still rise in spite of falling pollution intensity.

The turning point found after which pressure on the environment is supposed to diminish is usually slightly below or around 5,000 US$1985 income per capita (Panayotou 1993, Shafik 1994, Grossman and Krueger 1993, 1995) or somewhat higher between 8,000 and 10,000 US$1985 (Selden and Song 1994), depending on modelling strategy, sample size, definition of variables and the like. Even within single studies the range of turning points can be quite large, e.g., from 1,900 US$ for lead to 11,600 US$ for cadmium in Grossman and Krueger (1993). Average global per capita income in 1985 was about 4,360 US$1985, with a median of 2,420 US$1985, i.e. with a distribution function heavily skewed toward zero (own computations from Penn World Table Version 5 (Summers and Heston 1991)). This large difference between the mean and the median of the world income distribution suggests that total global environmental pollution is likely to rise in the future even for those emissions that are suggested to fall again after still higher levels of income are reached. These projections open up the scaring possibility of *total* pollution rising tremendously with future economic growth in spite of diminishing pollution per unit of output or per capita. As Ekins (1997, p. 824) has put it, the existing evidence shows „a stark environmental prospect, unless past growth/environment relationships can be substantially changed". Even Low (1992), an economist at the World Bank and generally in favour of economic growth, admits that „absolute toxic emission levels continue to rise worldwide" (p. 13) and that „it remains

to be seen at what point a cross over might occur, such that not only pollution intensity but also absolute pollution levels decrease with rising incomes“ (p. 8).

For Baldwin (1995, p. 61) „the nightmare scenario is that income growth in the poorest LDCs would stall at the point where they are in the high-emission stage, but not quite out of high-growth stage of their demographic transition“. Or even if it does not stall, it might be too late since environmental thresholds might have been exceeded and dramatic and possibly irreversible environmental deterioration will have already taken place. As Panayotou (1993, p. 1) observes, these thresholds are more likely to be relevant in today’s low-income fast-growing countries where often „tropical resources such as forests, fisheries and soils“ exist which „are known to be more fragile and less resilient than temperate resources“. The problem is that nobody knows where those thresholds are and attempts to measure them must rely on very crude assumptions that can easily be contested by opponents.

One cannot even rely on total pollution decreasing again once high enough levels of income are reached, since econometric evidence provides only correlations, but no reliable causal relationship. Cross-section econometric studies provide a picture of different countries being at different levels of income and exhibiting different environmental quality at a *given* moment of time. There is absolutely no guarantee that the environmental quality of a country that is *now* poor will be equal to the environmental quality of a country that is *now* rich *once* she has become rich herself.

5. Conclusion

What are the implications for the question of the environmental consequences of economic growth? Ferguson et al. (1996, p. 28) rightly argue that the existing evidence „cannot be used to justify a view that economic growth (...) will automatically be good

or bad for the environment. (...) The nature of this relationship lies to a large extent in the hands of those responsible for environmental policy and its enforcement.“ There is nothing inevitable about environmental quality deteriorating at early stages of development. Panayotou (1993, p. 14) is definitely wrong in claiming that the existing evidence „implies a certain inevitability of environmental degradation along a country’s development path, especially during the take off process of industrialization“. At the least, as Grossman and Krueger (1995, p. 372) suggest, given the recent increase in environmental awareness and the still expanding development of new cleaner technologies it might be possible for countries with current low incomes to achieve environmental improvements at lower levels of income than has previously been the case. Equally, Grossman’s claim that „attention to environmental issues is a luxury good poor countries cannot afford“ (quoted in Ferguson et al. 1996, p. 6) is his own normative statement that does not follow from the existing evidence.

On the other hand, there is nothing inevitable either about environmental quality improving at high levels of income. Panayotou (1993, p. 14) is again wrong in claiming that economic growth is „a powerful way for improving environmental quality in developing countries“. One cannot rely on economic growth curing environmental ills sooner or later. Even Panayotou (1993, p. 15) admits that following a development path along an environmental Kuznets-curve might be far from optimal because of high environmental damage costs, because it might be extremely costly to raise environmental quality ex post (i.e. after deterioration has taken place), because of the potential existence of environmental thresholds and because at least some forms of environmental degradation damage human health and economic productivity and are, ironically, themselves impediments to faster economic growth. Hence, there might be a good case for policy-makers to prevent environmental degradation at any stage of development.

One has to acknowledge therefore that no general conclusions on the relationship between economic growth and the environment can be drawn. As Common (1995, p. 103) has put it: „Definitive 'scientific' answers to these questions [of the relationship between economic growth and environmental quality, E.N.] are impossible. They are essentially matters of informed judgement". While there appear to be some cases where historically improvements in environmental quality coincided with higher incomes, one cannot rely on economic growth curing environmental ills. Economic growth on its own does not seem to be a viable prescription for the solution of environmental problems. A group of distinguished scholars from both economics and ecology came to a similar conclusion in their 'consensus' paper on 'Economic Growth, Carrying Capacity, and the Environment' (Arrow et al. 1995). In the end, whether you think economic growth will be beneficial or harmful to the environment in the long run remains a matter of belief. Science is not able to give one view preference over the other.

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Zusammenfassung

Ob Wirtschaftswachstum positive oder negative Umweltfolgen habe, ist eine seit langem diskutierte Streitfrage. Neoklassische Ökonomen und Politiker betrachten Wirtschaftswachstum oft als das beste Mittel, um eine bessere Umweltqualität zu erreichen. Diese Untersuchung des Zusammenhangs zwischen Wirtschaftswachstum und Umweltfolgen präsentiert zunächst die theoretischen Argument pro und contra einer optimistischen Einschätzung von Wirtschaftswachstum. Es wird gezeigt, daß vom theoretischen Standpunkt aus die Frage nicht entschieden werden kann: Wachstum

könnte sich sowohl positiv als auch negativ auf die Umwelt auswirken. Der Autor untersucht daraufhin empirische Studien und argumentiert, daß die vorhandene Evidenz unzureichend ist und keine allgemeinen Schlußfolgerungen zuläßt. Es gibt keine wissenschaftliche Antwort bezüglich der Umweltfolgen von Wirtschaftswachstum. Ob man einer optimistischen oder einer pessimistischen Sichtweise anhängt, ist letztlich eine Glaubensfrage.