Analysis of the Relationship between Growth in Carbon Dioxide Emissions and Growth in Income

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Abstract

The ratification of the Kyoto Protocol has renewed debate on the nature of the relationship between emissions of carbon dioxide and income. Much of this debate has centred on whether restricting emissions is likely to impair economic growth, especially in the Russian Federation. The following attempts to inform this debate by examining income and emissions in a range of countries. Unlike previous analyses, we do not rely on econometric techniques, but conduct an analysis of trends over time and rates of growth, thereby highlighting the actual development of income and emissions. This approach reveals a range of experiences, with rising incomes per capita accompanied by rising emissions in some cases and by falling emissions in other cases. A simple analysis of the data shows that there is not a unique relationship between emissions and income per capita that applies regardless of time and place. The nature of the relationship is undoubtedly dependent on the specific circumstances and the policies adopted in each economy.

1. Introduction

The ratification of the Kyoto protocol and subsequent negotiations over the future of the process has re-ignited debate on the relationship between carbon dioxide emissions and economic growth. Detractors have argued that economic growth involves an increase in emissions of carbon dioxide and that any attempt to curtail emissions will restrict economic growth (The Russia Journal, 2003). The following analysis attempts to give some perspective on future projections by examining previous trends in carbon dioxide emissions and in income for a range of countries. In particular, our analysis considers whether there is a uniform relationship between growth rates of emissions per capita and income per capita, as assumed in the argument that restricting emissions will impair growth.

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Section 2 briefly reviews the theoretical and empirical literature on the relationship between GDP and CO2. Section 3 considers the issues surrounding the selection of data for the analysis. The main results are presented and discussed in Sections 4 and 5, whilst Section 6 concludes the paper.

2. Literature Survey

The work on the relationship between income growth and emissions has been largely concerned with establishing a causal relationship between the two variables. It is widely hypothesised that pollutants and income are tied together in a Kuznets relationship (Shafik and Bandyopadhyay, 1992; Grossman and Krueger, 1995; Stern, 2004). Starting from a low base, pollutants per capita and income per capita increase together until a certain income level is reached at which growth of the pollutant flattens and then reverses. The existence of an Environmental Kuznets Curve (EKC) implies that once a certain level of income has been reached, economic growth can be secured without a proportional increase in pollutants. The corollary is that environmental degradation is best addressed through economic growth (World Bank, 1992).

Stern (2004) lists the factors that combine to generate the EKC as expansion in the scale of production, changes in the input and output mix, and improvements in technology. Each of these factors may be determined by underlying variables such as changes in preferences for environmental quality. Theoretical work on these factors has identified a variety of interactions, which under the appropriate assumptions generate an EKC. Most commonly, it is assumed that the structure of the economy shifts towards less polluting industries as economic growth occurs. Initially expansion of scale generates an increase in pollution per capita, but this is eventually dominated by changes in the output mix.[†] An alternative explanation assumes that environmental quality is a luxury good, and that political pressure for environmental protection increases with per capita income. These explanations are explored further in Copeland and Taylor (2004) together with explanations based on threshold effects and on increasing returns to abatement. However, theoretical and empirical research into the importance each of these mechanisms for CO2 emissions has been limited (Stern, 2004) and it is unclear which factors are most relevant.

Much of the research on the EKC has been aimed at identifying the income level at which emissions per capita stabilise before falling - this is assumed to vary from pollutant to pollutant (Heil and Selden, 2001). The work on carbon dioxide emissions has been largely inconclusive, with some studies indicating that per capita emissions increase monotonically with income growth and others identifying a range of turning points. Shafik (1994) finds evidence of a positive relationship between income and emission per capita with no evidence of a turning point. By contrast, Holtz-Eakin and Selden (1995) infer a turning point of $35,418 whilst Neumayer (2004) cites a range of between $55,000 and $90,000 as the turning point, depending on assumptions. The range of results and the sensitivity of these results to changes in model specification imply that that the conclusions drawn cannot be considered robust (Stern, 1998; Engli, 2002). Stern (2004) suggests that much of this econometric work is flawed, in that it

[†] It is assumed that in earlier stages of development economies grow via physical capital accumulation, and in the later stages by human capital accumulation.

often fails to take account of problems such as heteroscedasticity, simultaneity, omitted variables or co-integration. Alternatively, it may simply be the case that there is no single relationship between emissions and income, but that the evolution of emissions is dependent on a range of factors that vary according to circumstances.

The purpose of this paper is not to determine the existence of either an Environmental Kuznets Curve or any other causal relationship between income and carbon emissions. Rather, the aim of the analysis is to determine whether an increase in income is inevitably *associated* with an increase in emissions. To examine the association between the variables it is not necessary to conduct a formal econometric analysis - plots of data can also be useful in highlighting whether increases in emissions and increase in income are related to one another. This approach is adopted throughout the analysis.

3. Data Considerations

The data for the analysis is derived primarily from the Climate Analysis Indicators Tool (CAIT) database. This includes Population and National Income, for both of which the original source was World Development Indicators (2003). Supplementary data comes from the Penn World Data Tables (Heston et al, 2002). Emissions data is available from several sources, including the Energy Information Administration (EIA), the Oak Ridge National Laboratory (ORNL) and also from CAIT. The data for industrialised economies is generally consistent, but the data for those economies that have not yet made the transition is less reliable. In general, the differences between data from the ORNL and CAIT are less significant than between either of these two sources and the EIA. The following analysis takes the data from the CAIT database, and supplements this with data from the ORNL where necessary.

The data on GDP per capita used in Figure 1 is derived from the CountryWatch website[‡]. The GDP and GDP per capita data there are based on the purchasing power parity method.

The analysis focuses on the period 1980 - 2002, with brief consideration made of longer-term trends in the advanced economies of the USA and the UK. For the Economies in Transition, the analysis is restricted to 1990-2001 with focus on 1995-2001, since data is either unavailable or unreliable prior to this. It is also likely that recent experience provides a better guide to future changes in emissions than earlier trends. The effects of technological change or regulation in the late 1990s, for example, are likely to be of greater relevance going forward than the effects of technological change or regulation at an earlier date. In addition, the upheaval of transition makes it difficult to determine any clear trends in emissions and income in these economies.

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‡ http://aol.countrywatch.com/includes/grank/globrank.asp?TBLS=PPP+Method+Tables&vCOUNTRY=17&TYPE=GRANK, accessed September, 2005.

The analysis is conducted on a per capita basis. In many cases population growth has been substantial and will outweigh the effect of other factors such as a decline in the share of fossil fuels or a fall in the carbon intensity of the economy. A focus on per capita emissions also corresponds to proposals that reduction targets should be based, at least in part, on a per capita basis (Turton, 2004).

4. Analysis of Emission and GDP relations

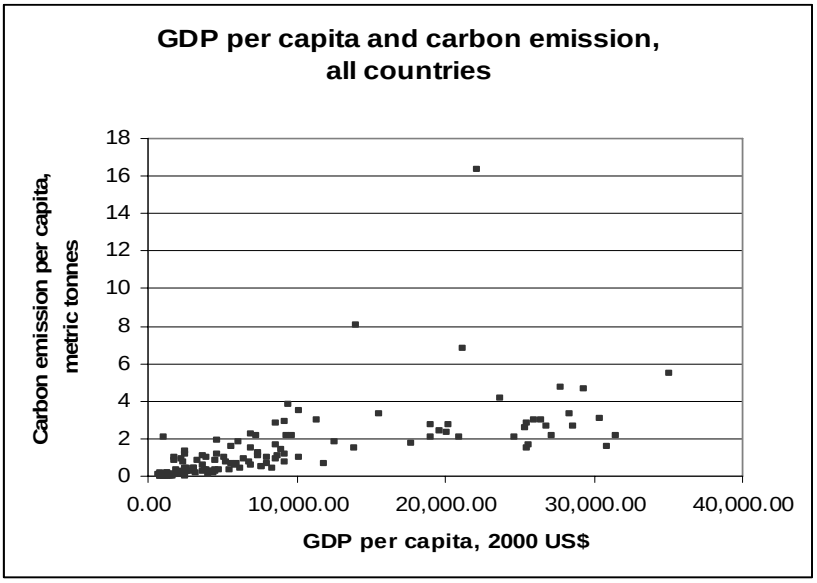
Carbon emissions and income for different countries in 2000

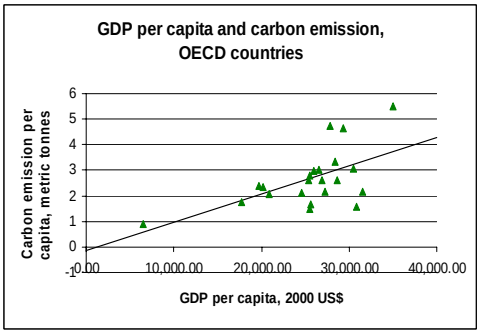
This section briefly reviews the cross-sectional data on emissions per capita and income per capita in 2000 for different countries which are clustered into 5 different groups according to the level of their economic development and other factors. Only countries with population more than 1 mln people and GDP per capita more than $770 (2000 US dollar) are considered. For the full list of countries see Appendix 1.

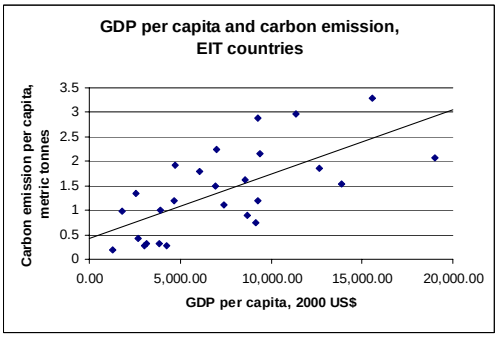
The following 5 groups were chosen:

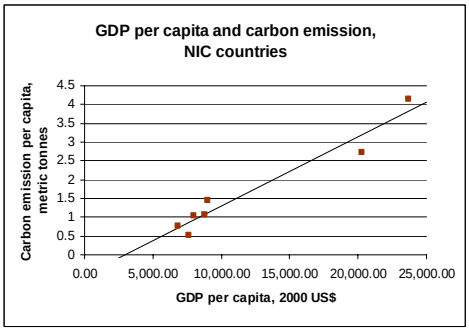
- Organisation for Economic Co-operation and Development 1990 Member Countries (OECD 1990),
- Countries with Economies in Transition (EIT),
- Newly Industrialized Countries (NIC),
- Organisation of the Petroleum Exporting Countries (OPEC), and
- Other countries.

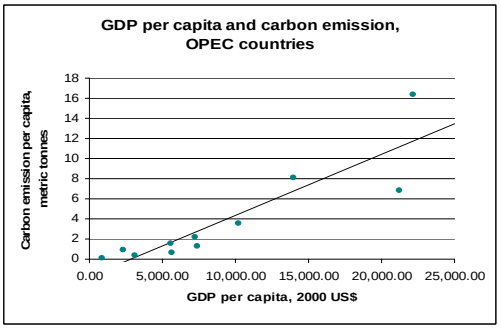
The first part of the analysis develops a global data set to show levels of emissions and income according to economic groupings. The data presented are indicative of a positive relationship between income and emissions, with especially strong relations for NIC and OPEC (see Figure 1).











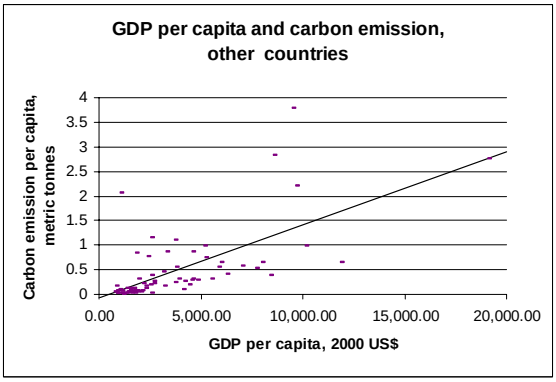


Figure 1 Emissions and Income Per Capita (2000) for 5 country groupings (see Appendix 1 for the list of countries considered) and the regression lines

Time series analysis of emissions and income per capita

In this section we study trends in emissions in carbon dioxide in some developed countries, which gives an indication of the trends in mature economies, and also in three rapidly developing countries, namely China, India and Malaysia, which allows us to get some insight into the processes of development and the evolution of emissions of carbon dioxide throughout the transition to mature economies.

In the context of the current debate it is more useful to consider the evolution of emissions and income per capita over time. As observed by Panayotou (2000) it is inappropriate to use static data on emissions and income from a range of countries to infer the relationship between these two variables in a country over time. The following uses time series data to examine changes in carbon dioxide emissions and income in a range of economies over a period of time.

The analysis is set in context by first considering the trend in the UK and the US over the past fifty years. Figure 2 shows carbon dioxide emissions per capita and income per capita for the United States and for the United Kingdom over the period 1950 to 2000 (indexed to a 1950 base). These economies were the earliest to industrialise and therefore are useful in illustrating possible trends in emissions in mature capitalist economies. Over the post-war period economic growth has occurred at a sustained rate, making it possible to examine whether an ongoing increase in income is associated with an increase in emissions.

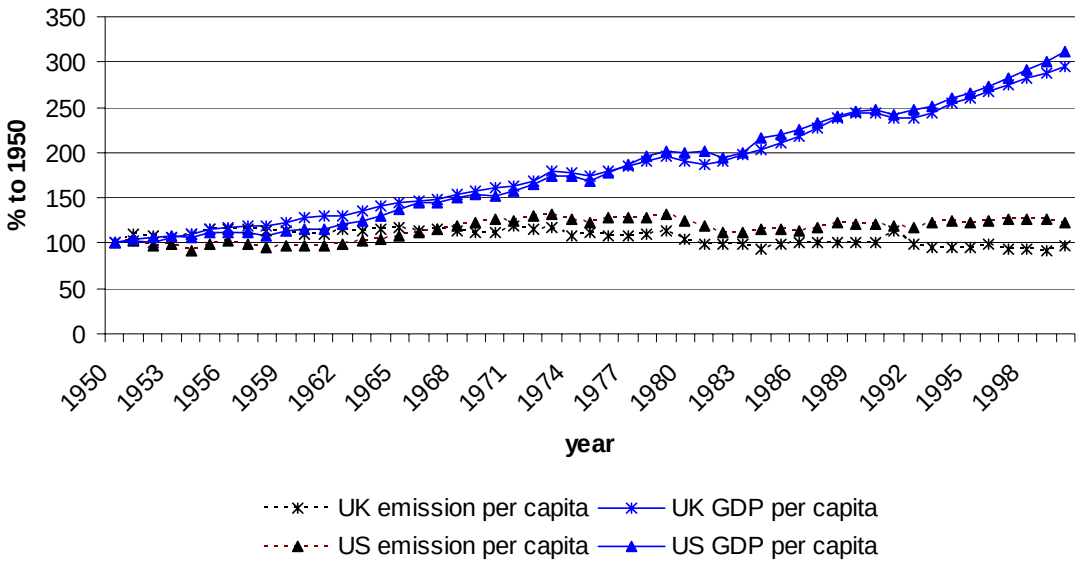


Figure 2 Emissions in the United States and United Kingdom, 1950 – 2000.

In both economies, emissions appear to peak around 1974, with the subsequent decline more marked in the UK than in the US. A second period of decline commencing at the beginning of the 1980s may also be observed - since then emissions per capita have been largely stable. It is obvious that these dates correspond to the oil price shocks,

prompting observations that an external shock may be necessary to force a change in behaviour. For example, Moomaw and Unruh (1997) argue the transition from increasing to decreasing emissions is a response to exogenous shocks, rather than being related to a certain level of income. Despite substantial economic growth in the United States, emissions per capita were at a similar level in 2000 as in 1950. Similarly, sustained economic growth in the United Kingdom has been accompanied by a slight fall in emissions per capita. The data presented runs contrary to the arguments that growths in income are necessarily associated with increases in emissions of carbon dioxide.

A number of analyses have examined the effects of the oil price shocks on emissions of carbon dioxide. Lanne and Liski (2004) conduct an econometric analysis of 16 countries over the period 1870-2028, and conclude that the oil price shocks correspond to a shift to a stable downwards trend in emissions per capita in few of the cases examined.[§] Moomaw and Unruh (1997) develop a structural transition model, and conclude that the oil price shocks do correspond to a shift from positive to negative emissions elasticity. This transition can thus be observed across a range of incomes, rather than being dependent on attaining a certain income level. Rather than adopting a cross-country approach, Friedl and Getzner (2003) examine the effect of the oil price shocks in Austria and find that carbon emissions continued to increase with economic growth after 1975, but at a lower rate. It is likely that the response to both exogenous shocks and also to changes in income is dependent on the specific circumstances of each economy.

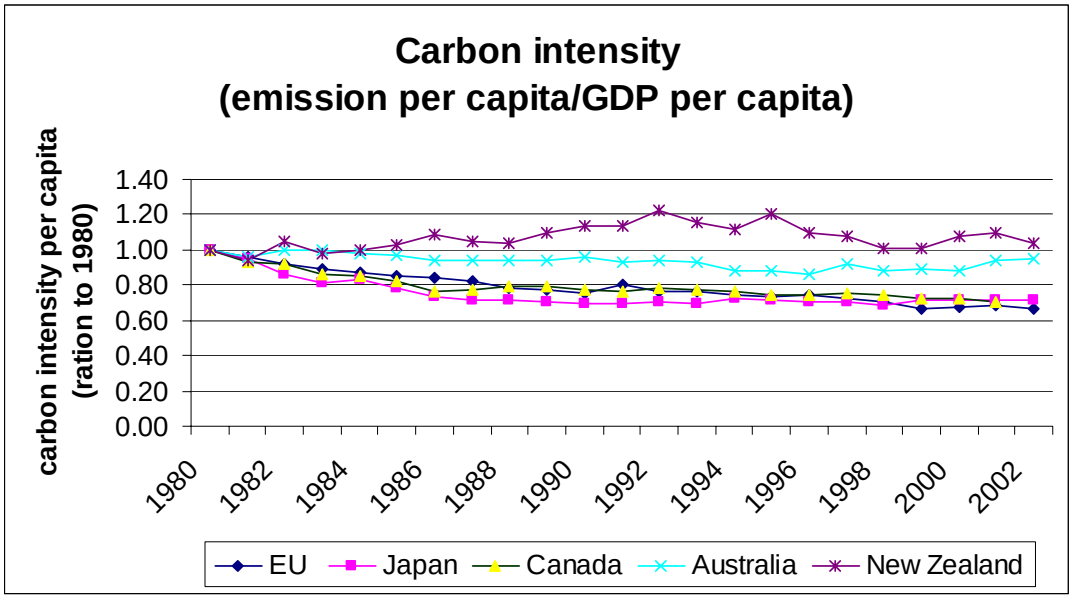


Figure 3 Carbon Intensity in the EU, Japan, Canada, Australia and New Zealand, 1980 - 2000 (1995 US dollar).

Broadening the analysis to a wider group of developed economies confirms that there is no clear linkage between growth in income and growth in emissions. Figure 3 shows the relative changes in carbon intensity per capita in the European Union,

[§] For Denmark and Belgium, there is also evidence of a structural break after the oil price shock, but this does not correspond to a shift to declining emissions per capita. The authors also find evidence of a break corresponding to lower growth in emissions per capita much earlier in the process of industrialisation.

Japan, Canada, Australia and New Zealand over the period 1980-2000. 1980 was chosen as the base year and all the other values were scaled as proportions of 1980 values. Growth in income per capita in the EU countries[**], Japan and Canada has been accompanied by a fall in emission per capita. The carbon intensities in these countries declined from 1 in 1980 to around 0.7 in the late 1990s and stayed at the same level till 2002. The carbon intensity in Australia was also declining and reached its minimum of 0.87 in 1996, after that the trend reversed as the carbon intensity per capita started to increase and reached 0.95 in 2002. In contrary to the other trends discussed above, the carbon intensity in New Zealand was stable in 1980-1985 and then started to increase till it reached its maximum over the period 1980-2002 of 1.22, and then decreased with some fluctuations to almost the 1980 value (1.01 in 1998-1999, 1.04 in 2002).

Hamilton and Turton (2002) employ decomposition analysis to examine the factors contributing to changes in emissions in the OECD countries between 1982 and 1997. This breaks down changes in emissions into changes in contributory variables such as energy intensity, structural change and economic output. Emissions growth was largely driven by economic growth, but that this growth was offset by a decline in energy intensity and the proportion of energy generated from emissions intensive fuels.

At a more detailed level of analysis, Hamilton and Turton (2002) show that both the US and the UK improved efficiency by cutting the energy intensity of production. Whereas in the UK the direction of this shift was reinforced by a reduction in the use of fossil fuels, it was weakened in the US by an increase in the proportion of electricity in final consumption. The EU as a whole also improved energy efficiency of production and increased the proportion of low carbon sources in the fuel mix. By contrast, the scope for increasing energy efficiency was limited in Japan, since substantial improvements had already been implemented following the oil price shocks. Emissions growth in Australia has been driven by increases in income without any corresponding improvements in fuel mix or energy intensity. Canada achieved a reduction in use of fossil fuels and in energy intensity, but did not achieve significant reductions in emissions due to economic growth. There has been a significant increase in emissions in New Zealand, driven by an increase in energy intensity and the share of fossil fuels in the fuel mix.

The foregoing analysis suggests that in the case of the mature economies, an increase in income may be associated either with a rise or a fall in emissions. However, the experience of these economies will not necessarily be replicated in those economies that are currently industrialising. In order to get some insight into the processes of development and the evolution of emissions of carbon dioxide throughout the transition to mature capitalist economies we considered three countries which achieved significant economic progress over the last twenty years, namely China, India and Malaysia.

Figure 4 compares the trends in emission per capita, GDP per capita and carbon intensity in India, China and Malaysia. As can be seen from the figure, the trends in carbon intensity in India are similar to those in New Zealand. The 2002 GDP per

[**] EU countries included in the analysis: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, UK.

capita in India was 211.83% of 1980 GDP while emission per capita in 2002 was 217.73% of 1980 emission, which means that the increase in GDP over the twenty year period is similar to increase in carbon emission per capita.

The carbon intensity in China over the same period was falling significantly from 1 in 1980 to 0.31 in 2002. This is because the GDP per capita in China was growing much faster the carbon emission per capita: 2002 GDP per capita was 562.21% of the 1980 GDP per capita while the 2002 emission per capita was 175.30% of the 1980 value, so the GDP per capita growth was 3.2 higher than the emission growth.

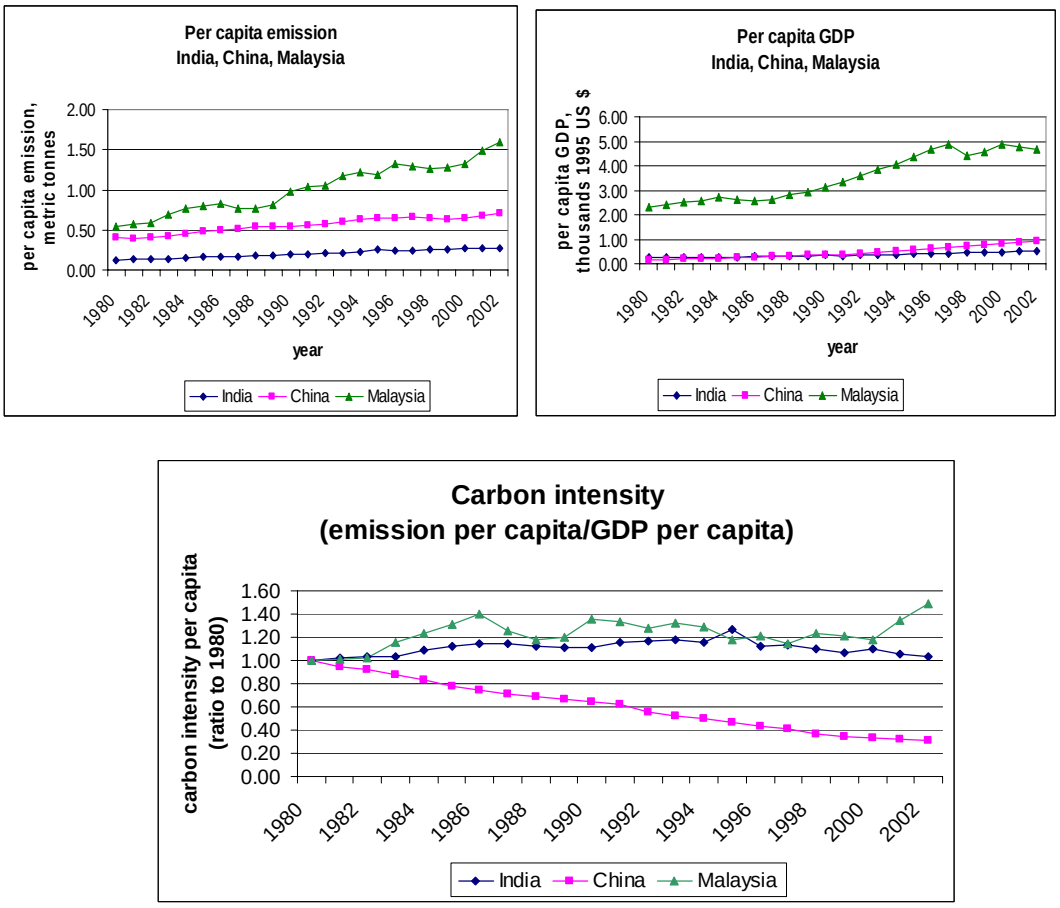


Figure 4 Emission per capita, GDP per capita and carbon intensity, in India, China, and Malaysia, 1980 - 2000 (1995 US dollar).

The changes in carbon intensity in Malaysia (see Figure 4) are quite stochastic and oscillating between 1 and 1.49 (in 2002). The growth in GDP per capita is much smaller than the corresponding growth in GDP emission per capita, and in 2002 they were equal to 199.64% and 296.80% of the 1980 values respectively.

The plots of emissions and incomes presented in this section confirm that the relations between emissions growth and income growth can be different. It is likely that this is dependent on country-specific factors - some indication of these factors can be given by decomposition analysis.

5. Analysis of Rates of Growth of Emissions and Income

This section studies the relations between growth rates in income and emission by analyzing the data for the OECD countries and countries with economies in transition. International treaties, such as the Kyoto Protocol, suggest setting limits on carbon emissions in order to reduce the growth of atmospheric carbon. If net carbon emissions rise and fall with income, this policy might have the perverse effect of slowing down the growth rate of income.

Figure 5 shows yearly growth rates of income and emissions in a number of OECD countries (see comments to Figure 5 for a list of countries) over the period 1980 to 2000. As can be seen from the figure, there are a number of instances in which incomes and emissions have either fallen or risen. There is heavy clustering of data-points around the 2.5% vertical axis, making it difficult to conclude that economic growth is associated with either an increase or a decrease in emissions over a considered period.

When the data is smoothed over a period of time, say 5-years, there is a fall in both number of instances of high growth in emission per capita and income per capita and also in the number of instances of large falls in both emission per capita and income per capita. This suggests that there are few instances where high growth in GDP per capita and emission per capita have been sustained over the longer term. Such periods of high growth in both variables are confined primarily to Portugal, which sustained high growth in emissions and income over three five-year periods. A period of declining income per capita is almost exclusively associated with declining emissions per capita, although there are a number of instances of declining economic growth and a simultaneous increase in emissions over the period considered.

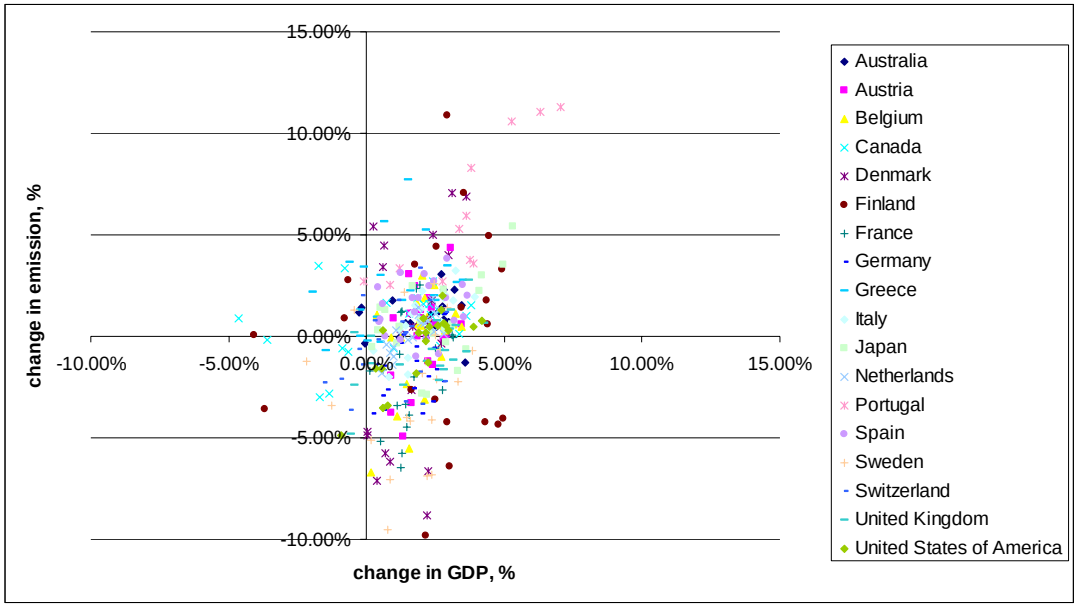


Figure 5 Yearly growth in emissions and income in a number of OECD countries[††] over the period 1980-2000.

[††] Those specified in Appendix 1 except Ireland, New Zealand, Norway and Turkey.

Figure 6 illustrates changes in emissions and income growths over a six-year period from 1995 to 2001 in countries that are currently undergoing the economic transition, rather than of those that are already classified as industrialised. Such an examination is likely to be of considerable relevance for non-Appendix 1 signatories of the Kyoto Protocol, particularly those signatories with a similar industrial structure. We focus on a six-year growth rate since this eliminates any short-term fluctuations in emissions and income, therefore giving a more realistic representation of underlying trends. Similarly, the years immediately following independence of the former Soviet Union states (i.e. 1991-1994) are excluded since this period of adjustment cannot be considered representative of long term trends in either emissions or income. In particular, all countries experienced a fall in economic activity in the initial years of transition, which was coupled with a fall in emissions.

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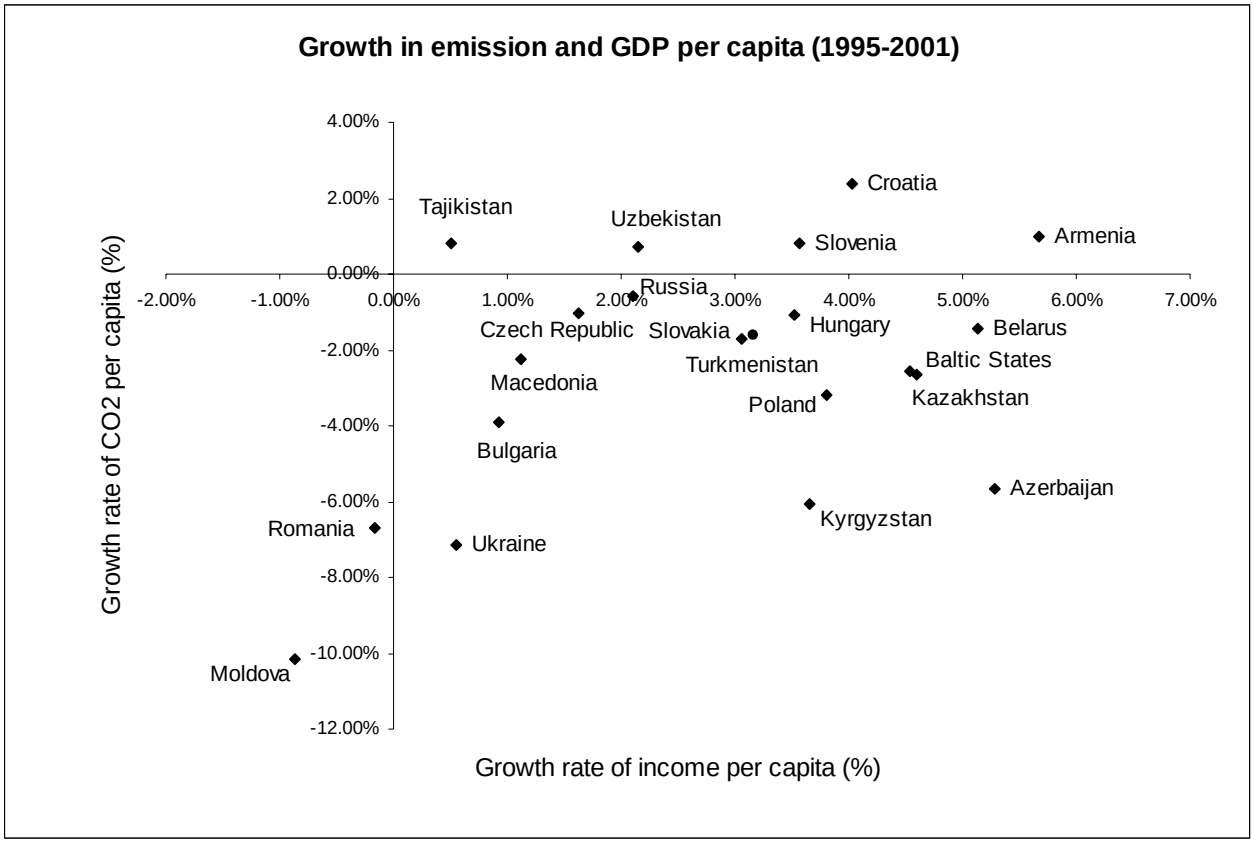

Figure 6 Per capita GDP growth rate vs. per capita CO2 growth Rate (1995 - 2001) in countries with economies in transition.

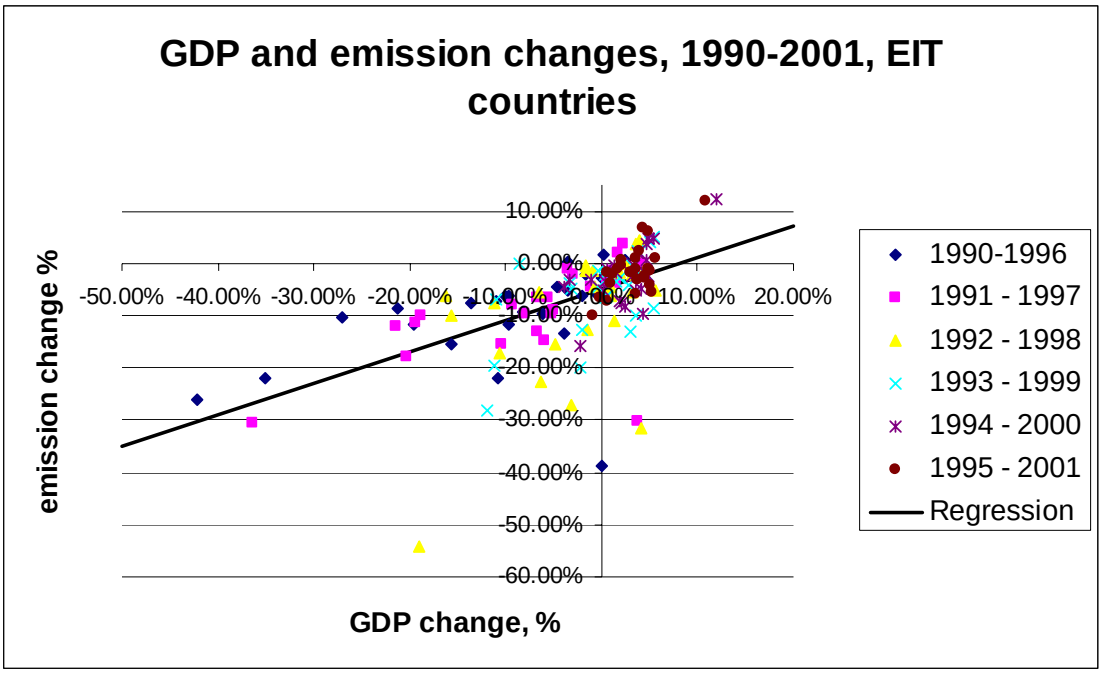

Figure 7 GDP and emission changes (in %) in countries[‡‡] with economies in transition, 1990-2001, 5 year moving average change rates.

Figure 7 shows the aggregate five-year moving average growth rate of emissions per capita and income per capita in a number of countries with transition economies over the period 1990-2001 (see comments to Figure 7 for the list of countries; only those countries were selected due to data plausibility). After the initial years of transition, the majority of economies have experienced an increase in per capita growth. Fischer and Sahay (2000) suggest that growth is closely related to the implementation of reform measures, with growth being faster in those economies that have embraced the reform process. The data shows that periods of economic growth have been associated with an increase in emissions for most of the countries considered, and there is an obvious tendency in this direction (see the regression line shown). This supports the conclusion that an increase in income per capita is often associated with an increase in emissions per capita but other factors specific to each economy are likely to bear on the relationship.

The reform process initiated in the transition economies should encourage improvements in energy efficiency as subsidies are removed and competitive forces are introduced. In addition, the transition to a market economy is likely to involve a shift in the structure of the economy away from energy intensive heavy industries towards lighter industry and services. Determining the contribution of these factors requires a more detailed examination of the processes at work in each economy.

[‡‡] The following countries were considered: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, FYR, Moldova, Poland, Romania, Russian Federation, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Baltic States (average data for Estonia, Latvia and Lithuania).

Cornillie and Fankhauser (2004) decompose changes in energy intensity in the transition countries into changes in the energy intensity in industry, transport and the rest of the economy, and changes in the structure of the economy. Their analysis shows that over the period 1992 – 1998, the effects of structural change and changes in the energy intensity of transport were generally minimal. Where reform was rapid and thorough, there were large falls in the energy intensity of industry whilst the energy intensity of the rest of the economy remained stable or declined slightly (Hungary, Latvia, Slovenia). In a second group of countries, reform of the industrial sector has been less successful and energy intensity in the rest of the economy has fallen more than in the industrial sector (Poland, Romania and Slovakia). Again, the importance of country specific factors is highlighted in determining trends in emissions – it is hypothesised that a large share of heavy industry in GDP may dampen political will to reform the industrial sector.

6. Conclusion

It is difficult to draw any conclusions regarding GDP-CO2 relationships. In the first place, data quality is highly variable over time and between countries - this is especially the case for the economies in transition where data prior to 1992 is inadequate and where there are concerns about the reliability of data after this date. Furthermore, and central to this analysis, any relationship between GDP growth and CO2 emissions growth seems to be very weak beyond the period of basic industrialisation.

The analysis presented above suggests that an increase in economic growth is not inevitably associated with an increase in emissions. Over the past twenty years, growth in the OECD countries has been variously associated with stabilising, declining and increasing emissions per capita. Analysis of the countries with economies in transition also reveals a range of experiences in the years following independence, with some countries showing a decline in emissions per capita and a simultaneous increase in income per capita. However, in the majority of the countries with economies in transition considered the growth of GDP per capita associates with growth in emission per capita, but the amplitude of the growth can very significantly and depends on other factors specific to each economy.

A simple analysis of the data has shown that there is not a unique relationship between emissions and income per capita that applies regardless of time and place. Whilst decomposition analysis can give some indication of the proximate forces that are driving changes in emissions, a fuller analysis requires a detailed understanding of the specific economic and political forces acting in each country. Such an analysis is likely to confirm that the relationship between emissions and income is highly complex and cannot be generalised.

References

Climate Analysis Indicators Tool (CAIT) version 1.5., 2003. World Resources Institute, Washington DC. Available at: http://cait.wri.org.

Copeland, B.R., and Taylor, M.S., 2004. Trade, Growth, and the Environment, *Journal of Economic Literature*, **XLII**, 7–71.

Cornillie, J and Fankhauser, S., 2004. The Energy Intensity of Transition Countries, *Energy Economics*, **26**, 283-295.

Egli, H., 2002. Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany, *FEEM Working Paper 25*

Fischer, S., and Sahay, R., 2000. The Transition Economies after Ten Years, *NBER Working Paper 7664.*

Friedl, B. and Getzner, M., 2003. Determinants of CO_2 emissions in a small open economy, *Ecological Economics*, **45(1)**, 133-148.

Grossman, G. M., and Krueger, A.B., 1995. Economic Growth and the Environment. *Quarterly* Journal of Economics **110(2)**, 353–77.

Heil, M.T. and Selden, T.M., 2001. Carbon Emissions and Economic Development: Future Trajectories Based on Historical Experience, *Environment and Development Economics*, **6**, 63–83.

Heston, A., Summers, R., and Aten, B., 2002. Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP).

Holtz-Eakin, D., Selten, T.M., 1995. Stoking the fires? CO2 Emissions and Economic Growth, *Journal of Public Economics*, **57**, 85-101.

Hamilton, C. & Turton, H., 2002. Determinants of emissions growth in OECD countries, Energy Policy, **30**, 63-71.

Lanne, M., and Liski, M., 2004. Trends and Breaks in per-capita Carbon Dioxide Emissions, 1870-2028, *The Energy Journal*, **25 (4)**, 41-65.

Moomaw, W. R., and Unruh, G. C., 1997. Are Environmental Kuznets Curves Misleading Us? The Case of CO2 Emissions, *Environment and Development Economics*, **2(4)**, 451-463.

Neumayer, E., 2004. National Carbon Dioxide Emissions: Geography Matters, *Area*, **36(1)**, 33-40.

Panayotou, T., 2000. Economic growth and the environment. *CID Working Paper 56, Harvard.*

The Russia Journal, *Kyoto Treaty Discrimnates Against Russia*, 6th October 2003.

Shafik, N., 1994. Economic Development and Environmental Quality: An Econometric Analysis. *Oxford Economic Papers*, **46**, 757-773.

Shafik, N. (1994), Economic development and the environmental quality: An econometric analysis, *Oxford Economic Papers* **46**, 757-773.

Shafik, N. and Bandyopadhyay, S., 1992. *Economic Growth and Environmental Quality: Time Series and Gross Country Evidence.* Washington, DC: The World Bank.

Stern, D.I., 1998. Progress on the Environmental Kuznets Curve? *Environment and Development*, **3**,175-198.

Stern, D.I., 2004. Environmental Kuznets Curve, *Encyclopaedia of Energy*, **3**, Elsevier.

Turton, H., 2004. Greenhouse Gas Emissions in Industrialized Countries; Where Does Australia Stand? *Discussion Paper 66, The Australia Institute*, Canberra.

World Bank, 1992. *The World Bank Development Report 1992: Development and the Environment*, Washington DC: The World Bank.

World Bank, 2003. *World Development Indicators,* Washington DC: The World Bank.

Appendix 1.

Country Classification (countries with population more than 1 mln people and GDP per capita more than $770 2002 US $)

OECD[§§] 1990 Member Countries	**EIT[***] Countries**	**NIC[†††]**	**Other Countries**
Australia	Albania	Argentina	Angola
Austria	Armenia	Brazil	Bangladesh
Belgium	Azerbaijan	Korea, South	Benin
Canada	Belarus	Malaysia	Bhutan
Denmark	Bosnia & Herzegovina	Mexico	Bolivia
Finland	Bulgaria	Singapore	Botswana
France	Croatia	Thailand	Burkina Faso
Germany	Czech Republic		Cambodia
Greece	Estonia		Cameroon
Ireland	Former Yugoslav Rep. of Macedonia		Central African Republic
Italy	Georgia	**OPEC[‡‡‡]**	Chad
Japan	Hungary	Algeria	Chile
Netherlands	Kazakhstan	Indonesia	China
New Zealand	Kyrgyzstan	Iran	Colombia
Norway	Latvia	Iraq	Congo, Rep. Of
Portugal	Lithuania	Kuwait	Costa Rica
Spain	Moldova	Libya	Cote d'Ivoire
Sweden	Poland	Nigeria	Cuba
Switzerland	Romania	Qatar	Dominican Republic
Turkey	Russia	Saudi Arabia	Ecuador
United Kingdom	Slovakia	United Arab Emirates	Egypt
United States	Slovenia	Venezuela	El Salvador
	Tajikistan		Gabon
	Turkmenistan		Gambia
	Ukraine		Ghana
	Uzbekistan		Guatemala
			Guinea
			Guinea-Bissau
			Haiti
			Honduras
			India
			Israel
			Jamaica
			Jordan

[§§] Organisation for Economic Co-operation and Development
[***] Economy in Transition
[†††] Newly Industrialized Countries
[‡‡‡] Organization of the Petroleum Exporting Countries

			Kenya
			Korea, North
			Laos
			Lebanon
			Lesotho
			Madagascar
			Mali
			Mauritania
			Mauritius
			Mongolia
			Morocco
			Mozambique
			Myanmar
			Namibia
			Nepal
			Nicaragua
			Niger
			Oman
			Pakistan
			Panama
			Papua New Guinea
			Paraguay
			Peru
			Philippines
			Rwanda
			Senegal
			Serbia & Montenegro
			South Africa
			Sri Lanka
			Sudan
			Swaziland
			Syria
			Togo
			Trinidad & Tobago
			Tunisia
			Uganda
			Uruguay
			Vietnam
			Yemen