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Article

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CESifo Forum

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Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Ciesielski, Anna; Beitz, Stephan; Lippelt, Jana (2013) : Historical CO2 Emissions and Their Worldwide Allocation, CESifo Forum, ISSN 2190-717X, ifo Institut - Leibniz-Institut für Wirtschaftsforschung an der Universität München, München, Vol. 14, Iss. 2, pp. 75-78

This Version is available at:

<https://hdl.handle.net/10419/166541>

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HISTORICAL CO₂ EMISSIONS AND THEIR WORLDWIDE ALLOCATION

ANNA CIESIELSKI, STEPHAN BEITZ AND JANA LIPPELT¹

While CO₂ emissions continue to rise worldwide, emissions per GDP are declining in most countries. Western nations in particular are achieving growing incomes, while their relative emissions drop. Countries like China and India are following this trend on a deferred basis. This article is concerned with the historical development of worldwide CO₂ emissions relative to GDP. The long observation period, starting in 1850, enables a precise analysis of past trends and the lessons that can be learnt from them for the future. In view of the current debates about the Kyoto Protocol this seems particularly important. The two countries that are responsible for the highest CO₂ emissions worldwide, the United States and China, never participated in the contract and other big emitters like Russia and Canada won't take part in a second period of commitment. Apparently, in order to avoid an economic slowdown, none of these countries is willing to accept a certain, self-imposed amount of emission reductions. This article will discuss this position by considering a history of over 150 years of depletion and utilization of fossil resources.

Figure 1 visualizes the development of the historical CO₂ emissions relative to GDP in world maps. The darker a country is the more tons of CO₂ it emitted. Between 1900 and 1950 these emissions increased all over the world, except for in Europe and the United States. Comparing the years of 1950 and 2000, emissions in the Western world decreased, while they continued to rise in the rest of the world. This may lead to the assumption that all countries experience

a similar transition, where the change from increasing to decreasing relative emissions sets in once a certain income level is achieved.

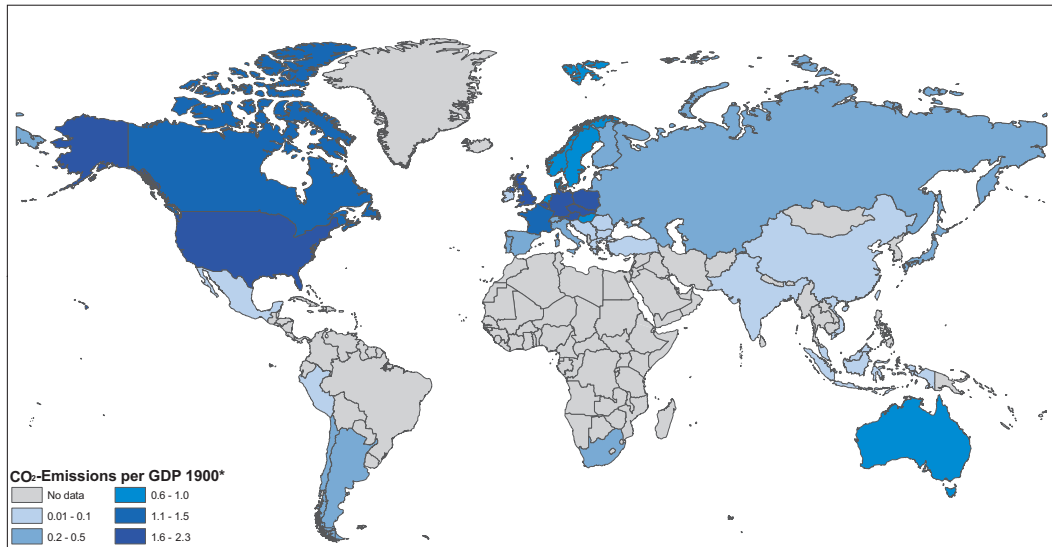
This idea is further investigated in Figure 2. This figure shows the development of CO₂ emissions relative to GDP in selected countries between 1850 and 2008. The red trend lines show similar characteristics in all six plots. Every country reveals a decline in relative emissions, which sets in at different points in time. In developed countries such as Britain, the United States and Germany maximum emissions were registered around 1900. By comparison the decrease in less developed countries such as China set in around 1960 and India, as well as the former USSR followed at the turn of the millennium.

Table 1 gives an overview of the points in time and the GDPs at which maximum emissions were achieved. A possible explanation for the discrepancies in the data may be the economies' sectoral composition at their respective states of development. Typically, while their income is growing, all countries experience a transition from an agricultural economy through industrialization to a services economy. Those countries that leave industrialization behind earlier also show earlier reductions in relative emissions. All curves have a positive slope until a certain income is achieved from which point onwards forward income grows faster than CO₂ emissions. In addition, in less developed countries such as India and China, the relative maximum emissions are smaller than in Britain or the United States, for instance. The data leads us to a weak connection between the maximum of emissions and the income level at which the maxima are found. Germany, for instance, arrived at its maximum emissions in 1917 at a GDP per capita of 2.704 Int.\$, in China this figure was only 0.662 Int.\$ in 1960 and in the former USSR 4.029 Int.\$ in 1995. One reason for a relatively low turning point in some countries may be a positive technology transfer. While those countries which were the pioneers in industrialization first had to develop technological innovations, they are already available for those countries that followed. For this

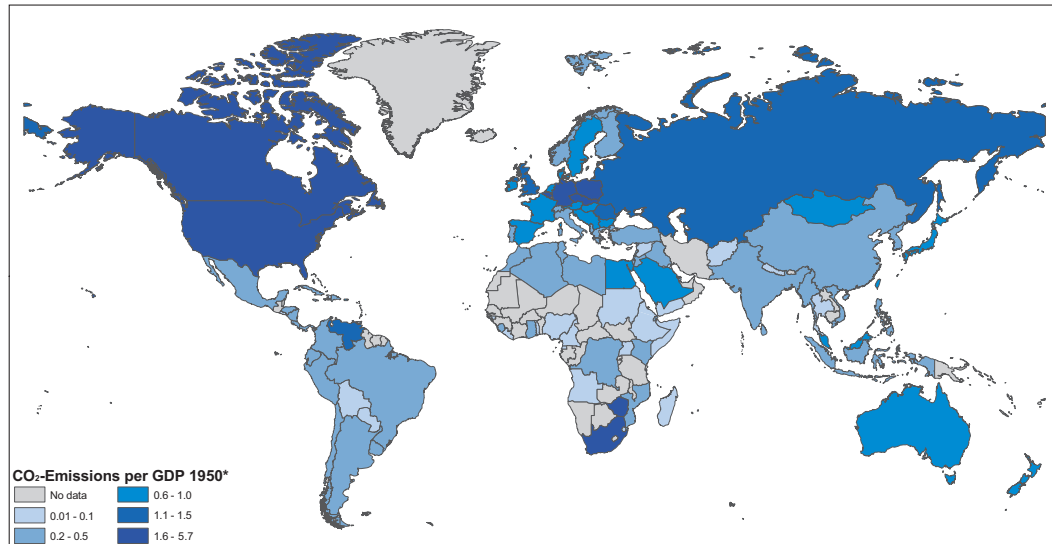
¹ Ifo Institute.

Figure 1

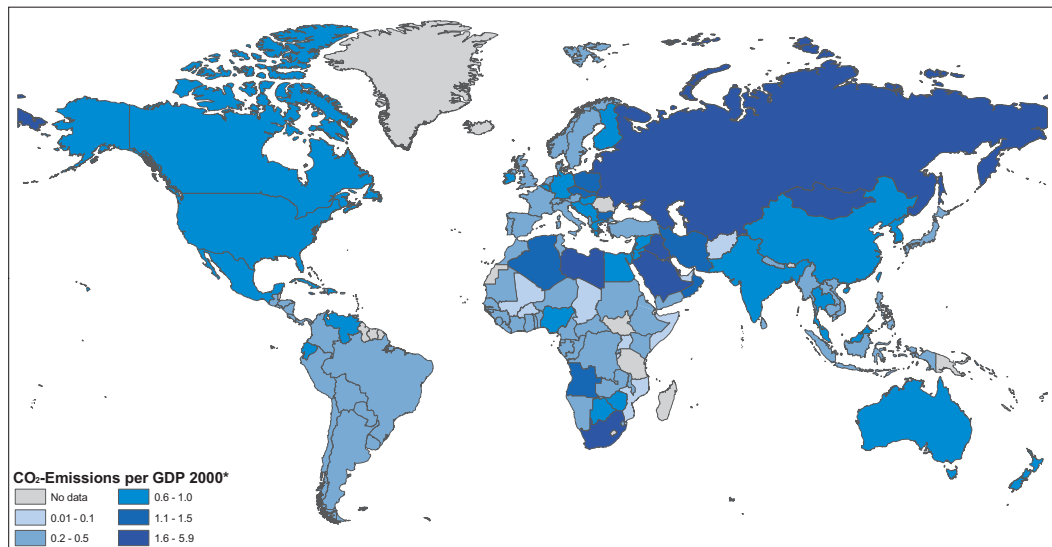
CO₂ Emissions per GDP



*tC per 1000 1990 International Geary-Khamis Dollar



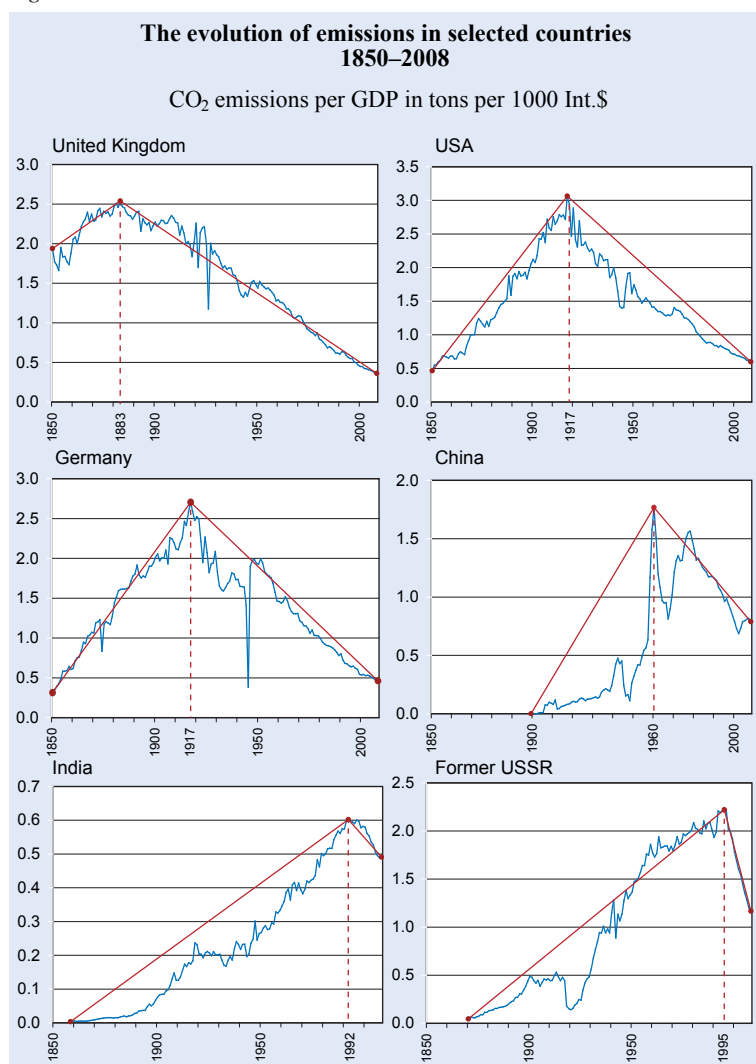
*tC per 1000 1990 International Geary-Khamis Dollar



*tC per 1000 1990 International Geary-Khamis Dollar

Source: Maddison (2010) and CDIAC (2013).

Figure 2



Source: Maddison (2010) and CDIAC (2013).

reason following countries were able to achieve a turning point at lower income levels. Only the former USSR is an exception. Even although industrialization here set in at the end of the 19th century, relative emissions did not decline before 2000. A possible reason for this long upward sloping trend may be relatively low commodity prices for fossil

fuels and subsidies to their depletion under the communistic regime. The sudden decline of relative emissions in 1995 could be a consequence of the collapse of the communistic system in the early 1990s.

Ultimately it remains to be said that, despite the fact that relative emissions are currently sinking, absolute CO₂ emissions continue to increase worldwide. For this reason further emission reductions are necessary, although their equitable worldwide allocation is hotly debated. Whether it is reasonable to expect major commitments from developing and emerging countries is a political question. In the past Europe has emitted large amounts of CO₂ itself, while its economy grew unconstrained. When European countries began to reduce their emissions, they were disproportionately larger than those of today's developing and emerging countries. Consequently it is self-explanatory that today's developing countries ask for less drastic emission reduction

schemes. However, if developing countries were allowed to emit as much as western countries have in the past (relative to their income), a tremendous increase in future emissions would have to be expected. This is a sharp contrast to the decided aim of climate protection and the reduction of CO₂ emissions, and it mirrors the difficulties of the Kyoto-Protocol.

On the one hand, worldwide CO₂ emissions need to be reduced. On the other hand many countries don't feel morally bound to their reduction.

To make global ambitions to stop climate change efficient and equitable, a compromise has to be found that prevents developing countries from unconstrained CO₂ emissions and,

Table 1

Maximum emissions per GDP in selected countries

Country	Year	Maximum relative emissions in tons of CO ₂ /1000 Int.\$	GDP per capita in Int.\$
UK	1883	2,540	3,643
USA	1917	3,065	5,248
Germany	1917	2,704	2,952
China	1960	1,768	0,662
India	1992	0,602	1,345
Former USSR	1995	2,221	4,029

Source: Maddison (2010) and CDIAC (2013).

at the same time, doesn't derail economic growth in those countries. Such a compromise could be a stronger technology transfer from developed to developing countries, which could reduce future emissions of the latter and allow for their economic growth.

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