Is there green growth in OECD countries?

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Is there green growth in OECD countries?
– Analysis by Figures –

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Abstract

Taking the Ecological Footprint (EF) as a broad measure of environmental impact of economic activity, there is substantial progress in decoupling economic output from environmental impact. However, this progress has been too slow to compensate the negative environmental impact of economic growth. But since mid of 2000s the EF declines in the OECD countries, and the global EF increase is driven by emerging countries, i.e. China. However, the decline could be mainly explained by a GDP growth slowdown. To achieve a significant reduction (comparable to the goals of the Paris Agreement) a further slowdown could be necessary. Moreover, the paper investigates the role of globalization because the greening of production in OECD countries could be due to a shift of dirty industries to non-OECD countries. Thus OECD countries are net importers of the EF embodied in traded goods. However, the amount of net EF imports is too small and not correlated with the eco-productivity of production. As ecological productivity is strongly correlated with enforced environmental policy, globalization could be used as a vehicle to promote eco-productivity also in non-OECD countries.

Keywords: Environmental Footprint, Carbon Footprint, green growth, degrowth, eco-productivity, globalization, environmental policy

JEL Classification: Q58, Q56, Q53, F18

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1 Introduction

The idea of "green growth" is here defined as a process of decoupling economic activities from environmental pressure in all its various forms. Such a decoupling is facilitated by two interrelated processes: technological progress and structural change. The former means that production becomes less resource- and pollution-intensive while the latter indicates that the structure and quality of the produced bundle of goods and services changes in time in favor of more sustainable consumption patterns. If decoupling is successful then *growing* economic activities are possible on the same or even declining level of environmental pressure. However, from both, theoretical and empirical perspectives, many authors are skeptical about the possibilities of decoupling, and they advocate zero growth or even degrowth (Ayres 1996, Daly 2013, Martínez-Alier et al. 2010). The main argument are various rebound effects such that each decoupling success further stimulates growth which then erodes the positive environmental effect. Moreover, diminishing returns to scale of decoupling effort will necessarily lead to rebound effects (Pasche 2002). On the other hand, as the GDP doesn't say anything about its composition and production conditions, why should it be an imperative to shrink it? Moreover, one important source of decoupling is technical progress which is also generally the long-term determinant of economic growth. So any sort of policy which aims to degrow has to prevent people from being creative and innovating – which is also the motor for greening the technologies. Therefore, Van den Bergh (2011) critically reviews the degrowth literature and argues in favor of "a-growth".

Another strand of critical discussion is related to the role of globalization. Rich countries are accused to use international specialization and trade patterns to get rid of the dirty industries which are then relocated to poor countries with less veto power against ecological degradation. This creates the illusion of not being responsible any longer (Andersson and Lindroth 2001). The "ecologically imbalanced" trade leads to an "anti-trade bias" in the discussion about sustainable development (for a critical review see Van den Bergh and Verbruggen 1999, and Van den Bergh and Grazi 2014). In the political debate, advocates of degrowth or post-growth are typically also the critics of globalization and the role of the rich (OECD) countries in the global trade system.

This paper uses the Ecological Footptint (EF) as a broad measure for most kinds of environmental impact of production and consumption. The rather complex method of footprint calculation is explained e.g. by Wackernagel and Rees (1996) and Jorgenson et al. (2002). Very briefly summarized, the basic idea is that the biosphere delivers various natural resources and also serves as a sink for pollution. The biocapacity for doing so is limited and depends on the type of land. The various production and consumption activities make use of these natural services which means that they occupy "land" which is measured in Global Hectare [*gha*]. The *gha* represents the average productivity of the ecologically productive areas within a region. Aggregating different forms of nature use can thus be made comparable as they are expressed in *gha* which are necessary to maintain these activities. The aggregation of all forms of nature use is the Ecological Footprint which can then be compared with capacity of the existing biosphere, also measured in *gha*. If the rela-

tionship is larger than one, the (world) economy needs more than the existing land, e.g. the entire globe, to maintain their operations, in other words: the activities are unsustainable.

Though becoming a popular measure which is increasingly used also in academic empirical research, the methodology is criticized for various reasons (see Moffatt 2000, Jorgenson et al. 2002, Van den Bergh and Grazi 2014). This discussion is not reviewed here. The *Global Footprint Network* which develops and uses this concept, is aware of the critique and acknowledges new insights in the further development of the footprint (Galli et al. 2016, Manchini et al. 2016). The argument for using the EF here is simply that (a) there is no other convincing broad measure which tries to capture the entire environmental impact in all its forms, (b) the concept makes the highly relevant difference between the EF of production and the EF of consumption which will play an important role for analyzing trade patterns, and finally (c) the detailed data are publicly available for nearly all countries since 1961.

One problem in the public debate, but also in the semi-academic literature, is that arguments are often not backed by rigorous empirical evidence. This paper provides some empirical material where it can be seen simply by "eyeballing" which narratives about the role of the OECD countries for the disastrous development of the global footprint is in line with the data and which is not. No econometric analysis is provided as a couple of common claims can easily be (dis)proven by looking to the graphs. All data are obtained from the National Footprint Account 2018 dataset provided by the *Global Footprint Network*, the Penn World Table Version 9.0, and the OECD environmental data and indicators database. All footprints are measured in *Global Hectare* (gha). I don't take the per capita values because sustainability requires a reduction of the *total* pressure on the environment.

2 The Footprint Development in OECD Countries

Figure 1 shows the increasing paths of the world EF including the EF of the OECD countries[2]. However, it can be seen that since mid of 2000s the OECD's footprint is slightly declining. Therefore, the EF values in 2014 are on a similar level than in the mid of 1990ies although the OECD's real GDP increased by more than 50%. This implies that the increase of the world EF by 40% between mid of 1990ies and 2014 is solely due to the non-OECD countries, i.e. China. Adding just China to the OECD's path leads to the same upwards trend than for the entire world. As can be seen from the statistics of the major OECD countries (USA, Canada, European OECD members), a stabilization or even decline of the EF can be observed even before the 2000s (see `data.footprintnetwork.org`).

Growing GDP with stagnating or even declining EF is a strong indicator for decoupling success, measured by the eco-productivity. The eco-productivity is here defined as the relation of the output-side real GDP to the Ecological Footprint (as an input variable). As the EF of production is typically different to the EF of consumption, both productivity measures are used. Figure 2 shows the development of

[2]See appendix for the list of OECD countries in this sample.

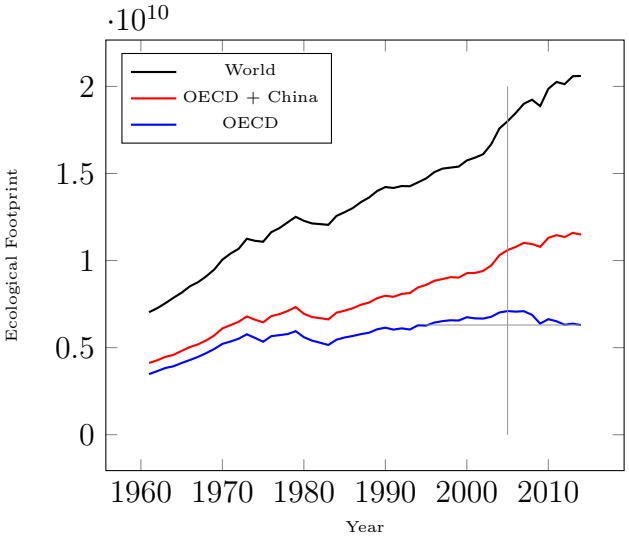

Figure 1: Ecological Footprint development 1961-2014 (in *gha*)

the productivities. Although there seem to be an impressing progress, the de-linking has been overcompensated by economic growth which might include e.g. rebound effects. However, this does not hold true for the time after the mid of 2000s where the EF declines.

Figure 2 shows that the labor productivity has increased by far more than the eco-productivity. This indicates that the focus of technical progress is on the expensive input factor labor which should be saved. Using the biosphere as a production factor is still too cheap so that the incentives for developing cleaner technologies and products are low. However, the discrepancy is explained mainly by the 1960ies and early 1970ies if we are looking to the growth rates of the productivities. Since at least two decades the labor productivity growth rates have a slightly declining trend ("secular stagnation") while the eco-productivity growth, though being more volatile, remains on a level which is meanwhile larger than for labor productivity growth (fig. 2, right).

The increase of real GDP/EF relation does not necessarily imply that economies invested into R&D to reduce natural resource inputs or emissions. It is simply a side effect of the increased labor productivity which pushes the numerator (real GDP). Figure 3 shows the close correlation between both productivities until the beginning of the 2000s. After that, the eco-efficiency growth is more pronounced compared to the declining labor productivity growth (compare also with r.h.s. of figure 2). This points to increasing efforts towards greener production. These efforts could be partially explained by more strict environmental policy which makes the use of nature more expensive. Figure 4 shows that eco-productivity and the environmental taxes (in Million USD - 2010 PPP) of the OECD countries are highly correlated. These taxes (e.g. energy taxes) serve as a rough proxy because other non-tax policy measures such like technical regulations also contribute to higher costs of nature use.

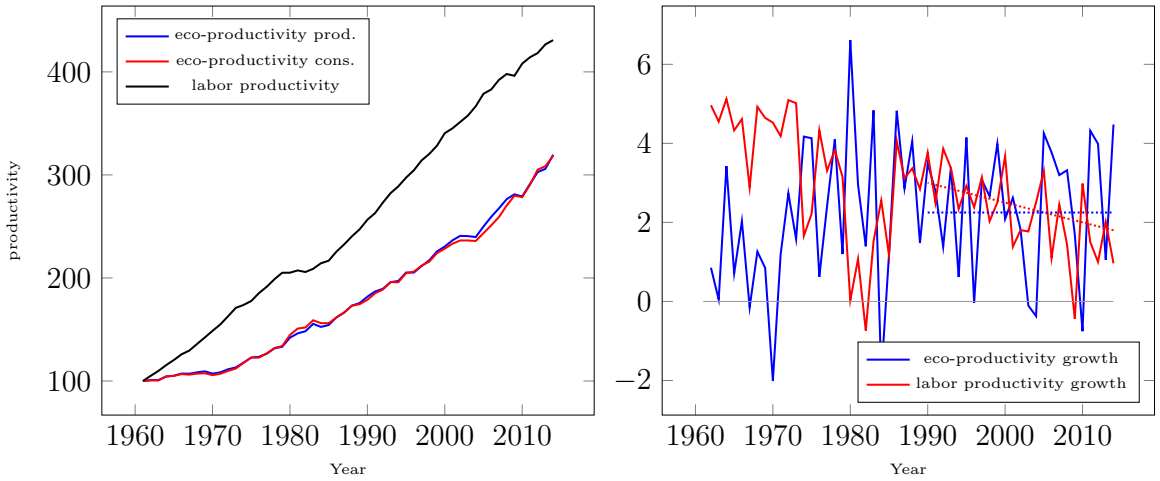

Figure 2: Eco-productivity in OECD 1961-2014 (1961=100)

One question is whether the higher eco-productivity of production in the OECD could be partially explained by shifting dirty industries to poorer countries which have lax environmental policy standards and less veto power of the population against environmental demise. OECD countries could use global trade as a vehicle to green their production to the expense of poorer countries, but to import the dirty products. In such a case we should observe (a) that the gap between EF of production and consumption becomes larger, in other words: the EF net imports embodied in traded goods increase, (b) the decline of the EF of production is *not* accompanied by a decline of the EF of consumption, and (c) that the growth of eco-productivity of production is explained to a significant extent by these net EF imports.

There is not much evidence for these arguments. There is also a decline of the EF of *consumption*, see figure 7. The eco-productivity of production and consumption grow with nearly the same rates, see figure 2. In fact, OECD countries are net importers of the EF embodied in the traded goods, see figure 5. So there is some truth in the argument of externalizing dirty industries to non-OECD countries. But this is perfectly in line with the predictions of standard trade theory based on comparative advantages (Dam, Pasche, Werlich 2017). The main driver of this specialization pattern can be seen in the role of strictly enforced environmental policy which leads to comparative cost disadvantages for dirty parts of the production chain and thus creates specialization effects (see also Copeland and Taylor 1994). In order to detect these comparative advantages regarding the input factors empirically, Leamer (1980) argued that one has to compare the factors embodied in the produced and the consumed bundle of goods. So a a positive net export of a factor embodied in traded goods indicates a comparative advantages regarding this factor.

The coefficient for enforced environmental policy is strongly correlated with the real income while the real income is highly correlated with eco-productivity of production (and consumption). So the ecologically "imbalanced" trade is a natural outcome of effective successful environmental policy in the OECD countries rather than a

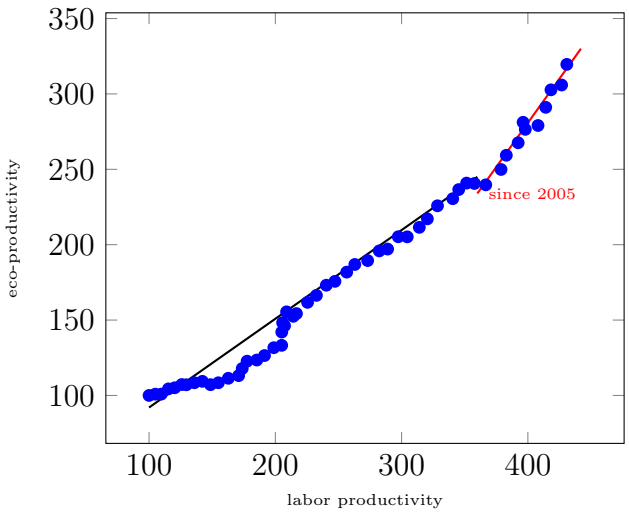

Figure 3: Labor- versus eco-productivity in OECD 1961-2014

scurrilous neo-colonial strategy of the rich countries. In addition, also the larger abundance of biocapacity in relation to labor in non-OECD countries contributes to these comparative advantages (see Dam, Pasche, and Werlich (2017) for details).

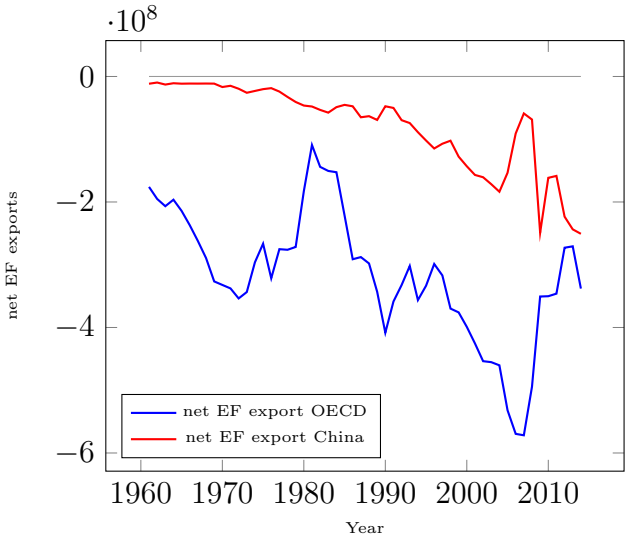

Figure 6: Net EF exports OECD versus China

Figure 5 also shows that the net EF imports (negative net EF exports) are more or less uncorrelated with the eco-productivity. Although they seem to have a common long-run trend, the growth rates and their volatility are significantly different. All time series are normalized to 100 in the year 1961, so we should observe a significant impact of EF net imports on the productivity especially in times of stagnation or reduction – but we don't see it. The EF imports are declining since the mid

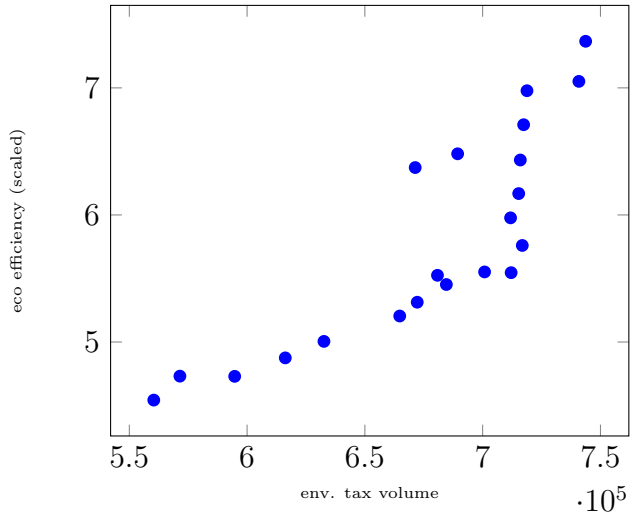

Figure 4: Environmental taxes and eco-productivity since 1994

of 2000ies[3]. In 2014 they are on the same absolute level than at the end of the 1980ies (implying that they are on a much lower level when measured per GDP unit). Hence the argument that the greening of production is to the expense of the non-OECD countries contradicts the empirical picture of the last decade. The greening of the production happened *despite declining* net EF imports. In contrast, emerging countries such like China also became large net importers of the EF, see figure 6. Furthermore, the absolute role of ecologically "imbalanced" trade, reflected in the net EF imports of the OECD is quite small as can be seen in figure 7.

An important part of the Ecological Footprint is the Carbon Footprint (CF) which is reported separately in the NFA 2018 database. As the use of fossil resources is highly relevant for the climate change, one should have a look whether the same trends also hold true for the CF. Figure 8 shows that this is the case. After many decades of increasing CF of consumption and production, and increasing net imports of the Carbon Footprint in traded goods, there seem to be a turning point in the mid of 2000s. However, on a global scale this decline is by far overcompensated by emerging countries such like China. This is roughly in line with the result of Xu and Dietzenbacher (2014) which is based on a much more sophisticated methodology. However, their dataset ends in 2007, so they didn't detect a turning point.

All these results indicate that decoupling economic activities from environmental pressure in the OECD countries is possible, and that after mid of 2000s this process led to an absolute decline of the EF and the CF. It was shown that the eco-productivity has permanently grown, and that the outsourcing of dirty industries to non-OECD countries played a very small and even declining role. Moreover, the trend of net EF imports has reversed since the mid of 2000s. But does all that mean that OECD countries invested a lot of effort into greener technologies and products? Figure 9 plots the GDP growth rates against the growth rate of the EF which are mostly negative after 2005. The graphic indicates that decoupling became

[3]The other spike of a decline is due to the global recession in the early 1080es.

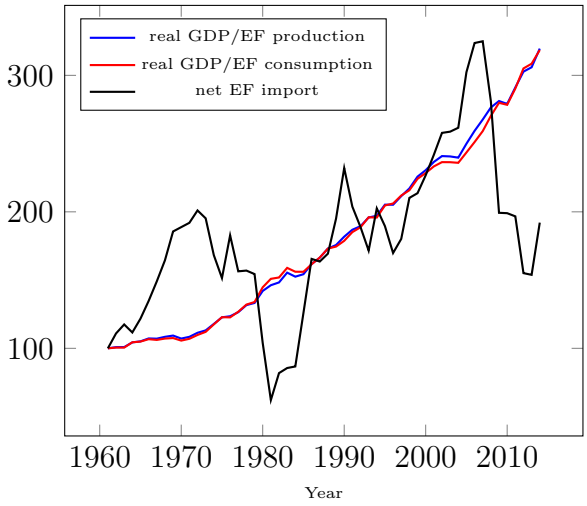

Figure 5: Eco-productivity and net EF imports in OECD (1961 = 100)

successful mainly because of a slowdown of economic growth which experiences the same "secular stagnation" trend like the labor productivity growth in figure 2. All negative growth rates of the EF are associated with GDP growth less than 2.5%. Without this slowdown, the high growth of eco-productivity would have been over-compensated like in the decades before. Therefore, the "greening of growth" should not be interpreted as a story of success. Those OECD countries which suffer from secular stagnation aim to promote growth, and the largest economy in the sample, the United States of America, left the Paris Agreement. So one could expect that it will become very difficult to maintain the reversed trend.

Figure 9 (right side, red line) shows the development of the EF (production) for the case that the GDP would have developed since 2000 with the average growth rate of the 1990ies (3.3%) but keeping the realized eco-efficiency values of the sample. Even though the eco-productivity has increased significantly no turning point would have been achieved. So the declining EF can be mainly explained by the GDP growth slowdown.

3 Policy implications

The growth of eco-productivity is impressing at the first sight. Although higher environmental standards and strictly enforced environmental policy contributed a lot to make production process and also consumption cleaner, a significant part of the eco-productivity increase is simply explained by the even more impressing increase of labor productivity which leads to higher a GDP (keeping the EF constant). But labor productivity alone cannot be the reason as the secular stagnation trend indicates. There is still much room for genuine technical progress towards more sustainable production. According to the economic logic, efforts in R&D are partially driven by the incentive to save expensive input factors. The labor productivity slowdown, however, is not because labor became cheaper but because of

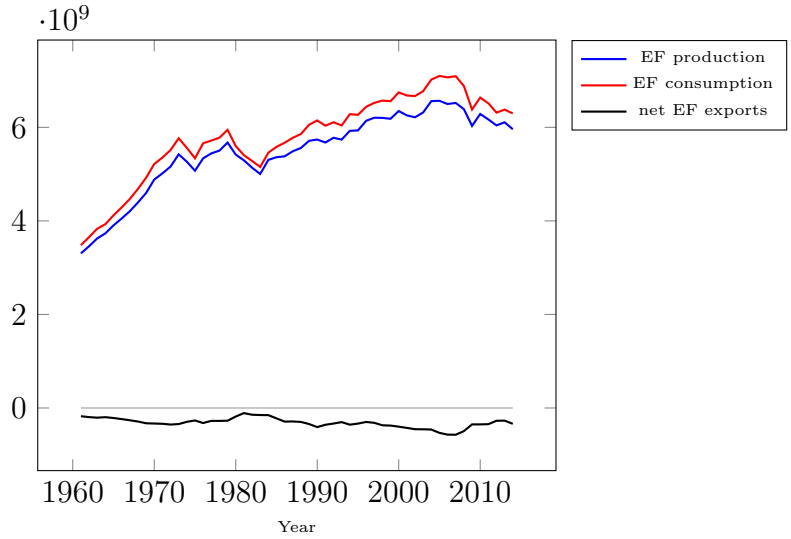

Figure 7: The role of net EF imports in OECD

declining marginal returns of innovation (see Cantner et al. 2018). In fact, labor is still relative expensive compared to the use of nature where the costs are still (globally) externalized to a very large extent. An even stricter environmental policy but also ecological tax reforms, thus rising the *private* cost of using nature, might help to shift the focus of technical progress and structural change towards cleaner and sustainable production.

The success of a declining Ecological Footprint can be partially explained by a slowdown of economic growth. Advocates of a degrowth paradigm claim that decoupling and green growth is an illusion because of rebound effects. Although I do not share the degrowth position one has to consider that since the mid of 1970ies where many governments of OECD countries started to develop environmental policies and stimulate a decoupling, there has been no success (in terms of an absolute decline of the footprint) for three decades, and the recent success since mid of 2000s is due to low growth (but not degrowth). So growth is still highly problematic despite all appreciated efforts. The problem in many fields of public policy such like managing public debt (Pasche 2018), maintaining social security systems, fighting unemployment, or redistributional policies depend more or less on growing economies. This automatically leads to a conflict with green growth and decoupling. As sustainable development can be seen as an imperative, the conclusion should be to think about how the tasks of public policy mentioned above could be made *independent* from growth. This is a question of institutional design of a social market economy.

The Paris Agreement to protect global warming commits the signing countries to achieve an emission level in 2030 which is 40% less than in 1990. Although the Carbon Footprint is not identical with CO_2 emissions, let us assume that the same 40% goal also holds true for the CF. Given the values for 1990 and 2014, an annual CF growth rate of -4% is required to achieve the goal in 2030. Algebraically, the CF growth rate is the GDP growth rate minus the growth rate of eco-productivity (GDP/CF). The red line in figure 10 indicates all combinations of GDP growth and

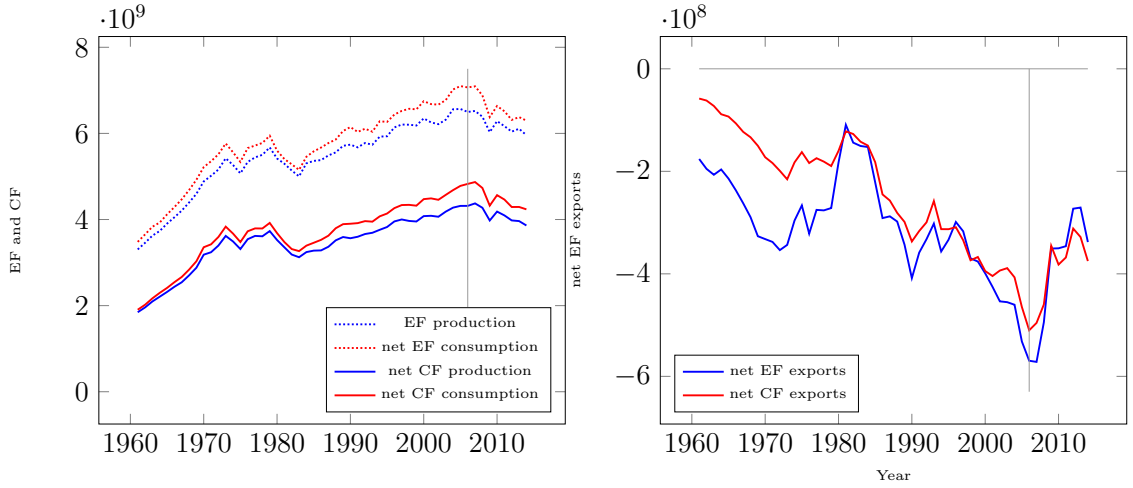

Figure 8: OECD Footprint development and net exports 1961-2014

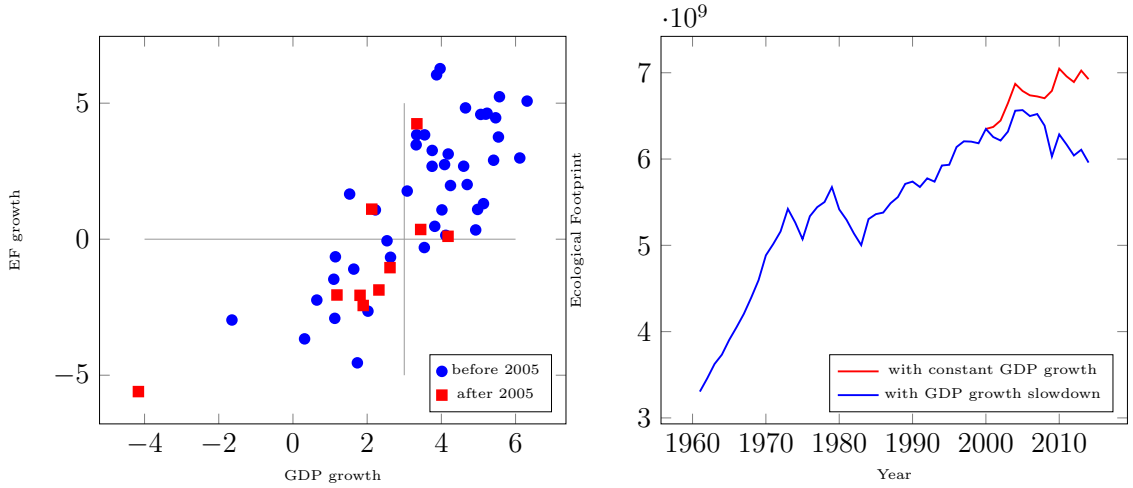

Figure 9: Reduction of EF due to GDP growth slowdown

eco-productivity growth such that the CF is reduced by 4% p.a. With few exceptions all realized combinations in the past are above this threshold. In the period 2010-2014 the average GDP growth was about 2%, and the eco-productivity growth rate about 3% (therefore leading to a decline of the CF). But this implies that c.p. either the speed of eco-productivity growth has to be doubled from 3% to 6%, or degrowth of -1% is required to achieve the goal (or a compromise, see arrows in figure 10). As doubling of the growth of eco-productivity is very ambitious and hard to achieve, a further GDP growth slowdown is then required. Taking into consideration that many OECD countries would like to spur growth (e.g. the stagnating Japan), it becomes rather unlikely that the 40% reduction goal could be achieved.

The empirical picture shows that strictly enforced environmental policy, by making pollution intensive industries more costly, induces a change of the pattern of comparative advantages, and thus making OECD countries becoming net importers of the

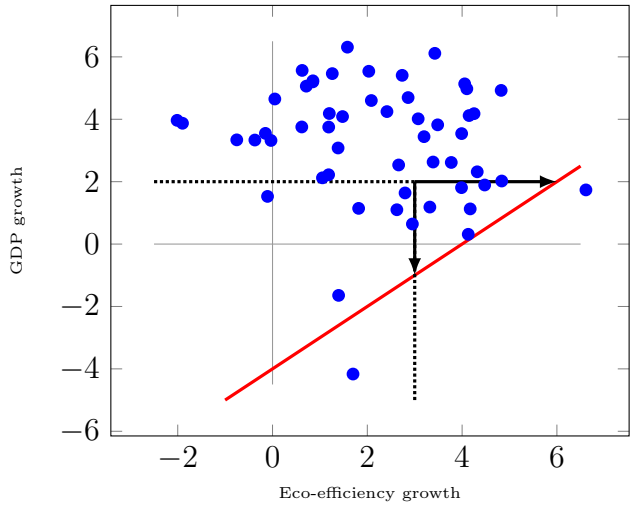

Figure 10: Threshold for reaching the 40% goal

Ecological Footprint, in other words: their footprint of consumption is larger than their footprint of production. As most OECD countries have a lower abundance of biocapacity per capita, these ecological "imbalances" in trade should not be seen as a problem *per se* but they could also enhance the global efficiency of nature use (Dam, Pasche, Werich 2017). On the one hand, specialization and trade is another source of global growth and insofar problematic for the EF. On the other hand, trade is facilitated by bi- or multilateral trade agreements. These could serve as a vehicle to "green" the production also in non-OECD countries. In the last decades, compliance to technical norms became a more and more important issue. Such (e.g. ISO) norms or standards could (and partially do) also define environmental standards of production and requirements of environmental reporting, and norm compliance is a requirement for market access.

Many politicians and some economists see such technical norms as "trade barriers" as they are creating additional costs in case of compliance, and prevent trade in case of non-compliance. However, it is much more reasonable to argue that such norms are a necessary vehicle to internalize global environmental costs in case of globally dispersed production chains. If the final good should be produced under more or less sustainable conditions (which might also include social and labor standards), this has to be guaranteed for the entire production chain. This requires appropriate instruments such like norms or standards. The empirical picture shows that especially the emerging and developing countries are now driving up the Carbon and the Ecological Footprint. Therefore, it is not meaningful to fight against globalization but to use global trade linkages to promote greener production also in other countries via norms. Fricke and Chapman (2017) have shown that the "ability to comply" with such norms might be an important factor for the development of poor countries. In order to attract higher value-added parts of the production chain, poorer countries have an incentive to comply with such environmental (and social) standards.

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Appendix

Country sample	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States. Other countries which joined the OECD much later than 1961 have not been considered.
Calculation of labor productivity	output-side real GDP / (Average Annual Hours Worked by Persons Engaged × Number of Persons Engaged); data from Penn World Tables 9.0
Calculation of eco-productivity	output-side real GDP / Ecological Footprint (of production or consumption)