DECOUPLING: A SOLUTION TO THE CLIMATE CRISIS?

Authors and date

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INTRODUCTION

Due to the tension between the environmental impacts of economic activity on the one hand, and the constraint of economic growth on the other, the concept of decoupling has gradually emerged in the public and scientific debate. This concept refers to:

- upstream, the ability to reduce the need for resources of the economy,
- downstream, the capacity to reduce the impact of the economy on the environment and ecosystems; these impacts are produced in particular by various types of pollution, of which greenhouse gases (responsible for climate change) are the best known.

Decoupling in this context means dematerializing the economy. Digital technology, rightly or wrongly seen as clean and partly immaterial, is the subject of many hopes for achieving decoupling ambitions, insofar as developing the share of digital services in many sectors of activity is supposed to reduce their materiality.

However, the very notion of decoupling is subject to debate. The objective of this note is to briefly present the reasons for this debate and the scientific evidence for assessing the reality and scope of decoupling possibilities.

FINDINGS AND DEFINITIONS

The link between economic growth, resource use and environmental damage is well established, even if various uncertainties remain in certain areas.

Economic growth is characterized by the Gross Domestic Product (GDP), evaluated at the level of individual countries and aggregated at the global level to define a global GDP. This GDP measures the value of goods and services dsold or traded in one year, usually corrected from inflation.

Resource withdrawals are measured in terms of the quantity produced in a year (e.g., tons of metals per year, barrels of oil per year, etc).

Measuring environmental impacts is more difficult, and is often replaced by a measure of pressure (e.g., pressure measured in tons of pesticides per year is used instead of the impacts produced by these pesticides on biodiversity and human health, which are much more difficult to quantify, even if the existence of these impacts is established).

The best known example of the coupling between the economy and resource use is the link between GDP and fossil fuel use. Figure 1(a) illustrates this point via the correlation between GDP and primary energy, remembering that ¾ of the world's primary energy comes from the use of fossil fuels.

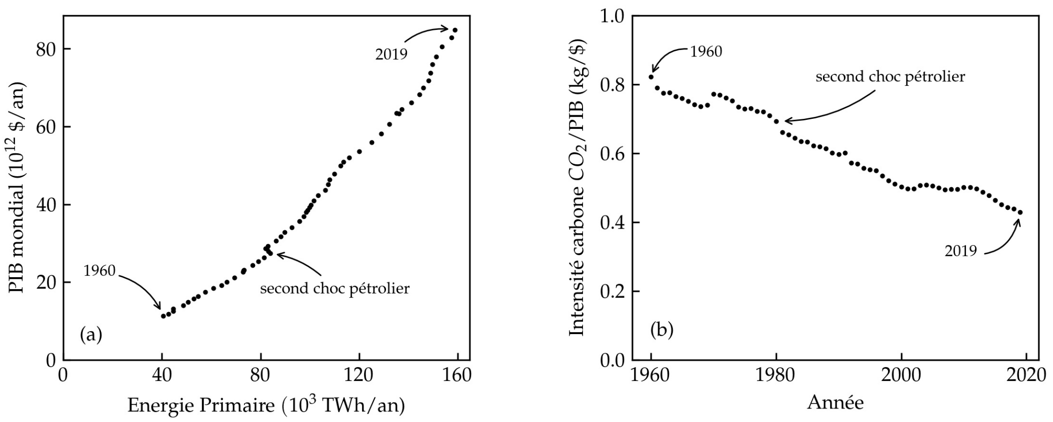
The best known example of coupling between economy and impacts is the similar correlation between GDP and carbon dioxide emissions (not shown, the curve is similar).

The notion of decoupling is approached from two angles:

- We distinguish between *decoupling from resources* and *decoupling from impacts*. Depending on the case, the critical point is located either upstream (resources) or downstream (impact) of economic exchanges. For example, non-renewable resources (fossil fuels, various mineral resources) have an inescapable tendency to be depleted over the long term, even if technological progress makes it possible to compensate for the loss of quality or the increased difficulty of exploiting the remaining resources over a more or less prolonged period. The question of the availability of non-renewable resources is therefore inevitable in the long term. At the other end of the chain, various types of toxic pollution can accumulate much faster than the non-renewable resources needed to produce them become scarce; in this case, the impacts represent the most critical factor in the problem.
- *Relative decoupling* occurs when the use of the quantity of interest (e.g., primary energy) coupled to the economy grows less rapidly than the economy itself.
- *Absolute decoupling* occurs when the use of this quantity of interest decreases in absolute terms while the economy grows.

The best-known example of relative decoupling is the decrease in the carbon intensity of the global economy, illustrated in Figure 1(b): the amount of fossil fuel required per point (percent) of GDP decreases over time by about 1% per year on a long-term trend, and the amount of CO_2 emitted decreases at a similar rate, as shown in the figure. This modest decrease is reflected in a slight increase in the slope of the curve in Figure 1(a). Absolute decoupling would result in a reversal of the slope: fossil primary energy would decrease while GDP would continue to grow. The only historical period in which an absolute decoupling of this type has been observed at the global level corresponds to the second oil shock at the end of the 1970s and lasted only a few years.

This slig: long-term relative decoupling of 1%/year is due to various factors, notably energy efficiency gains in the productive sector (primary and secondary sectors), and the growth in the weight of services and finance (tertiary sector) in the world economy, these activities being by nature less energy-intensive.



> **Fig. 1** -- **(a**) Correlation between GDP and primary energy use ; **(b**) Evolution of the average carbon intensity of the economy. The average carbon efficiency of GDP has been increasing by about 1%/year for the past 50 years. Data sources: *World Bank Database* (world GDP in constant $), *Our World In Data* (primary energy and CO_2 emissions). Figure by the author.

RELATIVE AND ABSOLUTE DECOUPLING: OVERVIEW OF THE PROBLEM

The depletion of non-renewable resources and the accumulation of pollution in the environment are phenomena that are ineluctably linked to human activity, and current trends are not sustainable. There is therefore only one alternative: either to reduce human activity, essentially economic activity, or to achieve an absolute decoupling between GDP and resource use on the one hand, and GDP and environmental and health impacts on the other. The first term of the alternative (reducing economic activity) is not considered acceptable by most political and economic leaders, which makes decoupling the only option really discussed. Without making any value judgement on this point, it should nevertheless be noted that this normative position is inevitably accompanied by a lack of assessment of the real possibilities of absolute decoupling in public discourse.

In this section, some evidence on the feasibility of such decoupling is briefly reviewed. The discussion is limited to the decoupling of GDP from greenhouse gas emissions for reasons of length. This decoupling is the best known and most widely discussed, followed by, in decreasing order of information, issues of material resources, especially mining, and finally issues of pollution, which are very poorly quantified. The interested reader may refer to two recent and thorough critical studies on all the problems related to the issue of decoupling [1,2].

The trends of the last two decades in the OECD countries and in the European Union in particular are a priori positive. Per capita CO_2 emissions have been stagnating or decreasing for the last ten to fifteen years [3]. This evolution is due to several factors: in addition to the trend gains in the productive sector (intra-OECD, but also with respect to imports of Asian finished products), the rates of equipment in individual goods and in structural collective equipment (notably networks and buildings) are saturated, economic growth is generally low in these countries, and largely driven by the growth of services, whose carbon intensity is lower than that of the productive sectors.

However, it is very difficult to generalize these trends to the entire global economy. The trend weight is being carried by emerging economies, primarily China. China is still far from having reached the saturation of individual and collective equipment that characterizes developed countries. Moreover, decoupling GDP from primary energy beyond the 1% per year trend mentioned above is extremely difficult in the long term. From this point of view, it is in practice impossible to limit global warming to 2°C through energy efficiency gains of this type in the time we have left (twenty to thirty years [4,7]): with a world GDP growing by 2% per year, we would need to achieve energy efficiency gains of about 5 to 7% per year[1], a figure which ignores the inevitable rebound effects[2] that would accompany such gains.

The only option to stay below the 2°C global warming limit is to decarbonize the economy, and therefore to generalize the transition to renewable energies[3]. However, the possibility of such a transition has not been credibly demonstrated to date, both in terms of deployment [5, 9] and resource accessibility, as renewable energies require considerably more metals than fossil energies for a given energy production rate [6]. The problems discussed in references 5, 6 and 9 relate exclusively to issues of pace of technological deployment and accessibility of resources in which digital technology plays essentially no role. As a consequence, digital technology has only a marginal influence on the problem of absolute decoupling, and an ambiguous at best and for the moment globally negative role on the problem of relative decoupling (the increasing role of digital technology in the service economy translates into an increase in the direct, indirect and systemic impacts of digital technology; see concept sheet "The rebound effect" and concept sheet "What is the acceleration effect?" .

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SOURCES

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1. This estimate results from the annual reduction needed to reach zero emissions, to which must be added the additional emissions due to the 2% annual global growth. This figure deliberately ignores the possibility of carbon sequestration, which is necessary in voluntary emission reduction scenarios. Unfortunately, these techniques are very expensive both economically and energetically, partially inefficient due to neglected methane emissions, and still not feasible on an industrial scale despite the considerable budgets allocated to their development [8]. ↩
2. The rebound effect refers to the propensity of economic activity to increase the use of a resource or the diffusion of a product when efficiency gains in resource use are realized per unit of product output. See concept sheet "The rebound effect" for more details. ↩
3. The global spread of nuclear power as an energy source raises issues of pace, cost and abundance of the resource, waste storage, and nuclear weapons proliferation, and nuclear fusion is still not operational despite more than half a century of research and development. ↩