

Macroeconomics of the transition to a zero-carbon economy**Reading notes**

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Humanity is at a historic turning point: it can self-destruct if it fails to resolve the climate and environmental crisis, or it can pull through if it manages to achieve major economic, social and democratic progress in the next few years.

This note relies on a review of the economic literature and on data analyses to draw up the main lines of a macro-economic policy that would make it possible to stabilise the economy in a system that respects planetary boundaries. This note aims to describe and resolve certain conflicts that exist between economic development and environmental degradation.

The first part of this paper explains the different visions for solving the climate crisis that exist in economic literature. The second part shows that two levers can be used to bring the economy within planetary limits and make it carbon neutral: reducing energy demand and boosting green investment. The third part discusses the distinct phases of the ecological transition.

Different macroeconomics of the climate crisis

In the economic literature, there are different views to approach the problem of global warming and environmental degradation. The first is the cost-effectiveness view, promoted by William Nordhaus. Many authors who adopt a cost-effectiveness approach based on integrated assessment models tend to significantly underestimate the damage that will be caused by climate change and environmental degradation. Robert Murphy (2018) explains that the increase in global average temperature that would accompany the "optimal" carbon price recommended by the Nordhaus model (known as "DICE") is equal to 3.5°C by 2100. The DICE model therefore recommends a temperature double that of the scientific consensus patiently built up over more than four decades by models that have proved to be visionary. In a recent study, William Nordhaus (2023) estimates that the 2100 temperature change for the cost-benefit optimal run is 2.7 °C, still above scientific recommendations.

Steve Keen (2023) considers economic analysis of climate change to be an interdisciplinary subject, but papers on the economic damage generated by climate change in integrated assessment models have been estimated by economists alone. To referee these articles correctly, scientific knowledge of global warming was required, which economists generally did not possess. As a result, the referees approved the publication of articles containing assertions about global warming that flagrantly contradicted the scientific literature.

Robert Pindyck, who in an article published in 2019 estimated the equivalent loss of GDP corresponding to a warming of 3°C at just 10% based on experts' claims, now believes in a book published in 2022 that current and planned efforts by governments are far lower than those needed to halt climate change, the social and economic costs of which are difficult to predict and estimate.

The sixth IPCC report (2023) states that at 2°C of global warming, overall risk levels associated with the unequal distribution of impacts, global aggregate impacts and large-scale singular events would be transitioning to high, those associated with extreme weather events would be transitioning to very high, and those associated with unique and threatened systems would be very high.



In a study published in 2022, several authors from Cambridge University and MIT (Kemp et al., 2022) believe that climate change could lead to the collapse of society or even the extinction of humankind, and that most studies fail to take these issues seriously. These authors consider that global crises tend to occur through such "synchronous failures" that reinforce and propagate across countries and systems, as was the case in the 2007-2008 financial crisis. It is plausible that a sudden change in climate could trigger systemic failures that destabilize societies worldwide. Human societies are vulnerable to cascades of risks triggered by climate change, such as conflict (including nuclear), political instability and systemic financial risk. The cascading impacts and extreme consequences of soaring temperatures are under-examined in the literature.

Contrary to those who recommend overly moderate action on the environmental crisis, some authors advocate solutions based on a shift away from economic growth. Within this post-growth / degrowth trend, however, there are disparities. According to Louison Cahen-Fourot and Antoine Monserand (2023), the term post-growth refers to the project of a society emancipated from the need to grow its economy to ensure socio-political stability and individual and collective well-being.

In the literature on degrowth, some authors point out that degrowth is not recession. This is the case of a study by Jason Hickel, Giorgos Kallis, Tim Jackson, Daniel O'Neill, Juliet Schor, Julia Steinberger, Peter Victor and Diana Ürge-Vorsatz (2022). In this case, post-growth and degrowth are synonyms. According to these authors, advanced economies should abandon the goal of GDP growth, reduce destructive and unnecessary forms of production to cut energy and materials use, and focus economic activity on satisfying needs and human well-being.

In the literature on degrowth, there are also authors who believe that degrowth should result in a mild recession in advanced countries (see Fontana and Sawyer, 2022). Other authors state that degrowth is not recession, but make proposals that will inevitably lead to recession (e.g. authors who state that a drop in production and consumption is necessary) if a government decides to implement such measures.

Several studies suggest that the possibility of green growth continuing indefinitely, or at least for many years to come, is unlikely. According to a study by Gaya Herrington, Head of Sustainability and Dynamic Systems Analysis at KPMG, published in the Yale Journal of Industrial Ecology, the findings of the authors of the book "The limits to growth" are very close to reality¹. Gaya Herrington and her team believe that the most likely future scenarios are those called "BAU2" (business-as-usual 2) and "CT" (comprehensive technology). The BAU2 and CT scenarios lead to a halt in growth around 2040. In the BAU2 scenario, industrial production falls by 85% between 2040 and 2100, and the world population collapses. In the CT scenario, industrial production falls by 40% between 2040 and 2100, and world population declines slightly. It is still possible to reach the SW (sustainable world) scenario, in which industrial production will stabilize around 2040, but the longer we wait, the further away we are from this scenario.

William Rees (2023) is even more pessimistic. According to this author, the scientific revolution and the use of fossil fuels have mitigated negative feedback, postponing unavoidable adjustment and allowing human activities to grow exponentially. Growth will continue until excessive consumption and habitat degradation once again lead to food shortages and famine, or disease and predators take their toll. The global economy will inevitably shrink, while the world's population will decline sharply over the course of this century. Only a minority of human beings will survive.

¹ Several economists including William Nordhaus have criticized the book «The limits to growth».



Vaclav Smil (2019) believes that growth must stop if humanity is to survive, and that economists don't seem to realize this. Without a healthy biosphere, there can be no life on the planet. Many economists believe that it is possible to decouple growth entirely from material consumption, but this is complete nonsense according to Vaclav Smil.

Stern and Stiglitz (2023) believe that solving the climate crisis will require massive climate action and investment, resulting in higher growth over the next 20-30 years before it comes to a halt. Joachim Peter Tilsted, Anders Bjørn, Guillaume Majeau-Bettez and Jens Friis Lund (2021), demonstrate that the goal of limiting global temperature rise to 1.5°C requires unprecedented rates of decarbonization that even the Nordic countries have not yet managed to achieve.

To bring the economy within planetary limits and make it carbon neutral, we need to activate two levers: reducing energy demand and boosting green investment.

Jason Hickel, Giorgos Kallis, Tim Jackson, Daniel O'Neill, Juliet Schor, Julia Steinberger, Peter Victor and Diana Ürge-Vorsatz, (2022), consider that *"the experiences of countries that have had to adapt to low-growth conditions, such as Cuba after the fall of the Soviet Union, and Japan, hold lessons"*. Growth in Japan has been very weak in recent years. However, greenhouse gas emissions are hardly declining in Japan (only -0.2% per year on average over the 2009-2019 period). In Denmark and the UK, GDP growth is still positive and higher than in Japan, even though both countries are experiencing greater reductions in greenhouse gas emissions (-4.7% for Denmark and -2.9% for the UK per year on average over the 2009-2019 period).

IDH21 shows that the 2007-2014 period of lowest GDP growth in EU member states was also characterized by a reduction in CO₂ emissions (while it remains to be seen how much is due to structural changes and how much to the slowdown of activities). There are therefore situations in which green growth can produce worse results than no growth in terms of decarbonizing the economy, and conversely situations in which green growth can produce better results than no growth.

While the work on the around *"The limits to growth"* and Stern and Stiglitz (2023) speak of global growth, many post-growth specialists make a distinction between advanced and less wealthy countries. According to Vaclav Smil (2019), *"Denmark has nothing in common with Nigeria. What we need in Nigeria is more food, more growth. In Philippines we need a little more of it and in Canada and Sweden, we need less of it. We have to look at it from different points of view. In some places we have to foster what economists call de-growth. In other places, we have to foster growth"*².

However, halting growth in advanced countries without altering growth in emerging countries is no easy task. Lower growth in advanced economies can translate into lower growth in emerging economies. During the subprime crisis, some emerging countries saw their GDP shrink, while others did not. If, as Schröder and Storm (2020) argue, global per capita GDP growth should be limited to 0.45% per year, emerging countries will never be able to catch up with the per capita standard of living of advanced countries by 2040 and beyond.

Complete decarbonization of the global economy by 2050 is now conceivable only at the cost of unthinkable global economic retreat, or as a result of extraordinarily rapid transformations relying on near-miraculous technical advances Vaclav Smil (2022).

Dominic Rohner, Michael Lehning, Julia Steinberger, Nicolas Tetreault and Evelina Trutnevyte (2023) highlight through what mechanisms fossil fuels threaten sustainability and peace, and, subsequently,

² Source : <https://www.theguardian.com/books/2019/sep/21/vaclav-smil-interview-growth-must-end-economists>



outline in detail how the green energy transition can concretely be achieved, stressing both key factors of reducing energy demand and boosting green energy supply. Several promising green energy policies can be implemented at a local, decentralized scale, helping to avoid the fatal concentration of resource rents and political power that has led to oil and gas hollowing out democracy, fuelling corruption and triggering civil and interstate wars. For the vast majority of uses, electrification and renewable supply would be far, far more efficient than fossil fuels. It is therefore necessary to strengthen green energy supply through innovation and incentives for adoption.

According to Stéphane His (2023), the assertion that "zero carbon" in 2050 would be prevented by a physical shortage of metals does not stand up to analysis and is refuted by the scenarios of the International Energy Agency. However, a lack of sobriety in uses, notably for transport, could lead us into ecological and social impasses.

Stern and Stiglitz (2023) consider that an immediate halt to global growth is neither necessary nor sufficient to achieve an economy characterized by zero net greenhouse gas emissions. Stopping growth would merely freeze emissions at very high levels. Such a policy would be socially unacceptable. The "no growth" argument diverts attention from the key issue of breaking the relation between consumption and production on the one hand and destruction of the environment on the other. That will be achieved by consuming and producing in different ways, and many of the technologies needed to do so exist already. According to Stern and Stiglitz (2023), investment and growth will be needed to overcome global poverty, make progress towards the sustainable development goals and increase well-being in all its dimensions, particularly in poor countries, over the next 20-30 years.

To say that investment and growth are essential in the coming two or three decades, it is not, however, a statement that growth should go on forever. Planetary boundaries do impose constraints (Rockström et al., 2009). In the next two or three decades, climate action is likely to help in addressing these problems. In the later part of the century and moving into the next, the boundaries may well constrain growth (both in GDP and population) and should already be prominent in thinking about public policy according to Stern and Stiglitz (2023). Stern and Stiglitz (2023) are, arguably, slightly too optimistic about the delta of growth that remains at global level before it ends. Other factors could slow growth in the decades ahead. A new financial crisis could well occur in the next few years. The slower the increase in climate-friendly investments and the transformation to a more energy-efficient economy, the greater the chance of a major financial crisis in the next few years.

According to Jean Pisani-Ferry and Selma Mahfouz (2023), the transformation is based on three economic mechanisms: the reorientation of technical progress towards green technologies, sobriety (defined as the reduction of energy consumption that does not result from gains in energy efficiency), and the substitution of capital for fossil fuels.

According to these authors, we are not permanently condemned to choosing between growth and climate. In the long term, the reorientation of technical progress can lead to stronger green growth than brown growth was or would have been. The falling cost of renewable energies is a sign that new growth is possible. Sobriety is not necessarily synonymous with degrowth and can also be a source of well-being. However, these authors do not take sufficient account of the negative effects and limits on GDP generated by the scarcity of resources such as minerals.

The different phases of ecological transition

Cahen-Fourot and Monserand (2023) explain that an economy in transition to post-growth can be thought of as the succession of three phases: the first two constitute the transition and the third the arrival point. In the first phase, GDP growth can result from massive investment in infrastructure,



equipment and all sectors of the economy, carried out with the aim of reducing the environmental impact of all productive activity as far as possible. The actual effect on growth will depend on the relative scale of the necessary investments and disinvestments, the multiplier effects thus generated, and the changes in consumption patterns that take place simultaneously.

The second phase will see a reduction in economic activity due to progressive changes in lifestyles and the reorganization of the economy towards greater simplicity and sobriety. According to these authors, this phase can be identified with degrowth. During this phase, private consumption tends to decline more than public consumption, and net private investment will tend to be negative. Public investment, on the other hand, may remain stable to maintain the quality of public services. Thirdly, the stationary or post-growth state is the point at which the volume of economic activity stabilizes, and all economic stocks and flows remain constant on average.

Major economies such as the European Union and the United States have a major role to play in the necessary return to an investment economy inspired by the principles defended by John Maynard Keynes, as was the case at the end of the Second World War. Several tax reforms could be implemented to reduce inequalities, increase investment and make the global economy more homogeneous and less unstable.

According to Stern and Stiglitz (2023), an increase in progressive taxation would increase public revenues and reduce the need to borrow. These revenues would go a long way towards providing the funds needed for climate-related investment. Better tax administration can lead to a sharp rise in tax revenues in all countries. The same applies to international agreements aimed at closing the avenues through which wealthy individuals and companies can avoid and evade taxes, including tax havens and profit shifting. Responding to climate change does not require austerity and cuts in public spending. It makes little sense to cut public investment in education, infrastructure, R&D or the environment today simply because, if things go wrong in the future, the debt may not be sustainable.

The investment and economic transformation phase will generate both positive and negative effects on GDP growth. The impact of investment in low-carbon infrastructure on growth will depend on Keynesian multipliers. The transformation of the economy will generate productivity gains, while the disappearance/reduction of destructive and unnecessary forms of production will generate negative effects on growth.

Three IMF economists (Vitor Gaspar, Shafik Hebous and Paolo Mauro, 2022) believe that evasion and avoidance cause the loss of revenue that could have financed social spending or infrastructure investments. Self-serving national policies of one country can affect others in damaging ways. If each sets its own tax policy without regard for the adverse effects elsewhere, all countries can end up worse off. In 2021, 137 countries achieved a major breakthrough in coordination through an agreement that establishes a global minimum corporate tax of 15%, which will come into force in 2024.

In the European Union, a number of tax reforms would accelerate the investments required for the transition to a low-carbon economy, notably by increasing the EU's general budget. In the United States, the Biden Administration wants to raise the Global Intangible Low Tax Income minimum tax rate to 21%. This means that subsidiaries of US multinationals located in countries where the income tax rate will be 15% will immediately have to pay an additional 6% tax in the USA if the Biden Administration has its way. The European Union and the United States will certainly have to pursue the tax reforms that will come into force worldwide, thanks to the impetus provided by the United States. These reforms are also necessary to make social systems financially sustainable when growth comes to a halt and approaches zero. If tax competition continues unabated, it could lead to a total economic collapse in a few years' time.



The role of the state is crucial in accelerating the transition to a sustainable economic model, as Kate Raworth (2017) points out. According to Jean Pisani-Ferry and Selma Mahfouz (2023), achieving climate neutrality will require a major transformation on a scale comparable to the industrial revolutions of the past. But compared with those revolutions, this transformation will be global, faster, and driven primarily by public policy rather than technological innovation and markets.

Much of the current concentration of greenhouse gases is due to the actions of advanced countries, and it is unlikely that emerging countries will be inclined to make such a transition without the help of developed countries. The Paris Agreement (which has yet to be fully implemented) provides for financial assistance (including technology transfer) from developed to emerging countries. Both emerging and advanced countries will have to develop models based on the circular economy, with consumption and production becoming more local, even if some international trade must continue (in the raw materials needed for the transition). Border taxes on polluting products (such as the EU carbon tax due to come into force in 2026 or 2027) would benefit from being offset by financial aid or investment in environmentally friendly projects and technology transfers, as provided for in the Paris Agreement.

Once we have launched the economic transformations and investments needed to transition to an economy that respects planetary boundaries, we need to stabilize the system in a post-growth economy, i.e. one that is no longer dependent on GDP growth. Several studies suggest that it is theoretically possible to achieve a stable economy characterized by zero GDP growth (Barret, 2018, Berg et al., 2015, Fontana and Sawyer, 2015, 2022, Jackson and Victor, 2015, Rosenbaum, 2015, Cahen-Fourot and Lavoie, 2016) even if this raises several difficulties. The economy is stable if there is an equilibrium robust to small shocks and economically desirable characteristics, namely balanced profit and wage levels, and low unemployment (Richters and Siemoneit, 2017).

Adam Barrett (2018) uses a model inspired by Keen's model of Minsky's financial instability hypothesis. His analysis focuses on dynamics as opposed to equilibrium, and scenarios of growth and no-growth of output (GDP) are obtained by tweaking a productivity growth input parameter. He finds that, with or without growth, there can be both stable and unstable scenarios. To maintain stability, firms must not change their debt levels or target debt levels too quickly. Further, according to the model, the wages share is higher for zero-growth scenarios, although there are more frequent substantial drops in employment.

Tim Jackson and Peter Victor (2020) show that it is possible to improve the environmental and social situation even when GDP per capita growth rates gradually reach zero. In the scenario of sustainable prosperity (the optimal scenario according to these authors), growth in GDP per capita slows down from 2027 onwards and becomes zero in 2050. The Gini index decreases (meaning that inequality also decreases), whereas it remains stable in the other two scenarios. The ratio of public debt to GDP modelled in the sustainable prosperity scenario increases. However, this ratio does not explode (even when GDP per capita growth reaches zero).

An immediate halt to growth without a policy of investment and economic transformation will not make the economy sufficiently sober. It is possible to have public finances that remain stable and a public debt that does not soar in a situation of zero GDP growth, but the sum of the public deficit and the interest rate must be lower than the inflation rate. In the short term and in the current context, the immediate halt to growth means that governments cannot (or at least only with difficulty) use the public deficit to invest and decarbonize the economy. For growth to be low in advanced countries between now and 2050 (e.g. between 1% and 0%), and for them to be able to invest and help emerging countries, interest rates need to be low or moderate. The environmental crisis has inflationary effects.



Although inflation has the advantage of reducing the value of public and private debt, it has to be contained by massively transforming economies to make them energy efficient.

During the transition period, policymakers should begin to use alternative indicators to GDP to steer the economy based on the work of Kate Raworth's "Doughnut Economics". Tim Jackson and Peter Victor (2020) use two composite indicators in their study: an environmental burden index (EBI) which describes the environmental performance of the model; and a composite sustainable prosperity index (SPI) which is based on a weighted average of seven economic, social and environmental performance indicators. The economy should be transformed massively during this period. Environmentally friendly alternatives should replace goods and services that consume a lot of energy and materials as far as possible by more.

Concluding remarks

There are several visions to approach the problem of global warming and environmental degradation. The first is the cost-effectiveness view. Studies produced using this method tend to underestimate significantly the damage that will be caused by climate change and environmental degradation. Contrary to those who recommend overly moderate action on the environmental crisis, some authors advocate solutions based on a shift away from economic growth. Within this post-growth / degrowth trend, however, there are disparities.

The transition to a sustainable economic system should take place in two main phases: an investment phase and a stabilization phase. The investment and economic transformation phase will be characterized by both positive and negative effects on GDP. Several studies suggest that global growth should continue for another 20 or 30 years before coming to a halt, if the system has not begun to collapse by then.

Two studies propose a robust path to solving the environmental crisis: the Stern and Stiglitz study (2023) and the Tim Jackson and Peter Victor study (2020). The Stern and Stiglitz study (2023) is perhaps slightly too optimistic about the delta of growth that remains at global level. This delta of growth would nevertheless be necessary to reduce global inequalities. Post-growth specialists, on the other hand, recommend that advanced economies stop focusing on GDP growth, to allow emerging economies to develop within planetary limits. The Tim Jackson and Peter Victor study (2020) proposes a transition path for an advanced economy (Canada) in which GDP per capita growth gradually comes to a halt, reaching zero by 2050.

Tax competition and growing inequality are among the factors that can lead to economic collapse today. Some IMF economists believe that tax evasion and avoidance result in the loss of revenue that could have been used to finance social spending or infrastructure investment. To solve the climate crisis, governments need fiscal resources, and their investments will benefit all economic players: citizens, businesses and the public. Kemp et al. (2022) consider that climate change could lead to the collapse of society or even the extinction of humankind, and that most studies fail to take these issues seriously.

Several levers can be used to stabilize the economy in a system that respects planetary limits. Policymakers can use alternative indicators to GDP to steer the economy. They can massively accelerate renewable energies investments or encourage economic players to replace certain goods and services with more efficient ones. Using only one of these levers without the others could lead to a counterproductive policy.



Prior to and in parallel with stabilizing the economic system in a post-growth situation, we need to implement a Keynesian economy with tax reforms that reduce inequalities, get rid of tax competition and invest massively in the transition to a low-carbon, energy-efficient economy. To achieve these objectives, the public deficit can be used temporarily. This investment and transformation policy will then stabilize the economic system in a world without growth in rich countries first. The opposite policy (stopping growth and/or lowering consumption without implementing Keynesian policies) risks leading to a situation that will not be socially accepted.

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