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## We Already Live in a Degrowth World, and We Do Not like It

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DISCUSSION PAPER SERIES

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**Wim Naudé**

*RWTH Aachen University and IZA*

MAY 2023

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## ABSTRACT

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# We Already Live in a Degrowth World, and We Do Not Like It

The Degrowth Movement calls for “degrowth” – a reduction in GDP in advanced economies – to avert an ecological crisis. This paper argues that the Degrowth Movement misses that the West is already in a state resembling degrowth – a Great Stagnation. This state of degrowth and its correlates, declining entrepreneurship, innovation, science, and research productivity, are described. It is concluded that the notion that a degrowth economy can generate the technological progress necessary to tackle ecological and social crises and challenges is far-fetched. Moreover, as economic stagnation has taught, the consequence of degrowth is a zero-sum society: redistribution, instead of production, becomes the basis of the economy. In such a context, more degrowth will only make problems worse. This paper concludes by discussing scenarios for moving beyond Degrowth. Whether collapse or unimaginable riches through breakthrough technological progress will be the future, these scenarios suggest that there is more to humanity’s future than envisaged by the Degrowth Movement.

**JEL Classification:** O40, O33, D01, D64

**Keywords:** economic growth, Degrowth, ecology, sustainable development, collapse

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# 1 Introduction

There are two broad approaches in the debate on tackling the ecological crisis best. One is Green Growth, according to which there are essentially no limits to economic growth and which promotes (eco-) innovation to reduce the impacts of growth on the environment, both in terms of resource use and emissions. The Green Growth approach is the mainstream global economic policy approach to the ecological crisis, as promoted for instance, by the European Commission (EC (2011)), OECD (2009, 2011, 2014), and World Bank (2012).

Another approach is that of the Degrowth Movement, which identifies strict limits to economic growth, which, if breached, would lead to an environmental catastrophe and “ghastly future” (Kallis, 2011; Kallis and March, 2015; Hickel, 2019, 2021; Bradshaw et al., 2021). A rallying cry is “you can’t have infinite growth on a finite planet” (Phillips, 2019). As such, economic growth needs to be curtailed, and indeed GDP in advanced economies needs to be reduced - it is time to “de-develop rich countries” as called for by Hickel (2015). This follows from Degrowth’s belief that Green Growth will not be able to decouple resource use and emissions from GDP (Hickel, 2019) - and that “growth is not working” to make the world a better place (Hickel, 2015).

In the Degrowth narrative, policymakers are “obsessed” with maximizing economic growth as measured by GDP, because of the nature of global capitalism, which also produces large inequalities between the Global North and the Global South - degrowth is a “demand for decolonization” (Hickel, 2021). The Degrowth movement therefore wants to reduce GDP in advanced economies and not the Global South, and do so via a “radical political project” of reconfiguration of the entire global socio-economic system, starting in the rich, decadent and consumption-driven West (Kallis, 2011, p.873). The Degrowth movement believes this is consistent with abundance and happiness and that the extent of GDP and consumption in the West can be significantly reduced without making people worse off (Hickel and Hallegatte,

2022). Moreover, they believe that limits and boundaries to GDP, consumption and resource use will stimulate innovation and creativity - leading to a better society all-round (Raworth, 2017; Kendrick, 2023).

The Degrowth movement is largely accurate<sup>1</sup> in its analyzes of the shortcomings of Green Growth in terms of the latter's ability to decouple growth from material use (Naudé, 2023a). This paper argues that where the Degrowth movement, however, goes astray, is in insisting on degrowth, and in claiming that this would make society and the environment better. Degrowthers misses that in the West, we already live in a degrowth-type world, and that there is much about it that we do not like.

This paper, therefore, describes the degrowth world - the Great Stagnation as it has been called by Cowen (2010) - that the West has been approaching since the 1970s, and its correlates: declining entrepreneurship, innovation and science, and research productivity. The declines in these suggest that the hope that a degrowth economy can generate the technological progress necessary to tackle ecological and social crises is far-fetched. Moreover, as recent decades of suffering under economic stagnation have illustrated, the consequence of degrowth is a zero-sum society. With the size of the economic cake essentially fixed or shrinking, the economy is a theatre of conflict. One group, or one country, can only make itself better off at the expense of another. Redistribution, instead of production, is the basis of the economy.

Thus, in a context of a curtailed ability to generate technological innovations and a zero-sum economy, even more degrowth, as proposed by the Degrowth Movement, will only make problems worse. Hence, this paper concludes by making some suggestions for moving beyond Degrowth - pointing to two divergent views of humanity's future, the one expecting societal collapse, the other expecting that breakthrough technology, such as an Artificial General

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<sup>1</sup>As is argued elsewhere, the Degrowth Movement is less accurate in analysing the links between economic growth, poverty reduction and subjective welfare. See e.g. Naudé (2023b), Coyne (2019) or Bruers (2021).

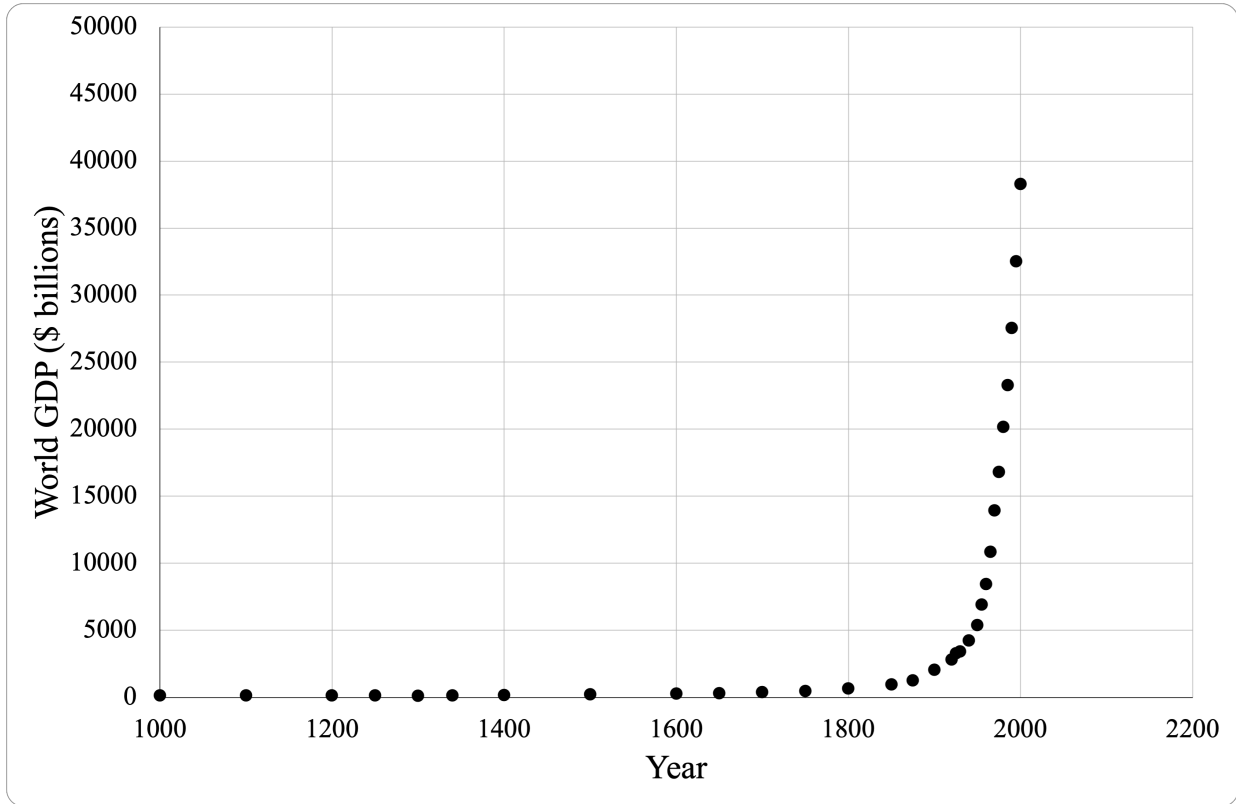
Intelligence (AGI) and/or whole brain emulations may result in a Singularity. Whether collapse or an unimaginably prosperous future enabled by breakthrough technological progress will be the future, these scenarios at suggest that there is more to humanity's future than envisaged by the Degrowth Movement.

The rest of the paper proceeds as follows. Section 2 asks: Can economic growth continue forever? In this section, it is shown that if one wants to believe in indefinite growth, that strong assumptions are needed concerning entrepreneurship, innovation, science, population and R&D productivity - and that the experience of the West over the past fifty years shows that these assumptions do not seem to hold. Sections 3, 4 and 5 lays out the empirical evidence in this regard, briefly analyzing the decline in the West of entrepreneurship (section 3), innovation and science (section 4) and research productivity (section 5). These sections are brief, as more details are available elsewhere, for instance, in Bhaskar (2021), Erixon and Weigl (2016), Gordon (2018) and Naudé (2022), amongst others. Section 6 argues that the declines in economic growth and its correlates have resulted in an economy increasingly characterised by zero-sum outcomes. Then, section 7 examines the Degrowth Movement's agenda against the context of an already degrowing economy in the West. It is argued that the Degrowth Movement itself can be seen as a social reaction against degrowth. Section 8 explores at least two possibilities for humanity beyond what the Degrowth Movement proposes, and section 9 concludes.

## **2 Can Economic Growth Continue Forever?**

As a result of the take-off in economic growth since around the end of the 18th century, world GDP per capita today, around US\$5400, is 5600% higher than what it was 10,000 years before, when we lived as foragers and hunter-gatherers (Syvitski et al., 2020) - see Figure 1.

Figure 1: World GDP, 1000 - 2000



Source: Naudé (2023a) based on data from DeLong (1998, pp.7-8).

Growth not only transformed the nature of the economy, but also of society, including its values. Democracy, tolerance, human rights, freedom, social justice - these were all enabled, and in turn contributed to, an expanding economy. As historian Ian Morris reminds us “Most people in the world today think democracy and gender equality are good, and that violence and wealth inequality are bad. But most people who lived during the 10,000 years before the nineteenth century thought just the opposite” (Morris, 2015).

But can this continue? The field of economics, in the time of Adam Smith, David Ricardo and Thomas Malthus started considering economic growth bounded by the finiteness of resources, such as land, labour and capital. Robert Solow’s 1956 Nobel Prize-winning contribution suggested that economic growth will over time decline to zero, unless technology “rain down” exogenously to keep growth positive (Solow, 1956). In 2018 Paul Romer received the Nobel



Prize in economics for showing how technological innovation can emerge endogenously from within the economic system, and so long as there is technological innovation, economic growth can continue indefinitely (Romer, 1986, 1987, 1990).

Romer's central contribution was to argue that innovation is unbounded because it is based on ideas (recipes) which are non-rival in use and can have increasing returns to scale - the more people there are, the more ideas there will be, and with a larger stock of ideas more new ideas can arise by combination of existing ideas (Romer, 1993). As Romer (2016) explains:

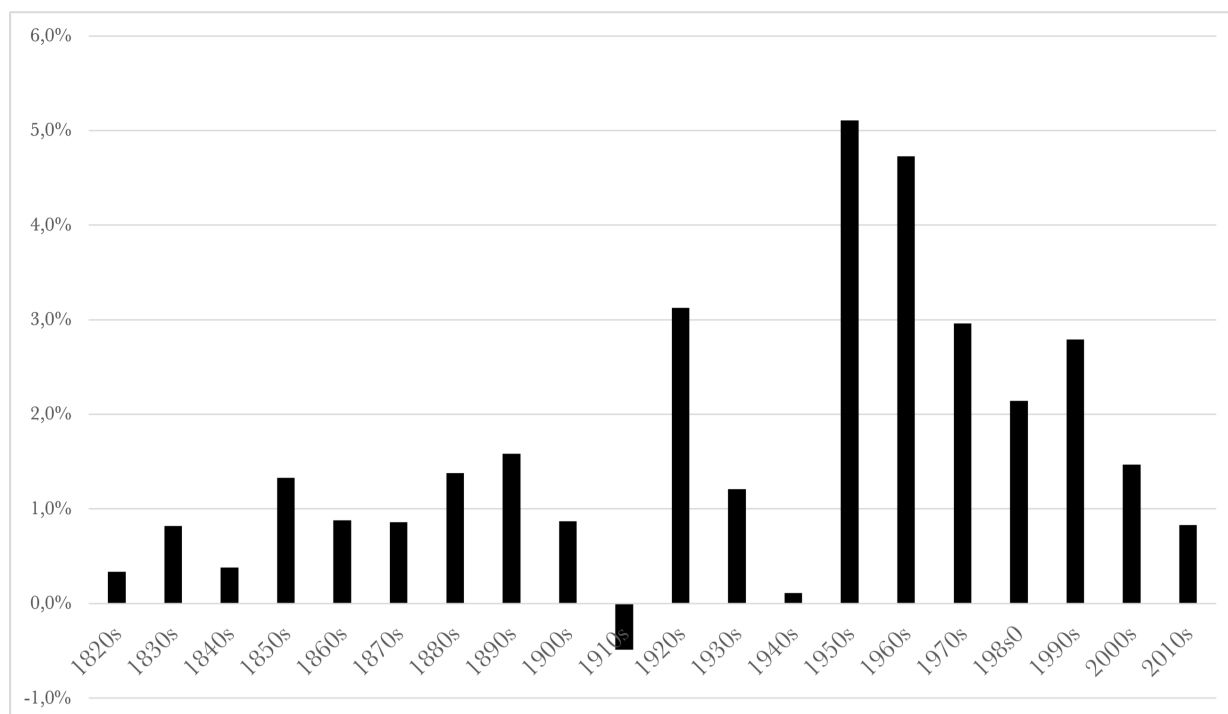
“For recipes that can have four elements, there are  $100 \times 99 \times 98 \times 97$  recipes, which is more 94 million. With up to 5 elements, more than 9 billion. Mathematicians call this increase in the number of combinations “combinatorial explosion.” Once you get to 10 elements [ideas], there are more recipes than seconds since the big bang created the universe.”

If economic growth therefore depends on ideas/recipes (technology), then, if one believes in unlimited economic growth, one must believe that (1) entrepreneurs will face sufficient incentives to continue to search for new ideas; (2) the population, from which ideas spring, will continue to grow; and (3) that research productivity (the search for new ideas) will not decline. Hence, if entrepreneurship, population and research productivity decline, there would not be increasing returns to scale in ideas, and indefinite economic growth would not be possible. Economic growth would be decreasing over time and eventually stop.

If we look at economic growth rates in the advanced economies, of say, Western Europe, then we see that it indeed has been declining since the 1950s and 1960s, which were in a historical context, the golden years of economic growth. Average economic growth rates in Western Europe today are historically low and resemble those of the 1860s (which saw the rise of Marxism and the founding of the First International), the 1870s (which saw the rise of the New Imperialism) and 1900s (a period of rising nationalism and militarism).

The decline in growth since the 1950s, which looks similar in the USA, has been described as the Great Stagnation (Cowen, 2010). No respite is in sight; indeed not only growth in the west, but in the rest of the world is according to a World Bank study set to fall further in coming decades, concluding that “Today nearly all the economic forces that drove economic progress are in retreat” (Kose and Ohnsorge, 2023, p.xix).

Figure 2: GDP per capita growth rates per decade in Western Europe, 1820s to 2010s.



*Source:* Author’s compilation based on data from the Maddison Project Database 2020, see Bolt and van Zanden (2020).

The Great Stagnation has been accompanied by declines in entrepreneurship, population growth, innovation, and research productivity. These are, in terms of Romer’s theoretical framework, causal mechanisms for slowing growth down. But, because these are endogenous to the economy, slower economic growth will also in turn depress entrepreneurship, innovation, and research productivity (Romer, 1994).

Let us consider some empirical trends in entrepreneurship, innovation, and research productivity in the West. Not everybody realises that behind the fascination with the digital world’s shiny objects, the economy has lost its innovative lustre. We do not really live in

such a fast-changing technological world as it is often made out to be. It is not that we have too many technological disruptions: it is rather that we may not have enough.

### 3 Declining Entrepreneurship

We live in an ossified, and not an entrepreneurial economy (Naudé, 2022). A growing volume of research has confirmed that entrepreneurship, according to many measures, has been declining since around the 1970s in the USA and other western economies, including the UK, Belgium, and Germany. For example, the share of new to old firms in the USA has dropped by 50% between 1978 and 2011 (Hopenhayn et al., 2018, 2022). The share of entrepreneurs in the country's working population has declined from 7.8% in 1985 to 3.9% in 2014 (Salgado, 2020). In Belgium, the new business formation rate declined from 12% in 1986 to -1% in 2014 (Bijnens and Konings, 2018), and in the UK start-up rates declined between 1998 and 2012 from 6.5% to 0.8% between 1998 and 2012 (Ugur et al., 2016). And evidence from Germany suggests that start-up activity declined by 50% between 1990 and 2013 (Naudé and Nagler, 2018).

These declines om entrepreneurship measures have been across sectors - including high-tech (Haltiwanger, 2022) - and has seen the share of young firms (who tends to be more innovative) dropping (Decker et al., 2014). It has been accompanied by declines in labor mobility, as the opportunities that firm dynamism create dries up (Konczal and Steinbaum, 2016). Historically, entrepreneurship has been a vehicle for social mobility (Connor and Storper, 2020), and accordingly, as this vehicle has been running out of steam, inequality has increased (Piketty, 2013). Declining entrepreneurship leads to slower growth and higher inequality, but it is just as much the case that slower economic growth and degrowth leads in turn to declining entrepreneurship (Naudé, 2008).

## 4 Declining Innovation and Science

Famously, as entrepreneur Peter Thiel said, “We wanted flying cars, instead we got 140 characters.” Predictions of the 2020s made back in the 1950s and 1960s turned out over-optimistic. According to Huebner (2005, p.980), “The rate of innovation peaked in the year 1873 and is now rapidly declining. We are at an estimated 85% of the economic limit of technology, and it is projected that we will reach 90% in 2018 and 95% in 2038.”

Other measures are consistent with such a bleak conclusion. For instance, in the UK labour productivity growth is the lowest in 200 years (Tenreyro, 2018); in Germany, total factor productivity growth (an indirect measure of innovation) averaged 2,73% in the 1960s but declined to -0,26% between 2000 and 2010 (Naudé and Nagler, 2018). Increasingly, patent registrations (another measure of innovation) have been getting narrower in scope and less original (Akcigit and Ates, 2019).

Kelly et al. (2021) constructed, using patent data, an aggregate innovation index for the USA covering 1840-2020. This shows that origin of breakthrough-patents has shifted over time, from engineering and manufacturing in the 19th century, to transport and chemistry in the first half of the 20th century, eventually to ICT (e.g., microchips) in the late 20th century. Indeed, outside of the computer industry there have been historically few breakthrough-patents the past three decades.

The slowdown in innovation is part of the broader slowdown in scientific progress and discovery. In particular, the fact that fundamental physics have not been making much progress in fifty years has been highlighted by several scientists. Hossenfelder (2018) for example pointed out that “Nothing is moving in the foundations of physics. One experiment after the other is returning null results: No new particles, no new dimensions, no new symmetries.”

Park et al. (2023, p.138) using data on 45 million papers and 3.9 million patents from six

large-scale datasets “finds that “papers and patents are increasingly less likely to break with the past in ways that push science and technology in new directions. This pattern holds universally across fields.” It suggests indeed that “progress is slowing in several major fields.”

More generally, in recent years scientific progress has been marked by hyper-specialization and hyper-authorship (Funk and Smith, 2022); reproducibility crises and false results (Baker, 2016; Ioannidis, 2005); retractions (Steen, 2011), and misconduct (Archer, 2020), an out-of-date peer review system (Dattani, 2022) where 90% of scientific papers are never cited (Meho, 2007).

## 5 Declining Research Productivity

The declines in entrepreneurship, innovation and science have been accompanied by a decline in research productivity - which in turn contributes to poorer entrepreneurship and innovation. Bloom et al. (2020), found that “Research productivity for the aggregate U.S. economy has declined by a factor of 41 since the 1930s, an average decrease of more than 5% per year.” This has been despite a substantial and steady increase in the number of researchers in the country. The authors conclude that “ideas are getting harder to find.”

It is not only that ideas are getting harder to find. Ideas are also getting harder to fund (Bhaskar, 2021). It is not possible to fund every new idea (there are basically infinite numbers of new ideas). In the competition for scarce funding, we may be selecting less-effective ideas - ideas which may promise more than they can deliver, which may be a problem pervasive in the ICT/digital industry where “gaming” R&D is common (Funk, 2019b,a).

The instability and crises in the global financial system - there has been more than 150 financial crises since the 1970s - is a feature of a stagnating economy in decline (Laeven and

Valencia, 2020) It has contributed, through central banks pumping trillions of \$'s and euros into economies as “quantitative easing” to prevent massive bank failure and recession, to excessive liquidity (Calcagnini et al., 2022) - real interest rates have in recent times declined to their lowest levels in 5,000 years (Holodny, 2016). In this environment, cash chases short term returns, with little consideration for long-term investments in technology and science that really matter.

## 6 The Zero-Sum Society

The consequence of the decline in growth in the west, and the simultaneous decline in entrepreneurship, innovation, science, and research productivity has created a zero-sum society. With the size of the economic cake essentially fixed, or shrinking, the economy becomes a theater of conflict. One group, or one country, can only make itself better off at the expense of another. Redistribution, instead of production, becomes the basis of the economy. In a zero-sum economy, higher and higher inequality is most often the outcome (Piketty, 2013) - an outcome also acknowledged by proponents of degrowth - see Hartley et al. (2020).

For firms, in a zero-sum economy defensive innovation (aimed to exploit a fixed niche ) becomes the default mode - to keep competitors out and extract more profits from existing markets. Hence, we have seen indicators of corporate dominance and industry concentration increase (Covarrubias et al., 2020), the share of labour in output decline (Autor et al., 2020), the rise of industrial policy nationalism (Johnston, 2023), de-globalization (Zeihan, 2023), poor quality, low-paying jobs (Graeber, 2018), and trade wars (Fetzer and Schwarz, 2021).

And in this degrowth, zero-sum economy, society is seemingly getting more risk averse. Schragger (2022) observes that “the effort to stop growth misunderstand human nature, which thrives on the motivation to create and improve. Dooming people to stagnation deprives

them of curiosity and purpose.” And in the process, new ideas are not so welcome anymore. According to Bhaskar (2021), “society has become more hostile to radical innovation, risk-averse, fractious, short-termist.” Society has also become less tolerant towards migrants,<sup>2</sup> and have experienced personal rights decline and inclusiveness stagnate (Deloitte, 2022). Governments are less trusted : public trust in government in the USA has, for instance, fallen from 77% in 1964 in the economic growth golden age, to 17% in 2019.<sup>3</sup> Science used to be a “candle in the dark” (Sagan, 1997). In the zero-sum, degrowth economy of the West, it is not so anymore: moral relativism (Boudry, 2021), religious dogma (McPhetres and Zuckerman, 2018) and even outright anti-science sentiment (Kuntz, 2012) is eroding whatever is left of Europe’s Enlightenment legacy.

## 7 The Degrowth Movement

It is in this context in which the Degrowth Movement has arisen. It is, like the rise in dogma, intolerance, and anti-science sentiment one of the outcomes - or symptoms -of degrowth in the West.<sup>4</sup> But paradoxically, the Degrowth Movement wants more of the same: more degrowth, not less. It is akin to prescribing alcohol for a hangover. It wants to degrow the world economy because it considers the world economy to be too big - overshooting planetary boundaries (Fanning et al., 2022). Ecological disaster, including runaway climate change will result in a “ghastly future”, unless we can live within planetary boundaries (Bradshaw et al., 2021; Huggel et al., 2022; Lenton et al., 2019; Steffen et al., 2015). The Movement often refers to the claim that we will need almost three planets<sup>5</sup> if everyone consumes as much as the average western citizen.

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<sup>2</sup>See <https://news.gallup.com/poll/320678/world-grows-less-accepting-migrants.aspx>.

<sup>3</sup>See <https://www.pewresearch.org/politics/2022/06/06/public-trust-in-government-1958-2022/>.

<sup>4</sup>Demaria et al. (2016, p.390) locates the “birth of degrowth as an international research agenda” to the first degrowth conference, in Paris in 2008: hence the Degrowth Movement was born in the midst of the Global Financial Crisis.

<sup>5</sup>See <https://www.oneplanetnetwork.org/programmes/sustainable-lifestyles-education/about>.

According to the Degrowth movement, policy makers are obsessed with maximizing economic growth as measured by GDP (Hickel and Hallegatte, 2022). This is, according to their narrative, due to the deep nature of global capitalism, which also generates large inequalities between the Global North and the Global South (Hickel, 2021). The Degrowth movement therefore wants to proactively reduce GDP in advanced economies (and not the Global South) and do so via a “radical political project” (Kallis and March, 2015, p.873). This entails reconfiguration of the entire global socio-economic system, starting in the rich, decadent and consumption driven West, in accordance with degrowth’s “powerful oppositional Marxist ecology that represents a path to a truly sustainable Earth” (Boettcher, 2021, p.vi).

The Degrowth movement believe that this will prevent an ecological overshoot and environmental collapse. It believes that, despite the facts to the contrary in the degrowth-west of the past 50 years, that this would lead to abundance and happiness, and that limits and boundaries to GDP, consumption and resource use will stimulate innovation and creativity - leading to a better society all-round (Raworth, 2017; Kendrick, 2023).

The Degrowth Movement is not wrong<sup>6</sup> in pointing to the limits of economic growth, or of its impacts on the ecological carry capacity of the Earth. But they are hardly the first, or only one, to do so. Romer’s Nobel-winning contribution implies that economic growth cannot be maintained indefinitely if entrepreneurship, innovation, science, and research productivity are subject to decreasing returns - as the experience of the West suggests they are (Johansen and Sornette, 2001; Jones, 2022; Naudé, 2022; Nordhaus, 2020). And the empirical literature has noted the lack of absolute decoupling between economic growth and material use, and economic growth and carbon emissions on a global level (Haberl et al., 2020; Hannesson, 2021; Jackson and Victor, 2019; Ward et al., 2016; Wiedmann et al., 2015).

The problem with the Degrowth movement is to think that we cannot decouple material use

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<sup>6</sup>Perhaps worth repeating that the Degrowth Movement is less accurate in its analysis of the links between economic growth, poverty reduction and subjective welfare. See e.g. Naudé (2023b), Coyne (2019) or Bruers (2021).



and carbon emissions from economic growth, but that we can indeed decouple innovation, happiness, social progress, tolerance, and 21st century values from the size and dynamics of the economy. As Murphy (2015) warned, Degrowth may undo the social progress that has taken place in a growing, positive-sum economy:

“In times of plenty, we can afford to be kind to those who are different. We are less threatened when we are comfortable. If our 21st Century standard of living peaks [...] then we may not have the luxury of viewing our social progress as an irreversible ratchet. Hard times revive old tribal instincts: different is not welcome.”

The Degrowth Movement may also be mistaken in assuming that we can in centralized fashion, through the political process, dictate an orderly process of scaling down resource use consumption (and hence GDP), when redistribution, instead of production, becomes the basis of the economy. A similar fantasy did not play out well in the Soviet Union, indeed, the ecological damage from the degrowth period under communism turned the Soviet Union and its Eastern European satellites into one of the most polluted regions in the world (Brain, 2010; Shahgedanova and Burt, 1994; Schiermeier, 2019). The legacy endures to the present (Varieur et al., 2022).

Degrowth has been labelled as “dirty” (van den Bergh, 2011); as a program of “ecological austerity for working-class people” (Chambers, 2021); and has been accused that it will “do more harm to the planet than good” (Nordhaus, 2020). When one realizes that we already live in a world resembling degrowth, and that we do not like it, these labels make sense.

A comprehensive critique of the Degrowth movement falls outside the scope of this paper. The reader is referred to critical analyses by amongst others van den Bergh (2011), Bruers (2021), Chambers (2021), Horowitz (2022), McAfee (2020), Naudé (2023b), Nordhaus (2020), Phillips (2019), Schragger (2022) and Schwartzman (2012).

## 8 Beyond Degrowth

In the ossified, degrowth economy of the West, we do not (yet) have the technological know-how, and organizational innovations to prevent, in a timely manner, ecological overshoot. Decades of low growth and stagnating science have left us less resilient and more vulnerable to adverse shocks. Certainly, the decarbonisation needed to achieve the climate targets necessary to prevent potentially dangerous global warming, will not be reached (Kaplan, 2023; Mann, 2014; Taylor and Vink, 2021). Green growth, the mainstream global economic policy approach to the ecological crisis, as promoted for instance by the European Commission (EC (2011)), OECD (2009, 2011, 2014), and World Bank (2012) will not be effective to prevent ecological overshoot.

But even more of degrowth, as the Degrowth Movement proposes, will only make the problem worse. The Degrowth Movement is mistaking the brake for the accelerator.

There are at least two possibilities for humanity beyond what the Degrowth Movement proposes. The first is that societal collapse may be inevitable.<sup>7</sup> It may be a feature, not a bug, of universal patterns characterizing growth from the smallest to the grandest scale (Bardi, 2017; West, 2017). The interest in societal collapse rose noticeably following the slowdown in Western growth rates in the 1970s and 1980s, starting with the Club of Rome's *Limits to Growth* (LtG) report in 1972 Meadows et al. (1972). The tone was further set by Joseph Tainter, in his 1988 book *The Collapse of Complex Societies* (Tainter, 1988) and John Leslie's 1996 book *The End of the World* (Leslie, 1996). Collapse could result in humanity ending up in a dystopian future - with a fate like that of the inhabitants of Easter Island (Diamond, 2005). Or collapse could, as an increasing number of scholars have been arguing,

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<sup>7</sup>The question is whether collapse will entail the extinction of humanity. Ord (2020), in his study of existential risks facing humanity, concludes that while the risks from climate change and environmental damage are serious, and higher than the risks of extinction from natural risks (which he puts at a probability of less than 0.05% per century) there is nevertheless a significant probability that humanity will survive. Collapse need not be fatal.

be necessary to make a new mode of economic growth - rebound growth - possible (Bardi, 2017; Beard and Torres, 2020; Odum and Odum, 2001; Scranton, 2015). Phoenix-like, a new and better society may arise.

More recently Hagens (2018, 2020), somewhat in line with Tainter’s view that collapse is a result of societies becoming too bureaucratic and inflexible because of growing complexity, recommended that the world prepare for a post-collapse, or *Great Simplification*.<sup>8</sup> For Bardi (2017), collapse would offer the opportunity to “get rid of obsolete structures.”

Foremost amongst the obsolete structures to rid the world of would amongst others be those structures that tilt the power in favour of large oligopolistic corporations (Fichtner et al., 2017); subsidizes fossil fuel giants (Kotchen, 2021) and promotes techno-feudalism (Varoufakis, 2021); that perpetuates the financialization of the economy (including so-called Modern Monetary Theory, and banks that are too big to fail) (Johnson and Kwak, 2011; Lazonick, 2014; Rogoff, 2019); that has created an unsustainable and unfair global food system (Monbiot, 2022; Holden et al., 2018; Willett et al., 2019); that burdens the innovation system with “systematic misalignment between market incentives and social objectives” (Acemoglu, 2023, p.1); and that have resulted in universities becoming risk-averse places gaming the R&D system, being locked into delivering at most incremental innovations - if not mostly non-replicable and fraudulent science (Archer, 2020; Baker, 2016; Ioannidis, 2005; Steen, 2011). The UN-system, based on the 1648 Peace of Westphalia idea of national sovereignty, is likely well past its sell-by date in its current form (López and Rodó, 2020; Peters, 2015). One could go on.

If ridding the world of these obsolete structures, and others, would generate a qualitatively different kind of economic growth,<sup>9</sup> perhaps supported with what Mazzucato (2018) calls “missions” and which Stern et al. (2022) termed “new approaches to the economics of cli-

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<sup>8</sup>See <https://www.thegreatsimplification.com/>.

<sup>9</sup>This indeed suggests that the Degrowth Movement fails to give sufficient attention to the qualitative aspects of economic growth, as Schwartzman (2012) has argued.

mate change,” a period of rebound growth could be possible wherein growth would be more inclusive and shared.

The second possibility for humanity beyond Degrowth is that societal collapse will be averted, and that the world will rid itself of its obsolete structures without collapse. Many put their hopes in exponential technological change, in particular Artificial Intelligence (AI) leading to a Singularity (Kurzweil, 2005). A Singularity - an inflexion in the world economy's growth mode - could herald super-exponential economic growth - a growth explosion of more than 30% GDP growth per annum (Davidson, 2021) - and enable humanity to eradicate poverty and disease, and deal with other wicked problems such as environmental overshoot. According to Domingos (2015, p.289) AI could turn the next millennium into “the most amazing in the life of planet Earth.” Russell (2019) considers it plausible that AI may help raise GDP per capita for the world's population to the current 88th percentile of that of the USA - which would add US\$674 trillion per year to the world economy.

Hanson (2018) argues that AI may not be needed for a growth explosion - but that the creation of digital people “Ems” through brain emulations may become a possibility in the future. In such an economy where digital people “largely work and play in virtually reality” at subsistence levels to produce the computer hardware, and the supporting infrastructure for the virtual reality, GDP growth will be so fast - because of all the billions and billions cheap digital people and the combinations of new ideas that can be generated very rapidly - that the world economy doubles every month.

The Singularity and Ems are still more science fiction rather than fact (Nordhaus, 2021). And AI may pose an existential threat to humanity, rather than being a saviour of sorts (Bostrom, 2014). AI may even accelerate ecological overshoot through rebound effects (Ligozat et al., 2022). For a discussion of the long-run risks and opportunities of AI in the context of economic growth, see Naudé (2023a).

## 9 Conclusion

Whether a collapse, with or without rebound-growth, or no collapse, and an unimaginably prosperous future enabled by breakthrough technological progress lies in store for humanity, the scenarios outlined in the previous section suggest that there is more to humanity's future than envisaged by the Degrowth Movement.

Perhaps the Degrowth Movement's most fundamental shortcoming is its shorttermism.<sup>10</sup> If seen from a planetary perspective, human civilization is extremely young. Of the brief 300,000 years that humans have been around, the economic growth that the Degrowth Movement is against, has taken place only in the last 0,08% of human history. Most humans, including potentially trillions of sentient digital people, must yet be born. Bostrom (2003) and Cirkovic (2002) have stressed the enormous loss in terms of potential lives lost if humanity fails to develop technologies to enable galactic colonization. According to Bostrom (2003, p.309), "the potential for approximately  $10^{38}$  human lives is lost every century that colonization of our local supercluster is delayed."

The development of technologies to prevent planetary overshoot, including a climate and ecological catastrophe, and the development of technologies to eventually reduce other existential risks and colonize the galaxy, enabling trillions of future humans to live prosperous lives, will come to a screeching halt if the Degrowth Movement's shorttermist worldview is imposed. Loeb (2023) reminds us that "Unrealistic illusions were the trademark of past civilizations that perished on Earth. Adaptation to reality based on evidence places a higher bar for our long-term survival." We should not wait for collapse to rid us of the unrealistic illusions that continue to shackle humanity's potential.

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<sup>10</sup>The shorttermism of the Degrowth Movement partly reflects its lack of consequentialist ethics, which is in turn perhaps ideological, but can also reflect that most proponents of the movement are far removed from any of the potential bad outcomes of their advice (the majority live privileged lives in the Global North) and/or that they do not have any "skin in the game" - if their policy advice should work out well, they benefit; if not, they do not lose anything.

## References

- Acemoglu, D. (2023). Distorted Innovation: Does the Market Get the Direction of Technology Right? *AEA Papers and Proceedings*, 113:1–28.
- Akcigit, U. and Ates, S. (2019). Ten Facts on Declining Business Dynamism and Lessons from Endogenous Growth Theory. *CEPR Discussion Paper no. 13668, Centre for Economic Policy Research*.
- Archer, E. (2020). The Intellectual and Moral Decline in Academic Research. *James G. Martin Center for Academic Renewal*.
- Autor, D., Dorn, D., Katz, L., Patterson, C., and Reenen, J. V. (2020). The Fall of the Labor Share and the Rise of Superstar Firms. *The Quarterly Journal of Economics*, 135.(2):645–709.
- Baker, M. (2016). 1,500 Scientists Lift the Lid on Reproducibility. *Nature*, 533:452–454.
- Bardi, U. (2017). The Seneca Effect: Why Growth is Slow but Collapse is Rapid. *Cham, CH.: Springer*.
- Beard, S. and Torres, E. (2020). Ripples on the Great Sea of Life: A Brief History of Existential Risk Studies. *Mimeo: SSRN*, 12 March.
- Bhaskar, M. (2021). Human Frontiers: The Future of Big Ideas in an Age of Small Thinking. *London: The Bridge Street Press*.
- Bijnens, G. and Konings, J. (2018). Declining Business Dynamism in Belgium. *Small Business Economics*, pages 1–39.
- Bloom, N., Jones, C., van Reenen, J., and Webb, M. (2020). Are Ideas Getting Harder to Find? *American Economic Review*, 110(4):1104–1144.
- Boettcher, K. (2021). Seeing Red over the Climate Crisis: Ecosocialism as Emergency Brake. *Thesis Presented to the Faculty Of California State University, Stanislaus*.
- Bolt, J. and van Zanden, J. (2020). Maddison Style Estimates of the Evolution of the World Economy. A New 2020 Update. *Maddison-Project Working Paper WP-15*.
- Bostrom, N. (2003). Astronomical Waste: The Opportunity Cost of Delayed Technological Development. *Utilitas*, 15(3):308–314.

- Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford: Oxford University Press.
- Boudry, M. (2021). Why Relativism is the Worst Idea Ever. *Blog of the APA*, 29 Jul.
- Bradshaw, C., Ehrlich, P., Beattie, A., Ceballos, G., Crist, E., Diamond, J., Dirzo, R., Ehrlich, A., Harte, J., M.E., Pyke, G., Raven, P., Ripple, W., Saltr e, F., Turnbull, C., Wackernagel, M., and Blumstein, D. (2021). Underestimating the Challenges of Avoiding a Ghastly Future. *Frontiers in Conservation Science*, 1:61541.
- Brain, S. (2010). Stalin’s Environmentalism. *The Russian Review*, 69(1):93–118.
- Bruers, S. (2021). The Case Against Degrowth. *Effective Altruism Forum Blog*, 30 Dec.
- Calcagnini, G., Gardini, L., g. Giombini, and Carrera, E. (2022). Does Too Much Liquidity Generate Instability? *Journal of Economic Interaction and Coordination*, 17:191–208.
- Chambers, C. (2021). Degrowth: An Environmental Ideology with Good Intentions, Bad Politics. *Liberation School*, 20 Jul.
- Cirkovic, M. (2002). Cosmological Forecast and its Practical Significance. *Journal of Evolution and Technology*, xii.
- Connor, D. and Storper, M. (2020). The Changing Geography of Social Mobility in the United States. *PNAS*, 117(48):30309–30317.
- Covarrubias, M., G.Guti rrez, and Philippon, T. (2020). From Good to Bad Concentration? US Industries over the Past 30 Years. *NBER Macroeconomics Annual*, 34:1–46.
- Cowen, T. (2010). *The Great Stagnation*. New York: Penguin (Dutton).
- Coyne, J. (2019). Is the World Really Getting Poorer? A Response by Steve Pinker. *Why Evolution is True Blog*, 31 Jan.
- Dattani, S. (2022). Real Peer Review Has Never Been Tried. *Works in Progress*, 8(21 Jul).
- Davidson, T. (2021). Report on Whether AI Could Drive Explosive Economic Growth. *Open Philanthropy*, 17 June.
- Decker, R., Haltiwanger, J., Jarmin, R., and Miranda, J. (2014). The Role of Entrepreneurship in US Job Creation and Dynamics. *Journal of Economic Perspectives*, 28(3):3–24.

- Deloitte (2022). 2022 Social Progress Index. <https://www.socialprogress.org/global-index-2022-results/>.
- DeLong, J. B. (1998). Estimates of World GDP, One Million B.C. - Present. *Department of Economics, U.C. Berkeley* at <http://econ161.berkeley.edu/>.
- Demaria, F., Schneider, F., Sekulova, F., and Martinez-Alier, J. (2016). What Is Degrowth? From an Activist Slogan to a Social Movement. *The Environment in Anthropology (Second Edition): A Reader in Ecology, Culture, and Sustainable Living*, edited by Nora Haenn, Allison Harnish and Richard Wilk, New York, USA: New York University Press, pages 390–400.
- Diamond, J. (2005). Collapse: How Societies Choose to Fail or Succeed. *New York: Viking Press*.
- Domingos, P. (2015). The Master Algorithm: How the Quest for the Ultimate Learning Machine will Remake our World. *London: Penguin Books*.
- EC (2011). Analysis Associated with the Roadmap to a Resource Efficient Europe Part I. *Brussels: European Commission Staff Working Paper SEC(2011) 1067 final*, 20 Sept.
- Erixon, F. and Weigl, B. (2016). The Innovation Illusion. *New Haven: Yale University Press*.
- Fanning, A., O'Neill, D., Hickel, J., and Roux, N. (2022). The Social Shortfall and Ecological Overshoot of Nations. *Nature Sustainability*, 5:26–36.
- Fetzer, T. and Schwarz, C. (2021). Tariffs and Politics: Evidence from Trump’s Trade Wars. *The Economic Journal*, 131(636):1717–1741.
- Fichtner, J., Heemskerk, E., and Garcia-Bernardo, J. (2017). These Three Firms Own Corporate America. *The Conversation*, 10 May.
- Funk, J. (2019a). Gaming the Systems of Venture Capital and R&D. *LinkedIn*, 23 Oct.
- Funk, J. (2019b). What’s Behind Technological Hype? *Issues in Science and Technology*, 36(1):36–42.
- Funk, J. and Smith, G. (2022). The Hyper-Specialization of University Researchers. *Mind Matters*, 4 Oct.
- Gordon, R. (2018). Why Has Economic Growth Slowed When Innovation Appears to be Accelerating? *NBER Working Paper 24554*. National Bureau for Economic Research.



- Graeber, D. (2018). *Bullshit Jobs: A Theory*. *New York: Simon & Schuster*.
- Haberl, H., Wiedenhofer, D., Virág, D., Kalt, G., Plank, B., Brockway, P., Fishman, T., Hausknost, D., Krausmann, F., Leon-Gruchalski, B., and et al. (2020). A Systematic Review of the Evidence on Decoupling of GDP, Resource Use and GHG Emissions, Part ii: Synthesizing the Insights. *Environmental Research Letters*, 15:065003.
- Hagens, N. (2018). Where are We Going? *Resilience*, 23 Apr.
- Hagens, N. (2020). Economics for the Future - Beyond the Superorganism. *Ecological Economics*, 169:106520.
- Haltiwanger, J. (2022). Entrepreneurship in the Twenty-First Century. *Small Business Economics*, 58:27–40.
- Hannesson, R. (2021). Are We Seeing Dematerialization of World GDP? *Biophysical Economics and Sustainability*, 6(4).
- Hanson, R. (2018). *The Age of EM: Work, Love, and Life when Robots Rule the Earth*. *Oxford: Oxford University Press*.
- Hartley, T., van den Bergh, J., and Kallis, G. (2020). Policies for Equality Under Low or No Growth: A Model Inspired by Piketty. *Review of Political Economy*, 32(2):243–258.
- Hickel, J. (2015). Forget Developing Poor Countries, It’s Time to De-develop Rich Countries. *The Guardian*, 23 Sept.
- Hickel, J. (2019). The Contradiction of the Sustainable Development Goals: Growth versus Ecology on a Finite Planet. *Sustainable Development*, 274(5):873–884.
- Hickel, J. (2021). What Does Degrowth Mean? A Few Points of Clarification. *Globalizations*, 18(7):1105–1111.
- Hickel, J. and Hallegatte, S. (2022). Can we Live within Environmental Limits and Still Reduce Poverty? Degrowth or Decoupling? *Development Policy Review*, 40:e12584.
- Holden, N., White, E., Lange, M., and et al. (2018). Review of the Sustainability of Food Systems and Transition using the Internet of Food. *npj Science of Food*, 2:18.
- Holodny, E. (2016). The 5,000-year History of Interest Rates Shows just how Historically Low US Rates are Right Now. *Business Insider*, 14 Dec.

- Hopenhayn, H., Neira, J., and Singhanian, R. (2018). From Population Growth to Firm Demographics: Implications from Concentration, Entrepreneurship and the Labor Share. *NBER Working Paper no. 25382*.
- Hopenhayn, H., Neira, J., and Singhanian, R. (2022). From Population Growth to Firm Demographics: Implications for Concentration, Entrepreneurship and the Labor Share. *Econometrica*, 90(4):1879–1914.
- Horowitz, J. (2022). Degrowth: A Dangerous Idea or the Answer to the World’s Biggest Crisis? *CNN Business*, 15 Nov.
- Hossenfelder, S. (2018). The Present Phase of Stagnation in the Foundations of Physics is Not Normal. *Nautilus*, 23 Nov.
- Huebner, J. (2005). A Possible Declining Trend for Worldwide Innovation. *Technological Forecasting & Social Change*, 72:980–986.
- Huggel, C., Bouwer, L., Juhola, S., and et al. (2022). The Existential Risk Space of Climate Change. *Climatic Change*, 174(8).
- Ioannidis, J. (2005). Why Most Published Research Findings are False. *PLoS Med*, 2(8):e124.
- Jackson, T. and Victor, P. (2019). Unraveling the Claims for (and against) Green Growth. *Science*, 366(6468):950–951.
- Johansen, A. and Sornette, D. (2001). Finite-Time Singularity in the Dynamics of the World Population: Economic and Financial Indices. *Physica A*, 294(3-4):465–502.
- Johnson, S. and Kwak, J. (2011). 13 Bankers: The Wall Street Takeover and the Next Financial Meltdown. *Random House: New York*.
- Johnston, R. (2023). Industrial Policy Nationalism: How Worried Should We Be? *Columbia SIPA*, 7 Feb.
- Jones, C. (2022). The End of Economic Growth? Unintended Consequences of a Declining Population. *American Economic Review*, 112(11):3489–3527.
- Kallis, G. (2011). In Defence of Degrowth. *Ecological Economics*, 70(5):873–880.
- Kallis, G. and March, H. (2015). Imaginaries of Hope: The Utopianism of Degrowth. *Annals of the Association of American Geographers*, 105(2):360–336.

- Kaplan, S. (2023). World is on Brink of Catastrophic Warming, U.N. Climate Change Report Says. *The Washington Post*, 20 Mar.
- Kelly, B., Papanikolaou, D., Seru, A., and Taddy, M. (2021). Measuring Technological Innovation over the Long Run. *American Economic Review: Insights*, 3(3):303–320.
- Kendrick, J. (2023). Kate Raworth: Boundaries unleash Creativity. *EU Observer*, 10 May.
- Konczal, M. and Steinbaum, M. (2016). Declining Entrepreneurship, Labor Mobility and Business Dynamism. *New York, Roosevelt Institute*.
- Kose, M. A. and Ohnsorge, F. (2023). Falling Long-Term Growth Prospects: Trends, Expectations, and Policies. *Washington DC: The World Bank*.
- Kotchen, M. (2021). The Producer Benefits of Implicit Fossil Fuel Subsidies in the United States. *Proceedings of the National Academy of Sciences of the USA*, 118(14):e2011969118.
- Kuntz, M. (2012). The Postmodern Assault on Science. *EMBO Report*, 13(10):885–889.
- Kurzweil, R. (2005). The Singularity is Near: When Humans Transcend Biology. *New York: Viking Press*.
- Laeven, L. and Valencia, F. (2020). Systemic Banking Crises Database II. *IMF Economic Review*, 68(2):307–361.
- Lazonick, W. (2014). Profits without prosperity. *Harvard Business Review*, September.
- Lenton, T., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., and Schellnhuber, H. (2019). Climate Tipping Points - Too Risky to Bet Against. *Nature*, 27 Nov.
- Leslie, J. (1996). The End of the World: The Science and Ethics of Human Extinction. *London: Routledge*.
- Ligozat, A., Lefèvre, J., Bugeau, A., and Combaz, J. (2022). Unraveling the Hidden Environmental Impacts of AI Solutions for Environment. *arXiv:2110.11822 [cs.AI]*.
- Loeb, A. (2023). Nothing Lasts Forever. *Medium*, 23 May.
- López, L. and Rodó, X. (2020). The End of Social Confinement and COVID-19 Re-Emergence Risk. *Nature Human Behaviour*, 4:746 – 755.

- Mann, M. (2014). Earth Will Cross the Climate Danger Threshold by 2036. *Scientific American*, 1 Apr.
- Mazzucato, M. (2018). Mission-Oriented Innovation Policies: Challenges and Opportunities. *Industrial and Corporate Change*, 27(5):803–815.
- McAfee, A. (2020). Why Degrowth is the Worst Idea on the Planet. *Wired*, 6 Oct.
- McPhetres, J. and Zuckerman, M. (2018). Religiosity Predicts Negative Attitudes Towards Science and Lower Levels of Science Literacy. *PLoS One*, 13(11):e0207125.
- Meadows, D., Meadows, D., Randers, J., and Behrens III, W. (1972). The Limits to Growth; A Report for the Club of Rome’s Project on the Predicament of Mankind. *New York: Universe Books*.
- Meho, L. I. (2007). The Rise and Rise of Citation Analysis. *Physics World*, 20(1).
- Monbiot, G. (2022). The Banks Collapsed in 2008 - And our Food System is About to do the Same. *The Guardian*, 19 May.
- Morris, I. (2015). Foragers, Farmers, and Fossil Fuels: How Human Values Evolve. *Princeton: Princeton University Press*.
- Murphy, T. (2015). You Call this Progress? *Do the Math Blog*, 16 Sept.
- Naudé, W. (2008). Entrepreneurship in Economic Development. *Working Paper 2008/20, UNU-WIDER, Helsinki*.
- Naudé, W. (2022). From the Entrepreneurial to the Ossified Economy. *Cambridge Journal of Economics*, 46(1):105–131.
- Naudé, W. (2023a). Melancholy Hues: The Futility of Green Growth and Degrowth, and the Inevitability of Societal Collapse. *IZA Discussion Paper No. 16139*.
- Naudé, W. (2023b). Seven Reasons why Degrowth is No Solution to the Ecological Crisis. *Illuminem*, 23 Mar.
- Naudé, W. and Nagler, P. (2018). Technological Innovation, Entrepreneurship and Productivity in Germany, 1871-2015. *SPRU Working Paper Series (SWPS), 2018-02. Science Policy Research Unit, University of Sussex*.
- Nordhaus, T. (2020). Must Growth Doom the Planet? [Review of Growth: From Microorganisms to Megacities, by V. Smil]. *The New Atlantis*, 61:76–86.

- Nordhaus, W. (2021). Are We Approaching an Economic Singularity? Information Technology and the Future of Economic Growth. *American Economic Journal: Macroeconomics*, 13(1):299–332.
- Odum, H. and Odum, E. (2001). A Prosperous Way Down: Principles and Policies. *Boulder, CO.: University Press of Colorado*.
- OECD (2009). Eco-Innovation in Industry: Enabling Green Growth.
- OECD (2011). Towards Green Growth. *OECD Green Growth Studies*. *OECD Publishing, Paris*.
- OECD (2014). Green Growth Indicators 2014. *OECD Green Growth Studies, OECD: Paris*.
- Ord, T. (2020). The Precipice: Existential Risk and the Future of Humanity. *New York: Hachette Books*.
- Park, M., Leahey, E., and Funk, R. (2023). Papers and Patents are Becoming Less Disruptive Over Time. *Nature*, 613:138–144.
- Peters, L. (2015). Sovereignty: The UN and the Westphalian Legacy. *In: The United Nations*. *Palgrave Macmillan, New York*.
- Phillips, L. (2019). The Degrowth Delusion. *Open Democracy*, 30 Aug.
- Piketty, T. (2013). Capital in the 21st Century. *Harvard University Press*.
- Raworth, K. (2017). Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. *London: Random House*.
- Rogoff, K. (2019). Modern Monetary Nonsense. *Project Syndicate*, 4 May.
- Romer, P. (1986). Increasing Returns and Long-Run Growth. *Journal of Political Economy*, 94(5):1002–1037.
- Romer, P. (1987). Growth Based on Increasing Returns Due to Specialization. *American Economic Review*, 77(2):56–62.
- Romer, P. (1990). Endogenous Technical Change. *World Development*, (5):S71–S102.
- Romer, P. (1993). Idea Gaps and Object Gaps in Economic Development. *Journal of Monetary Economics*, 32(3):543–573.

- Romer, P. (2016). The Deep Structure of Economic Growth. *Blog at <https://paulromer.net/economic-growth/>*, 13 Apr.
- Romer, P. M. (1994). The Origins of Endogenous Growth. *Journal of Economic Perspectives*, 8(1):3–22.
- Russell, S. (2019). Human Compatible: Artificial Intelligence and the Problem of Control. *Viking Books*.
- Sagan, C. (1997). The Demon-Haunted World: Science as a Candle in the Dark. *New York: Ballantine Books*.
- Salgado, S. (2020). Technical Change and Entrepreneurship. *Mimeo, Wharton School, Available at SSRN*.
- Schiermeier, Q. (2019). Soviet Unions Collapse Led to Massive Drop in Carbon Emissions. *Nature*, 1 July.
- Schrager, A. (2022). Growth Is Still Our Best Hope. *City Journal*, 21 Nov.
- Schwartzman, D. (2012). A Critique of Degrowth and its Politics. *Capitalism Nature Socialism*, 23(1):119–125.
- Scranton, R. (2015). Learning to Die in the Anthropocene: Reflections on the End of a Civilization. *City Lights Publishers*.
- Shahgedanova, M. and Burt, T. (1994). New Data on Air Pollution in the Former Soviet Union. *Global Environmental Change*, 4(3):201–227.
- Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 70(1):65–94.
- Steen, R. (2011). Retractions in the Scientific Literature: Is the Incidence of Research Fraud Increasing? *Journal of Medical Ethics*, 37:249–253.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S., Fetzer, I., and et al. (2015). Planetary Boundaries: Guiding Human Development on a Changing Planet. *Science*, 347(6223):1259855.
- Stern, N., Stiglitz, J., and Taylor, C. (2022). The Economics of Immense Risk, Urgent Action and Radical Change: Towards New Approaches to the Economics of Climate Change. *Journal of Economic Methodology*, 29(3):181–216.

- Syvitski, J., Waters, C., Day, J., and et al (2020). Extraordinary Human Energy Consumption and Resultant Geological Impacts Beginning around 1950 CE Initiated the Proposed Anthropocene Epoch. *Communications Earth and Environment*, 1:32.
- Tainter, J. (1988). The Collapse of Complex Societies. *Cambridge: Cambridge University Press*.
- Taylor, G. and Vink, S. (2021). Managing the Risks of Missing International Climate Targets. *Climate Risk Management*, 2021:100379.
- Tenreyro, S. (2018). The Fall in Productivity Growth: Causes and Implications. *Bank of England Peston Lecture Theatre, Queen Mary University of London*.
- Ugur, M., Trushin, E., and Solomon, E. (2016). A Firm-Level Dataset for Analyzing Entry, Exit, Employment and R&D Expenditures in the UK: 1997-2012. *Data in Brief*, 8:153–157.
- van den Bergh, J. (2011). Environment versus Growth - A Criticism of Degrowth and a Plea for A-growth. *Ecological Economics*, 70(5):881–890.
- Varieur, B., Fisher, S., and Landrigan, P. (2022). Air Pollution, Political Corruption, and Cardiovascular Disease in the Former Soviet Republics. *Annals of Global Health*, 88(1):48.
- Varoufakis, Y. (2021). Techno-Feudalism Is Taking Over. *Project Syndicate*, 28 Jun.
- Ward, J., Sutton, P., Werner, A., Costanza, R., Mohr, S., and Simmons, C. (2016). Is Decoupling GDP Growth from Environmental Impact Possible? *PLoS ONE*, 11(10):e0164733.
- West, G. (2017). Scale: The Universal Laws of Life and Death in Organisms, Cities and Companies. *London: Weidenfeld and Nicolson*.
- Wiedmann, T., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., and Kanemoto, K. (2015). The Material Footprint of Nations. *PNAS*, 112(20):6271–6276.
- Willett, W., Rockström, J., Loken, B., Springmann, M., and et al. (2019). Food in the Anthropocene: the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems. *The Lancet*, 393(10170):447–492.
- World Bank (2012). Inclusive Green Growth: The Pathway to Sustainable Development. *Washington DC: The World Bank*.
- Zeihan, P. (2023). Deglobalization: Theres No Stopping It Now. *Zeihan on GeoPolitics*, 2 Feb.