Coping with the complexity of socio-ecological systems

Investigating the Degrowth Paradigm through prospective Modeling

Dynamic models of the economy that adequately incorporate different values and high levels of uncertainty can give insights into the effects of degrowth proposals. Participative processes should be used to avoid questionable assumptions about human behavior like the homo oeconomicus.

By François Briens and Nadia Maïzi

The development paths followed by a fraction of humanity in the last decades seem to lead humanity as a whole in front of a complex, multi-dimensional crisis. Non-renewable resources depletion and dramatic environmental impacts, including climate change issues, seriously question the sustainability of the intensive economic metabolism of industrialized societies as well as the possibility to an everlasting match of the fast-increasing world energy and material demands.

As a way to address these issues, many take a stand in favor of green growth, with the hope that technological progress will eventually enable a decoupling of energy and material throughput and environmental burdens from economic growth. Others instead advocate for a specific slowdown of the economic activity in high consumption countries: a sustainable Degrowth (e. g. Kallis 2011; Bayon et al. 2010).

Is Degrowth voluntary?

Throughout the last decade, significant theoretical work has been done to outline the key features of what is now consolidated as a complex and multifaceted political project. For the wealthiest countries, where the ecological footprint per capita is greater than the sustainable global level, Degrowth may be envisioned as a voluntary, socially sustainable, equitable, smooth downscaling of production and consumption, and thus throughput, to an environmentally sustainable level, "that increases human well-being and enhances ecological conditions at the local and global level, in the short and long-term" (Kallis/Schneider 2008).

Another approach is to depict it as a project of transition toward "a society of frugal abundance" (Latouche 2011), a definition that has the merit of challenging a dual presupposition widely admitted in economics, that is original scarcity and boundless human "needs" (Rist 2010).

Modeling for Degrowth

Yet, the possible socio-economic outcomes of such a project still remain uncertain. For instance, while gross domestic product degrowth is not per se an objective of Degrowth, it will very likely be a consequence of the downscaling of production and consumption (Kallis 2011). However, in the current capitalist systems, economic growth may not be an option, but rather a structural imperative stemming from fundamental institutions such as "the use of private property as a collateral, debt, interest rate and credit, and the grow-or-die competition of private enterprises for profit and market share" (Kallis 2011). In this context, an inversion or a slight slowdown in economic growth quickly translates into rising unemployment rates, dramatic social tensions, poverty and increasing government debt in the short term, as well as potential environmental harm in the medium or long term due to lower investments in environmental protection or industrial maintenance (Bayon et al. 2010).

Therefore, several questions remain unanswered, for example: What concrete proposals could initiate and drive such a transition successfully? What could such paths induce in terms of energy consumption, waste production and greenhouse gas (GHG) emission mitigation? What structural or institutional obstacles must be overcome and how? Can a welfare state be sustained in a degrown economy?

Such complex questions call for careful prospective research. In this respect, we propose an approach relying on applied modeling as it may bring valuable elements to the debate.

In what follows, we first highlight some important pitfalls faced when trying to implement a Degrowth paradigm in an applied macro-economic modeling framework. Then we describe the approach and the model we developed, and finally, briefly present an example of how a Degrowth proposal can be implemented in our model.

Preliminary Concerns

Taking an applied modeling approach to Degrowth requires specifying two points. Firstly, it has to be defined how Degrowth would concretely be translated and implemented into a modeling framework and secondly, the criteria for the assessment of Degrowth scenarios have to be defined.

One possible approach to operationally translate the Degrowth project into elements that can be processed within an applied modeling framework is to consider concrete tentative political proposals emerging from the Degrowth movements.

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These reflect a great variety, including for instance taxation or pricing mechanisms, but also, and more importantly, cultural and fundamental changes in the behavior of economic agents, which may bring into question the core aspects of mainstream economic theories (e. g. not-for-profit organizations, commons, and voluntary simplicity, versus profit and utility maximization). Some proposals also suggest a redefinition and reorientation of technical progress (e. g. selective moratoria on technologies, switching from industrial agriculture to agroecology, small-scale and organic farming), while others involve structural changes in the economy (e. g. localization), or transformations of fundamental institutions such as money and credit. Besides, many of these proposals arise from systemic considerations, and are designed and intended to be combined and to work as a system. For instance, an unconditional autonomy allowance is seen as paired with an income ceiling, and complemented with work-sharing (Liegey et al. 2013), while the transformation of the money creation system is considered as an indispensable measure to accompany the expected contraction of the economy (Farley et al. 2013). Hence, exploring Degrowth scenarios and strategies requires simultaneously implementing combinations or sets of these proposals of different nature and scale.

A second point to be addressed refers to the choice of appropriate criteria for assessing the Degrowth scenarios we want to model. This choice remains highly subjective and value-laden. Therefore, in the absence of a clear consensus, which may never exist, the inclusion of a sufficiently broad range of detailed indicators of both socio-economic and biophysical natures is welcome. In order to match the minimum requirements of value pluralism, this set of indicators should enable assessments based on different valuation systems, and make it possible to reflect and account for possible trade-offs.

These two points illustrate the complexity of the challenges of covering and dealing with the diversity of Degrowth proposals and with the variety of the indicators.

When old recipes appear inappropriate

One approach commonly used to provide possible visions of the future consists in identifying and extrapolating historical trends and behaviors. While this option has the advantage of providing empirical foundations, it may however quickly show its limits for our purpose. Since it relies on statistical stabilities and regularities produced by institutional systems, whose own stability is inevitably local and temporary, the validity of this approach is generally restricted to local, short-term issues (Costanza/Ruth 1998). This is not our case. Degrowth proposals imply a joint mutation of values, institutions and structures, which may compose a significantly different context with no historical precedent, and generate new system behaviors, rendering extrapolative approaches and estimates based on the past obsolete. Yet, a retrospective diagnosis remains an indispensable step to identify and understand drivers and inertias from the past that may sometimes still occur.

An alternative option lies within micro-funded approaches, which aim at determining agents' behavior from deep parameters, motivations, or rules that are assumed to be policy-invariant and to persist over time. Agent-based models and Computable General Equilibrium models follow this approach. However, suggesting invariant determinants for social agents' behaviors remains a bold and rather arbitrary task, given that human and social behaviors always involve plural value systems, which are constantly subject to change.

The reductionist utilitarian homo oeconomicus paradigm is one such approach and still the most commonly used in macro-economic modeling. Theoretically and conceptually flawed, misrepresentative and practically inoperative for quantitative applied modelling, it is also fundamentally unsuitable and irrelevant to the very object of our focus. In particular, it excludes a priori pro-social and pro-environmental behaviors and lifestyles, leaves no room for options like voluntary simplicity, or ignores or implicitly assumes away psychological and social mechanisms or processes that Degrowth proposals draw upon. Much more comprehensive conceptual models of agents' behavior would be needed if such an approach is to be employed to study Degrowth. However, let alone quantification and data availability issues, one can fear that sophisticated behavioral models would introduce a much higher level of complexity in the modeling tool, raising further epistemological issues.

Dealing with uncertainty

This takes us to the core difficulty of our project, which is dealing with the inherent dual complicatedness and complexity of societal and ecological systems. A model generally consists in a simplified representation of a perceived, complicated or complex subset of reality, whose fundamental aim is to provide intelligibility. However, on the one hand, drastic simplifications in models always bear the risk of mutilating reality and yielding misleading results. On the other hand, if system complexity may be preserved to some extent, this generally comes at the expense of intellectual accessibility (Oreskes 2000). Indeed, in many cases developing, using and understanding models has remained the privilege of a small community of experts and modelers, while outsiders have been left with so called take-it-or-leave-it results generated by what they see as black boxes (Funtowicz/Ravetz 1992).

Developing applied macro-models to explore Degrowth scenarios thus requires adopting a delicate compromise between representativeness and intelligibility, which takes us back to an old dilemma, that is, to paraphrase Paul Valery (1942): "Ce qui est simple est toujours faux; ce qui ne l'est pas est inutilisable" (what is simple is wrong, what is not is unusable). Given that, as Andersson et al. (2013) put it, "no realistic levels of realism beats chaos for very long", we are inclined to think that priority would more usefully be put on intelligibility and transparency here.

Finally, it also follows from the above that an applied modeling approach to Degrowth cannot dispense with adequate management of uncertainty. This may involve short-term simulations to test models, sensitivity analyses, and the assessment of a wide diversity of what-if scenarios reflecting different narratives, so as to explore the variety of potential outcomes under alternative assumptions, or courses of action or inaction (Oreskes 2003).

Description of our approach

Bearing in mind the previous considerations, we have developed a dynamic simulation macro-model of the French formal economy [1]. Dynamic features may indeed be preferable to static or stationary models when exploring the impacts of Degrowth proposals that may drive the socio-economic system outside its standard conditions of evolution. Where the latters might reach unrealistic equilibriums, dynamic models may still provide valuable information on the transitory dynamics and on the path followed by the system before it reaches critical states.

In order to capture the impact of qualitative and structural changes in lifestyles, institutions and in the economy that Degrowth narratives imply, our model features a sectorial disaggregation of the French economy into 37 branches and a detailed representation of the French fiscal apparatus and public administration budget. It has been built using public data from the French national accounts, and from the French national statistics institute (INSEE), mainly for the period from 1978 to 2012. The model allows us to run medium to long term simulations starting in 2010 and up to 2050 and after.

Describing the model in a nutshell, the production is driven by the final demand for each branch, via an input-output analysis. The level of production for each branch determines the amount of investment and labor required, on the basis of hypotheses about the evolution of the productive combination. Socio-economic outcomes, including employment and unemployment, inequalities and poverty, public budget balance and debt, depend on the choice of working time, public expenditures, fiscal and redistributive policies. Energy consumption, GHG emissions and waste production are inferred from the production structure and level, using intensity coefficients computed for each branch, and from detailed hypotheses on the evolution of lifestyles. For the sake of simplicity, there is no explicit monetary sector in our model.

With a similar concern for transparency and intelligibility, uncertain parameters and relationships related to highly complex or poorly understood mechanisms, or deriving from agents' behaviors and political choices, are kept exogenous and are subject to sensitivity analyses. This is in particular the case for the most organic elements of our model. These are evolution of lifestyles, implementation of degrowth-oriented practices and possible changes in consumption patterns, from which the final demand derives. For such elements, we chose to implement participative schemes involving the consultation and participation of lay citizens through open focus groups. The main objective of these focus groups is to discuss jointly in what possible, desirable or acceptable proportions degrowth proposals may emerge and diffuse, and consequently, the extent to which each component of the demand could evolve. These results, as well as additional suggestions from participants, will thus provide the narrative backbone for scenario building. Embedding our macro-economic model into a participative narrative-based framework makes it a powerful instrument for social learning and consensus building.

The Example of Co-housing

Among the elements brought by this modelling approach, one is to carry sensitivity analyses on different parameters affected by Degrowth proposals in order to explore their possible socio-economic and environmental impacts, and thus to identify leverages that could play a key role in a Degrowth transition.

With the example of co-housing, which implicitly involves sharing and commoning practices, this proposal can be reflected by an evolution of the average size of households. Then, discerning the households-proportional from the population-proportional components of demand makes it possible to explore the potential impacts of household size. By doing so, we find for instance that the low household size projection from the INSEE, which corresponds to a trend decline from 2.27 people per household in average in 2010 to 2.07 by 2030, induces about 3 percent more final energy consumption. It also induces about 1.7 percent more GHG emissions in 2030 to match the related increase in demand, than if the average household size were to remain constant at its 2010 value. On the contrary, coming back to the 1990 average household size, a linear increase from 2.27 to 2.59 people per household, would yield lower final energy consumption and GHG emissions from production respectively by about 3.9 percent and 2.2 percent with respect to the constant household size scenario. This illustrates the potential impact of such non-technical proposals related to lifestyle changes.

In the same way, combining different proposals into various scenarios will make it possible to study interactions or synergies, and to identify Degrowth strategies that may have a relevant potential for addressing both environmental and socio-economic issues.

Conclusion

In order to explore some possible socio-economic and environmental outcomes of Degrowth scenarios, we have developed a specific approach, involving participative surveys and supported by ad-hoc macro-economic modeling. Our preliminary results, deriving from sensitivity analyses, already demonstrate the importance of structural, cultural and social, non-

technical factors involved in or influenced by Degrowth proposals. They suggest that energy and environmental issues cannot be considered apart from broader societal projects. Further results, including scenario modeling and assessment, are to come soon.

Of course, in addition to the inherent complexity of natural and social systems, the qualitative nature of many Degrowth proposals remains a major obstacle to its transcription within an applied modeling framework. Yet, applied modeling may still prove valuable to the Degrowth debate. If used critically and with circumspection to question our intuitions and beliefs, it may help open the way to alternative social imaginaries and thus, together with voluntary social experiments that it cannot substitute, contribute to the continuous collective elaboration of a new societal paradigm. Let us take care not to fall along the way into what Alfred North Whitehead (1925) has termed "The Fallacy of Misplaced Concreteness".

Annotation

[1] Our model has been developed with the system dynamics modeling software STELLA.

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AUTHORS + CONTACT

Nadia Maïzi is Professor at the Center for Applied Mathematics at MINES Paris Tech.

Nadia Maïzi, MINES ParisTech, PSL – Research University, CMA-Center for Applied Mathematics, CS 10207 – 1, rue Claude Daunesse, 06904 Sophia Antipolis Cedex, France.
Email: nadia.maizi@mines-paristech.fr,
Phone: +33 497 157 079.

François Briens is researcher at the Center for Applied Mathematics at MINES Paris Tech.

François Briensis, MINES ParisTech, PSL – Research University, CMA-Center for Applied Mathematics, CS 10207 – 1, rue Claude Daunesse, 06904 Sophia Antipolis Cedex, France.
Email: francois.briens@mines-paristech.fr,
Phone: +33 497 157 078.