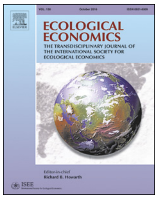
Ecological Economics 152 (2018) 118–130

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon



Can degrowth overcome the leakage problem of unilateral climate policy?

Mario Larch[a], Markus Löning[b], Joschka Wanner[c,*]

[a] University of Bayreuth, CEPII, CESifo, GEP at University of Nottingham, and Ifo Institute, Universitätsstrasse 30, Bayreuth 95447, Germany
[b] The Chorley Institute, Department of Geography, Pearson Building, University College London, Gower Street, London WC1E 6BT, UK
[c] University of Bayreuth, Universitätsstrasse 30, Bayreuth 95447, Germany

ARTICLE INFO

JEL classification:
F18
Q54
Q57

Keywords:
Degrowth
Climate policy
Gravity model
Carbon leakage

ABSTRACT

Unilateral climate policy suffers from carbon leakage, i.e. the (partial) offset of the initial emission reduction by increases in other countries. Different than most typically discussed climate policies, degrowth not only aims at reducing the fossil fuel use in an economy, but rather (besides other social and political goals) at a reduction of all factor inputs, which may lead to different leakage implications. We conduct the first investigation of degrowth in a multi-country setting in order to (i) compare the leakage effects of national pure emission reduction policies to degrowth scenarios, (ii) identify underlying channels by decomposing the implied emission changes into scale, composition, and technique effects, and (iii) investigate which country characteristics determine degrowth's relative effectiveness to overcome the leakage problem. Using a structural gravity model, we find that degrowth indeed significantly reduces leakage by keeping the sectoral composition of the country more stable and reducing uncommitted countries' incentives to shift towards more energy-intensive production techniques. The higher effectiveness of degrowth in reducing carbon emissions is most pronounced for small and trade-open economies with comparatively clean production technologies.

1. Introduction

The relationship between unilateral climate policy and international trade has been of major interest in the last years. The focus of attention has been on carbon leakage. Leakage occurs if emission reductions in one country are offset by emission increases elsewhere (Felder and Rutherford, 1993). It mainly works through two channels: First, stricter climate policy in one country will lead to higher carbon prices (e.g. through carbon certificates, taxes, or regulations). This will make carbon-intensive production relatively more expensive in that country. In response, production in strongly affected sectors may relocate to other countries with laxer climate policy and increase emissions there. Carbon-intensive goods can then be redistributed to the first country via international trade. Second, stricter climate policy in one country will lead to lower energy demand, which in turn leads to a fall of the price for energy on the world market. In response, other countries may use more energy in production relative to other factor inputs and hence increase emissions. In this case, climate policy leads to an adjustment of energy intensities via the international energy market (see e.g. McAusland and Najjar, 2015).

The obvious and ideal solution to overcome carbon leakage is a globally coordinated climate policy which involves all countries (see e.g. Branstetter and Pizer, 2012). The Paris Climate Agreement marks an important step in this direction. However, past negotiations have highlighted the difficulty to coordinate and enforce targets on a global level. The Paris Agreement relies on targets which are individually determined and not internationally enforceable. If some countries fail to submit or fulfil their targets, sub-global initiatives will prevail. Hence, a better understanding of unilateral action remains important.

Besides global climate policies, one approach that may be capable of reducing carbon leakage is degrowth. Degrowth has been proposed by a growing group of authors as an alternative to more conventional measures such as pure emission targets.[1] As a climate policy, we take degrowth to imply not only an emission reduction, but also the downscaling of the economy as a whole. In particular, we assume degrowth to restrict the quantity of available factor inputs (e.g. work time, natural resources and land). With restricted factor inputs, production will be reduced. Since degrowth additionally decreases income through reduced factor incomes and hence demand, the decline in carbon-intensive production is less likely to be compensated by an increase in production abroad. Degrowth can therefore potentially limit leakage.

The interest in degrowth and related fields (such as steady-state economics, ecological macroeconomics, prosperity/managing without growth,

---

* Corresponding author.
E-mail address: joschka.wanner@uni-bayreuth.de (J. Wanner).

[1] Key contributions to the degrowth literature are e.g. Victor (2008), Jackson (2009), Paech (2012), Dietz and O'Neill (2013), D'Alisa et al. (2014). The current degrowth literature is strongly inspired by the seminal works of Daly (1972, 1996), Georgescu-Roegen (1971, 1977), Meadows et al. (1972). For recent literature surveys, see e.g. Weiss and Cattaneo (2017), Hardt and O'Neill (2017), Urhammer and Røpke (2013), Kallis et al. (2012), Martínez-Alier et al. (2010).

https://doi.org/10.1016/j.ecolecon.2018.05.026
Received 9 November 2017; Received in revised form 12 May 2018; Accepted 29 May 2018

and Postwachstum, sometimes jointly summarised as post-growth) has considerably grown during recent years. Contributions to these fields are diverse. There is no single account of what exactly degrowth means and what precise policies would follow from it (see e.g. van den Bergh, 2011). Degrowth proponents generally argue for a broader set of social and political goals based on a deeper transformation of the social and economic system as a whole. Common goals include the reduction of poverty and income and wealth inequality, full employment, the promotion of international cooperation, as well as the development of new indicators of human well-being (see e.g. Victor, 2008; Jackson, 2009; Dietz and O'Neill, 2013; D'Alisa et al., 2014). Regarding climate policy, most authors agree that at least a temporary downscaling or stabilisation of the economy is necessary to reach an ecologically sustainable level. However, the aim is not to shrink the economy per se. Rather, due to the high degree of coupling between economic activity and environmental impact, a reduction of the economy as a whole is deemed inevitable in order to reduce and stabilise the impact on the environment (see e.g. Schneider et al., 2010; Kallis, 2011; Research & Degrowth, 2010).

One strand of empirical research on degrowth is based on the LowGrow model developed by Victor and Rosenbluth (2007) and Victor (2008, 2012). LowGrow results suggest that degrowth can substantially decrease emissions for Canada and at the same time improve welfare in terms of poverty, inequality, adult literacy and longevity when appropriately adjusting tax rates and public spending on health care and education. Similar results have been obtained when models inspired by LowGrow were developed for the German and French economy (see Gran, 2017; Briens and Maïzi, 2014a,b, respectively).

A second line of research is centred around the system dynamics models developed by Jackson et al. (2016), Jackson and Victor (2015, 2016), Jackson et al. (2014), and Naqvi (2015). SIGMA and FALSTAFF based studies show that declining growth rates need not lead to higher inequality (Jackson and Victor, 2016) and that zero growth can be stable in the presence of interest-bearing debt (Jackson and Victor, 2015). The ECOGRO model incorporates environmental extensions to SIGMA and FALSTAFF and is used to explore different policy scenarios including a degrowth scenario wherein household and government consumption are reduced by 10% leading to a reduction of more than 2% in output, real income and emissions (Naqvi, 2015).

All of these studies rely on a single-economy model. We therefore take a complementary approach to previous studies by investigating degrowth scenarios in a multi-country general equilibrium framework. The goal of this paper is to investigate how the embedding of a country into the world economy affects the consequences of national degrowth scenarios. We compare a pure emission reduction policy wherein the policy country only reduces its energy usage to degrowth scenarios in which it also reduces other factor usages. We investigate the emission effects in both the policy country and all other countries, additionally making use of a decomposition of emission effects into scale, composition, and technique effects. Further, we try to identify the driving mechanisms that determine in which macroeconomic circumstances the differences between the pure energy reduction scenario and degrowth scenarios are particularly pronounced.

The extended version of the structural gravity model developed by Larch and Wanner (2017) is especially appropriate for this purpose. The model incorporates a sectoral production structure with varying energy intensities. A trade model with such a sectoral structure is well suited to capture the first, trade-driven leakage channel. The additional inclusion of a separate energy sector in which prices can adjust endogenously and which uses an internationally tradable energy resource (such as oil or other kinds of fossil fuels) allows to take into account the second, energy-market leakage channel. Different from classical quantitative trade gravity models,[2] this model also includes two economy-environment links. One channel works through the production structure which uses energy as an input factor and generates emissions as a side output. The other channel works through the utility function in which higher global emission levels negatively affect welfare. While we hold this model structure to be well suited to consider the trade and leakage effects of degrowth scenarios, it restrains us from considering a number of other important questions related to degrowth, such as distributional consequences within countries, alternative welfare indicators, or questions related to the monetary system.

The remainder of this paper is organised as follows. Section 2 introduces the structural gravity model with energy production by Larch and Wanner (2017) and the decomposition of the total emission effects and describes how the different emission reduction and degrowth scenarios can be implemented in this framework. Section 3 describes the data set. Section 4 discusses the results of the counterfactual analysis. Section 5 concludes.

2. Structural Gravity with Energy Production

This section introduces the multi-country, multi-sector, multi-factor structural gravity model by Larch and Wanner (2017, henceforth LW). Specifically, we use the model extension presented by LW which incorporates energy production in order to allow for leakage effects via the international energy market. We show how to implement counterfactuals including fixed emission targets and degrowth scenarios in their model. For brevity, we only give the most important equations in the main text and delegate further formal details to the Online Appendix.[3]

2.1. Supply Side

On the supply side, the model incorporates one non-tradable goods sector S, a set $\mathscr{L}$ of L tradable goods sectors and a separate energy sector E in each of the N countries. Input factors are skilled and unskilled labour, capital, land, natural resources, jointly summarised in set $\mathscr{F}$, energy E, and an international energy resource R. Let countries be denoted by superscript i, sectors by subscript S, l and E, and factors by subscript f, E and R.[4] Output in tradable sector $l \in \mathscr{L}$ in country i (q_l^i) is modelled by a Cobb-Douglas production function:

$$q_l^i = A_l^i (E_l^i)^{\alpha_{lE}^i} \prod_{f\in\mathscr{F}} (V_{lf}^i)^{\alpha_{lf}^i}, \tag{1}$$

and accordingly in the non-tradable sector. A_l^i is a sector- and country-specific productivity parameter, E_l^i denotes the use of the factor energy, and V_{lf}^i denotes the use of factor $f \in \mathscr{F}$ in sector l in country i. The energy sector is neither part of the non-tradable nor tradable goods sectors. It has a separate production function given by:

$$E^i = A_E^i (R^i)^{\xi_R^i} \prod_{f\in\mathscr{F}} (V_{Ef}^i)^{\xi_f^i}, \tag{2}$$

where R^i is the use of the internationally freely tradable energy resource with exogenous global supply R^W as in Egger and Nigai (2015). E^i denotes the total energy output, while E_l^i denotes the sector specific energy input. Note that energy and emissions are denoted by the same variable. Given the very high correlation between energy use and emissions (cf. e.g. Egger and Nigai, 2015), they are assumed to be directly proportional. According to the Cobb-Douglas structure, the α and ξ parameters denote factor cost shares in production, with $\alpha_{lE}^i + \sum_{f\in\mathscr{F}} \alpha_{lf}^i = 1$, $\alpha_{SE}^i + \sum_{f\in\mathscr{F}} \alpha_{Sf}^i = 1$, and $\xi_R^i + \sum_{f\in\mathscr{F}} \xi_f^i = 1$.

The assumption of Cobb-Douglas production functions allows an

---

[2] See Eaton and Kortum (2002) and Anderson and van Wincoop (2003) for seminal contributions in the field and Head and Mayer (2014) for a survey.

[3] The Online Appendix contains a list of variables and parameters, detailed model derivations, detailed descriptions of how to solve the baseline and counterfactual model, tables with the sector and country aggregation, and some additional tables and figures with results.

[4] Whenever necessary, additional superscripts j and k are used for countries, subscript m for tradable sectors, and subscript g for factors.