

Title:

Decoupling, Interest Rates, and the Environmental Impact of Intermediate Production in an Ecological Stock-Flow Consistent Input-Output Model

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Extended Abstract:

This paper builds upon and extends previous work on Stock-Flow Consistent Input-Output models (SFCIO model) [1] to explicitly incorporate stocks of natural resources. The model is used to demonstrate that different compositions of gross output can have different environmental impacts, even if final GDP is the same for both compositions of gross output. The model is used to analyze the issue of decoupling economic growth from environmental impacts, to determine whether or not conditions of environmental sustainability and economic growth are compatible, and the different environmental and economic impacts of using renewable vs. non-renewable energy sources. Assets other than money, including bonds and equities, are added to the model, and the conditions under which positive interest rates are compatible with a non-growing economy are considered. Additional economic features are added to the model, including an ex-ante/ex-post treatment of time and capacity utilization targeting by productive industries.

a) Explicit Incorporation of Stocks of Raw Materials and Natural Resources

Although there do exist Environmentally-Extended Input-Output models (EEIO models), those models typically do not explicitly incorporate stocks of raw materials and natural resources from the physical environment. Instead, they typically calculate the flow quantities of raw materials and natural resources that would be required to produce a given vector of total output. As a result of this way of treating raw materials and natural resources, it is not possible for there to be shortages of natural resources. Instead, it is simply implicitly assumed that an infinite quantity of natural resources are available for human use in the natural environment. However, in this model, we make no such assumption, and the flow of raw materials and natural resources from the physical environment must be extracted from the earth, which contains a limited quantity of any given raw material or natural resource. In the model, if not enough of the required raw materials and natural resources are available to produce a desired amount of output, then that output cannot be produced. There are therefore environmental limits to economic activity in the model. Some part of raw materials and natural resources can be recycled, while other parts go to waste and cannot be re-used for economic activity. In particular, non-renewable resources cannot support sustainable economic activity, and the model is thus able to illustrate the need for a transition to economic activity which is based upon renewable resources.

b) Positive Interest Rates in a Stationary Economy

In the light of the Stock-Flow Consistent Input-Output model of [1], we investigated whether a stationary economy is compatible with positive interest rates – or if the monetary production economy is subject to a growth imperative. We concluded that the stability of the stationary state depends on the interplay between interest rates and the parameters of the consumption function. However, this analysis was based on a model containing only loans and money deposits, and could not incorporate the more complex financial interaction of maturity transformation, liquidity preference, and different marginal propensities to save that were considered as relevant determinants of a growth imperative in [2,3]. By adding additional financial assets, portfolio decisions and the interplay of different interest rates can be considered explicitly.

c) Decoupling and the Composition of Gross Output

Finally, the paper considers the issue of whether economic growth can be “decoupled” from environmental impacts. We argue that the issue of decoupling cannot be properly analyzed just in terms of GDP, but rather must consider the composition of gross output. The model is used to analyze a transition from an economy which predominantly uses non-renewable energy sources to an economy which predominantly uses renewable energy sources. We find that different compositions of gross output have different environmental impacts, even if overall GDP is the same. The question, therefore, is not as simple as whether or not GDP can increase. Instead, an economy could grow in an environmentally sustainable manner if there are appropriate changes in resource use and in the structure of intermediate production. Or, alternatively, given that current levels of fossil-fuel based economic activity are not environmentally sustainable, the environmental impact of the economy could be reduced by maintaining (or lowering) the current level of GDP but altering resource use and the structure of intermediate production. If a given use of natural resources and raw materials is consistent with environmental sustainability, there may be more than one composition of gross output – and hence more than one level of overall GDP – which is compatible with environmental sustainability.

References:

- [1] Matthew Berg, Brian Hartley and Oliver Richters (forthcoming January 2015): “A *stock-flow consistent input-output model with applications to energy price shocks, interest rates, and heat emissions*.” New Journal of Physics.
- [2] Wenzlaff, Ferdinand, Christian Kimmich and Oliver Richters (2014): “Theoretische Zugänge eines Wachstumszwangs in der Geldwirtschaft”. Discussion Paper, Centre for Economic and Sociological Studies, Hamburg University, ISSN 1868-4947/45.
- [3] Kimmich, Christian und Ferdinand Wenzlaff (2013): Structure and Agency in the Dynamics of Growth: A monetary macroeconomic equilibrium perspective on growth imperatives and stagnation. ESEE conference ‘Ecological Economics and Institutional Dynamics’, Lille.