Mitigating Climate Change through Greener Consumption Patterns: an application of the AD-DICE model

Integrated Assessment Models (IAMs) are often applied to estimate the effects that mitigation will have on future climate change damages. Furthermore, optimal mitigation strategies are suggested based on IAMs. In these models mitigation is modelled as changes in energy production methods, where greener energy technologies can be used which results in fewer emissions per unit of energy produced.

Mitigation may also, however, originate from changes in consumption patterns. Consumers may wish to switch consumption from dirtier to cleaner products. The production of certain goods inherently causes more Greenhouse gas (GHG) emissions than the production of others. This form of mitigation is not explicitly considered in such models.

In this paper we wish to distinguish between mitigation in the form of using alternative energy sources and mitigation in the form of consumption mix changes. This can help us understand the extent to which we can limit GHG emissions by diverting our consumption from dirty to cleaner products.

To address this issue we disaggregate the production function of an IAM (namely AD-DICE) into three types of production: clean, moderate and dirty production. The AD-DICE model is an IAM based on DICE including two distinct adaptation decision variables besides the original mitigation variable of DICE (de Bruin et al. 2009). The AD-DICE model is an aggregated global model, though sometimes simplistic this model serves our purpose well as a first analysis of the effects of global consumption patterns.

Based on data from the GTAP database version 8.1 (Narayanan, Aguiar and McDougall, 2012), we estimate the production shares of these three categories of goods and their substitutability. This is done in two steps. Firstly, we aggregate the 57 sectors in GTAP Data Base into these three categories, based on their CO2 emissions, associated with both their production and consumption. By doing so, we attempt at considering these categories in the light of their ‘dirtiness’ more holistically than just by looking at production or consumption. In other words, for example, coal production may not be as 'dirty' as textile production, but coal consumption is definitely dirtier than textile consumption. If we were to just classify based on emissions from production, therefore, there is a risk of coal being a cleaner product than textiles are. We avoid such situations by our way of classification. Secondly, we aggregate the consumption demand parameters in the GTAP model (Hertel, 1997), which are based on Constant Difference Elasticity function (McDougall, 2002), to these three types of production, after obtaining their implied own-price and cross-price elasticities, by simulating a numeraire shock to the standard GTAP model. By this methodology, we obtain two different sets of elasticities: Allen’s partial elasticity of substitution and uncompensated cross-price elasticity of household demand. The

We also calibrate energy savings mitigation cost function (i.e. the traditional mitigation cost functions) for each production type. With this model we can estimate to which extent dirtier goods can be substituted with cleaner goods in order to limit climate change and its effects.

We expect to find a consumption shift towards cleaner products when climate change is taken into account. The magnitude of this is, however, limited due to the imperfect substitution between clean and dirty goods.

References:

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