Multi-regional Comparison of Carbon Footprint Taxation schemes

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Abstract: In this paper we investigate the effects of two types of taxation reforms on carbon emissions by using a global multi-regional model approach. We take into account not only domestic emissions but also indirect and induced emissions thereby covering the carbon footprint. We compare two schemes that tax production-based and consumption-based carbon footprints in each of the EU27 member states and investigate the effects of these tax reforms in each country as well as EU-wide as an unilateral ambition to reduce the global footprint. Tax revenues are in all cases 100 % recycled via lower social security revenues. The analysis is executed with the ADAGIO (A Dynamic Global Input-Output) model that is based on Supply and Use Tables of 67 countries and covers 59 industries. We expect that the effect of the tax reform on carbon footprint, carbon leakage as well as on socio economic factors is different in each country based on its economic structure, the trade balance, energy system and the feedback effects due to price reactions in consumption and production. The results are work in progress at the moment.

Keywords: Multi-regional, Input-Output, carbon footprint, carbon taxation,

INTRODUCTION

The Paris agreement set out a global action plan to limit the global warming to below 2°C. To achieve this goal global action is needed and various instruments are investigated. One of the discussed instruments is the pricing of CO_2 emissions. If this is undertaken in one single world region in form of an unilateral climate policy this leads to several problems challenging the competitiveness of such a region and the global effect of the policy. One of the central problems is described as "carbon leakage" where the energy and emission intensive production is reallocated towards regions that do not face carbon constraints. Another indirect effect is the so-called "green paradox" effect where the decreasing demand of fossil fuels – due to climate policies - in one major world region leads to decreasing prices of fossil fuels on the world market. This constellation could lead to increasing demand in other regions due to these low prices and to lock-in effects in the capital stocks of manufacturer and consumer. Large parts of the literature have investigated the effects of border tax adjustments which potentially dampen the negative effects (Eichner and Pethig, 2015, or McAusland and Najjar, 2015). Some studies (McAusland and Najjar, 2015) discussed an alternative approach about taxing carbon footprint and developed a theoretical framework of the implementation of taxes on production-based and production-based carbon footprints. Sommer and Kratena (2016) attempted to add comparative empirical analysis to this discussion by applying the theoretical framework of carbon footprint taxation into an single-region model of the EU27 by simulating a traditional CO_2 taxation in the domestic production and an environmental fiscal devaluation via taxes on consumption commodities. This paper attempts to extend this study.

METHODS

This paper combines the frameworks of two studies and extends the approach from a single-region to a multi-region model. The first study (Sommer and Kratena, 2016) contains a model-based approach to calculate carbon footprints of each consumption commodity (COICOP classification) of a representative private household of the aggregated EU27. The applied model - the DYNK (DYnamic New Keynesian) - is a hybrid between an econometric IO and a CGE model and is c characterized by the integration of rigidities and institutional frictions. In the long-run the model works similar to a CGE model, and explicitly describes an adjustment path towards a long-run equilibrium. The term 'New Keynesian' refers to the existence of a log-run full employment equilibrium, which will not be reached in the short run, due to institutional rigidities. These rigidities include liquidity constraints for consumers (deviation from the permanent income hypothesis), and wage bargaining (deviation from the competitive labour market). The model describes the interlinkages between 59 industries as well as the consumption of five household income groups by 47 consumption categories and covers the EU 27 (as one economy).

The second study (Sommer and Kratena, 2015) applies two different tax reform schemes of carbon taxation based on recent studies (McAusland and Najjar, 2015) in the DYNK model for the EU27. The two tax reform schemes differ mainly in where the taxation takes place and the emissions covered. The first reform resembles the classical 'Green Tax Reform' (GTR) where direct domestic CO_2 emissions of the domestic production sectors are taxed. The second is an 'Environmental Fiscal Devaluation' (EFD) where CO_2 emissions embodied in private consumption are taxed at the same rate and on the same increasing scale as in GTR above. In both cases social security contributions (employers' and employees') are reduced simultaneously so that (ex post) public revenue neutrality is guaranteed. This tax reform can be seen as a special case of fiscal devaluation, i.e. a change in the tax system that mimics the price effects of a devaluation of the currency by rising taxes on consumption (higher prices of domestic consumption) and lowering taxes on labour (lower prices of exports). In the case of EFD consumption prices rise due to taxation of embodied emissions, and export prices decrease due to lower social security contribution. Note that in the concept of 'Environmental Fiscal Devaluation' all consumption goods are taxed irrespective of their origin, so that no inconsistency with international trade agreements arises.

In this paper both approaches are combined and transferred from the single-region "DYNK" model into a multi-regional model "ADAGIO" (Kratena and Streicher, 2014) that is part of the "DYNK" model family, contains 67 countries and covers about 85% of the world GDP. In a first step the carbon footprint of each country of the EU27 is calculated in accordance with Sommer and Kratena (2016). Based on this calculated carbon footprint and specific carbon prices and we derive a set of tax rates (irrespective of origin) that we apply in the second step on commodities of private consumption (Environmental Fiscal Devaluation) and manufacturing (Green Taxation) as in Sommer and Kratena (2015). The results of a single-country tax reform are in a last step compared with an unilateral EU-wide tax reform. Advantages and disadvantages of both tax reforms (consumption-based and production-based) and both regional applications (EU-wide and single) are discussed.

FINDINGS AND ARGUMENT

The effects of the tax reforms on carbon footprint, carbon leakage and economic performance (GDP, employment) for each of the EU-member states as well as the EU27 as single economy are results of the simulations. We expect that the effects are different in each country based on the economic structure, the trade balance, energy system and the feedback effects due to price reactions in consumption and production. Thus the results allow a comparison of the effectiveness of these instruments amongst the EU member states.

The results are work in progress at the moment. At the Workshop (30.3.) we will present the preliminary results and the approach in detail.

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