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Simulating the economic impact of resources depletion using a computable general equilibrium model for Romania

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Abstract

Resources depletion is a pressing problem affecting the today's economies with multiple implications on the economic activities and main economic indicators. In this context, the paper builds a computable general equilibrium model capturing the mechanisms through which the availability of energy resources affect the economy. The analysis focuses on fossil energy resources depletion. The model is an open economy general equilibrium model with bilateral trade and a nested CES production function to capture the impacts of depletion. The effects on the main relevant economic indicators like: GDP, sectorial production, household consumption, welfare are analyzed.

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Keywords: resources depletion; fossil energy resources; computable general equilibrium model; economic indicators; economic activities;

1. Introduction

General equilibrium models are frequently used in testing and substantiating the economic policies. Their applications include environmental policies (Capros et al. 2013, Kouvaritakis et al. 2005), taxation policies and

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economic development (Mohora 2006, Perry et al. 2001), international trade (Martin and Winters 1996; Harrison et al. 1997).

The paper builds a general equilibrium model that describes the working of a small open economy like Romania. The characteristics of the Romanian economy are reflected in the calibration of the economic agents' behavior functions parameters based on the available data.

The objectives of the paper are two folded. First of all, it aims at presenting the characteristics of a general equilibrium model and its' behavior functions. Second of all, it analyzes the economic impact of fossil energy depletion. The analysis focuses on the impact of the shocks on: a) the domestic price of fossil energy; b) the international price of fossil energy and the impact of subsidies for alternative energy resources on key economic variables like: sectorial production, welfare.

2. Literature review

The negative impact of the greenhouse gases and the increase demand for environmental policies (see European Commission 2011a, 2013, 2014) generated an increase connectivity between energy resources deplation and climate change analyses. Frequantly used approaches in these areas are integrated assessment models (Nordhaus 1991, Ackerman and al 2009), general equilibrium models (Capros and al 2013, Kouvaritakis and al 2005) and the cost-benefit analysis of climate policies where one of the main instruments are the marginal abatement cost curves (Vogt-Schilb and Hallegatte 2014, IEA 2010).

The methodology used in this paper follows the direction established by the general equilibrium models. This represents a major research direction used in fundamenting economic policies. From this perspective the European Commission employs in its environmental policy analyses PRIMES and GEM-E3 (see Capros and al 2013, European Commission 2011b) which are general equilibrium models. The model developed in this paper is not a global model as in the case of PRIMES and GEM-E3, thus its' aim is not to integrate the behaviors of the European countries but focuses on the innerworking of the Romanian economy. The advantages of this approach results from the the emphisis on one country. At the same time the paper fills a gap in the general equilibrium applications on the Romanian economy especially in the area of resource deplation and climate change analysis (see Loisel 2009, Mohora 2006).

The model develop in the paper is based on Shoven and Whalley (1984). A number of changes to this framework are implemented: a) increasing the number of sectors and economic goods which leads to an increase of the complexity and fidelity of the analysis; b) introducing intermediate consumption which captures the effects of changes in one sector on the other sectors of the economy; c) introducing LES utility functions which take into account the minimum consumption level of the households; d) the introduction of a foreign trade block which captures the impact of changes in the international price of fossil energy resources.

3. Model description

The model is structured in four blocks: production/firms, households, the governmental block and the foreign trade block. The economic agents adopt an optimization behavior in the spirit of the neo-classical theory. As a consequence the model's equations are derived from the first order condition of the behavior functions in the context of specific budget constraints. The solution of the model reflect an economy which is in an equilibrium state.

The calibration of the specific behavior functions parameters was done using the Social Accounting Matrix for Romania from Eurostat, for the last available year 2010. Some algebraic changes were operated so to reflect the economic structure described in the table below.

Table 1. The aggregated structure of the sectors included in the model

Code for the sectors included in the model	Sector Name	Branch codes (of the classification based on 65 branches) included in the respective sector
S1	Agriculture	1..3, 5
S2	Fossil energy	4, 10