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ANALYSIS

Economic and environmental efficiency using a social accounting matrix

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ABSTRACT

This paper aims to show the utility of the so-called Social Accounting Matrix and Environmental Accounts (SAMEA) for economic and environmental efficiency analysis. The article uses the SAMEA for Spain in 2000, applied to water resources and greenhouse gas emissions. This matrix is used as a central core of a multisectorial model of economic and environmental performance, and it calculates the denominated "*domestics SAMEA multipliers*" and their decomposition into characteristic, direct, indirect and induced effects. These multipliers show some evaluation of economic and environmental efficiency. Also, we present an application of these multipliers that demonstrates that there is no causal interrelation between those sectors with higher economic backward linkages and those with higher environmental deterioration backward linkages.

1. Introduction

Environmental problems caused by humans activities has led the establishment of rules that seek to prevent environmental degradation and to make economic and social development compatible with the viability of natural systems, in what has been termed sustainable economic development. Of special importance are two problems that are altering climatic processes and causing serious imbalance in ecosystem health: the shortage and dilution of resource quality and emissions polluting the atmosphere, causing the greenhouse effect.

The importance of these issues makes it necessary to develop an analytical instrument to analyse them and to design the most appropriate economic and environmental strategies. This work contributes to this objective, using a methodology to analyse the efficiency of all productive sectors.

To this means, we use the domestic Spanish Social Accounting Matrix and Environmental Accounts (SAMEA) for 2000, sourced from official data of the Spanish Statistical Office in Morilla (2004). This SAMEA integrates physical water circular flow and emissions to the atmosphere of greenhouse

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effect gasses (GE), together with the economic flow sourced from the National Accounting of Spain.

Using this database, we obtain the domestic production multipliers, emissions of greenhouse effect gasses and consumption of water. We decompose the SAMEA in direct, indirect, induced, and a new multiplier, characteristic effects and, finally, the backward linkages. These decompositions allow us to analyze the efficiency – or not – of each activity sector along the whole economic circuit and to draw conclusions on the economic and environmental systems of Spain.

2. Theoretical fundamentals of the hybrid systems and the SAMEA

The idea of confronting environmental and economic accounts has had conceptual precedents in the works developed by: Daly (1968), Isard (1969), Ayres and Kneese (1969), Leontief (1970) and Victor (1972). These works introduced the analysis of the "physical economy" in the input–output model. Also, from an analytical perspective, there has been significant contribution following the symmetrical environmental input–output table (SEIOT) based on the Leontief methodology, namely, those that are concerned with atmospheric emissions and water. We will highlight the following: Leontief and Ford (1971), Stone (1972), Forsund (1985), Proops (1988), Proops et al. (1993), Lofting and McGauhey (1963) and Hawdon and Pearson (1995).

From an official statistics perspective, it was not until the approval of the "National Accounts System of United Nations, 1993 (NAS93)," where it appeared, for the first time, that the national system of accounts was extended to environmental accounting. However, NAS93 only introduced the debate on how to introduce environment metrics in the national accounting system, without choosing a methodology to use. Accordingly, it was constituted in 1994, in the Statistical Commission of the UN, the so called Group of London on Environmental Accounting that has energized international discussion in this area. Finally, from 2003 we have the last version of SEEA03 (System Environmental and Economic Accounting). This manual collects, in a systematic and coherent way, the precisions and conceptual delimitations of the cost of physical flows linked to the environmental sphere and its connection with monetary flows associated with production activity and consumption. Sections 4 and 6 refer to the combined articulation of a Social Accounting Matrix (SAM) and physical flows associated to this, giving a hybrid SAM, which means, a SAMEA in accordance with the regular terminology.

It has been the European Community that has carried out the most important progress in this domain. In this sense, the document produced by the European Commission in 1994, titled "Directions of the European Union in relation to the environmental indicators and the Green National Account: the integration of the systems of information economic and environmental" is an important starting point in this area.

In Spain, at an official level, there is a precedent of a regional agency, part of a regional government – Andalusia – which elaborated the Environmental Input–Output Table for 1990 (TIOMA-90) based in Pajuelo (1980), although this work was not subsequently continued. Based on this table, it is necessary to highlight the following applications: Castro et al. (1996), Saenz de Miera (2000), Velázquez (2003) and André et al. (2005). Similar table was made in Valencia (Almenar et al., 1998).

Also, we want to note the contribution of Manresa and Sancho (2004) that used a Social Accounting Matrix for Catalonia-1987, to integrate data from energy consumption and atmospheric emissions and to evaluate the environmental repercussions using SAM multipliers. We also note the study developed by Sánchez Chóliz et al. (1994), in which the "water values" for Aragón, a northern region of Spain, were calculated.

At the national level, these hybrid systems of information have not developed much. In fact, there is no official Environmental Social Accounting Matrix. However, the National Statistical Office has advanced the development of statistical environmental information concerning water, residuals, flows of materials and environmental protection, following Eurostat. These statistics, in our opinion, need greater connection to extend the economic accounts toward social and environmental accounting as a whole. The unique reference nowadays for an Environmental Social Accounting Matrix, we find in Morilla (2004), on which this work is based.

The Social Accounting Matrix and Environmental Accounts (SAMEA) follows the structure proposed in the SEEA03, the NAS93 and the EAS95, and contains the following elements (refer to Table 1 and Table A.1, in the Appendix):

- From an economic point of view, the SAMEA contains a Social Accounting Matrix (SAM), where the flows are expressed in monetary units, associated to the economic flow, that means, these are related to production activity

Table 1 – Structure of an environmental SAM

SAMEA	National economy	Rest of the world economy	National environment	Rest of the world environment
National economy	SAM: flows of product, distribution of income, final consumption and capital formation		Residuals by resident	Residuals by resident to ROW
Rest of the world economy			Residuals by non-resident	
National environment	Natural resources inputs	Natural resources exports		
Rest of the world environment	Natural resources from ROW			
National residuals	Residuals reabsorbed			Cross boundary residual outflows
Rest of the world residuals	Residuals reabsorbed		Cross boundary residual inflows	

Source: Morilla (2004).