A SOCIAL ACCOUNTING MATRIX APPROACH TO APPRAISE SECTORS WITH A ZERO DEFICIT PUBLIC BUDGET

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Abstract
The aim of this paper is to develop a mixed empirical methodology to identify, in a zero public deficit framework, those sectors with the capability for growth of output and employment, while also considering the environmental implications of the production of each sector. Their economic activities are ranked and selected in terms of their output, employment, and emissions multipliers. For an empirical analysis, a Social Accounting Matrix of the Spanish economy for 2008 is used. Among the findings, highlights the fact that consideration of the zero deficit in the public budget significantly alters the importance of the sectors for economic development, turning out key choosing a criterion for determining the allocation of public funds.

Keywords: Public spending; Zero deficit, Social Accounting Matrices, Linear models; Employment, Growth, GHG emissions

JEL codes: D57, H62,E60,Q58

Resumen
El objetivo de este trabajo es el desarrollo de una metodología empírica mixta para identificar, en un marco de déficit público cero, los sectores que tienen la capacidad de crecimiento de la producción y el empleo, teniendo también en cuenta las implicaciones ambientales de la producción de cada sector. Las actividades económicas se clasifican y seleccionan en función de sus multiplicadores de producción, empleo, y emisiones. Para un análisis empírico, se utiliza una Matriz de Contabilidad Social de la economía española para 2008. Entre los resultados, destaca el hecho de que la consideración del déficit cero en el presupuesto público altera significativamente la importancia de los sectores de desarrollo económico, resultando clave la elección de un criterio para determinar la asignación de los fondos públicos.

Palabras clave: Gasto público; déficit cero; Matrices de Contabilidad Social; modelos lineales; empleo, crecimiento; emisiones de GEI.

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1. Introduction

In the current context of economic crisis (although a recovery has begun), it is particularly necessary to determine which economic sectors have a special capability for the development of the growth of output and employment, without forgetting the mandatory environmental commitment, in order to prioritize the destination of public spending. Thus, this paper proposes an empirical methodology for the determination of sectors that hold a greater potential of the economy in a zero-deficit context, using different complementary approaches, with the idea of identifying those areas where a higher rate of return exists as well as those where reductions in public spending can have less impact.

The first of these approaches is a description of the economic structure of the country through classic output multipliers, to describe the general behaviour of activities in the Spanish economy. The second approach classifies industries according to their capacity to generate employment. This analysis is completed by evaluating for each branch of the economy their impact on the environment, using as proxy their emissions of Greenhouse Gases (GHG). For empirical analysis, a Social Accounting Matrix is used of the Spanish economy for 2008 (SAMESP2008) estimated by Fuentes and Mainar (2008).

2. Methodology and data

2.1. The Social Accounting Matrix of Spain 2008 (SAMESP2008)

A Social Accounting Matrix (SAM) provides a consistent framework, within which flows of expenditure and income for the various agents in the economy are recorded. A SAM is a square matrix where each agent is represented by a column (expenditure) and a row (income) that record, respectively, the expenditures and incomes of each account.

A SAM integrates social statistics into the traditional input-output model, and represents an extension of these models. In this way, the interdependence of the productive and institutional sectors and their relationship with final demand are captured, as well as the income flows between production factors and components of final demand, thereby completing the circular income flow in a square matrix. In this paper, a SAM of the Spanish economy for the year 2008 is used (Fuentes and Mainar (2008)).

Since the last "official" symmetric table of the Spanish economy refers to 2005, this paper uses a symmetric matrix obtained from the latest published tables (at the time of its completion) of Supply and Use of the Spanish economy, referring to the year 2008 (INE, 2010).

The symmetric table is obtained "industry by industry" and follows the assumption of a fixed product sales structure (Eurostat, 2008). Table 1 portrays schematic structure for a SAM, with aggregated data, taking into account that a detailed micro SAM contains 84 accounts: 73 productive sectors, 2 production factors (Capital and Labour), 3 institutional sectors (Households, Enterprises, and Government), 3 accounts for taxes and subsidies, a Saving- Investment account and 2 accounts for the Rest of the World (European Union and Rest of the world).

Table 1. Simplified structure of the SAMESP2008 (Millions of Euros).

	Activities (industries)	Factors	House holds	Enter prises	Govern ment	Save-Investment	Rest of the World
Activities (industries)	1,108,904		557,192		211,407	301,380	291,525
Factors	995,775						1,525
Households		764,961		98,202	147,762		20,398
Enterprises		212,556	57,028		11,729		40,934
Government	22,345	18,206	285,019	41,561		15,317	8,730
Save-Investment			98,999	105,776	7,655		104,267
Rest of the World	343,384	1,577	33,085	76,708	12,624		

Source: Fuentes and Mainar (2014)

2.2. Specific linear multipliers based on Social Accounting Matrices.

In order to analyse the context of zero-deficit rule, it is considered in this paper that the Public Sector (Government account) is the only exogenous variable, and assumed that all other industries and institutional sectors are working to meet their needs. This can imply a bias, especially due to the endogenization of the foreign sector, which generates an overestimation of the multiplier effect and contravenes the hypothesis of "small country". To solve this problem, the use of a special version (see Duarte et al., 2015) of a well-known linear SAM model is proposed, with a slight modification in order to maintain imports as exogenous through an extension of the domestic technical coefficients matrix:

$$\mathbf{x}^n = \mathbf{A}^n\mathbf{x}^n - \mathbf{Z}\mathbf{x}^n + \mathbf{y}^n \Leftrightarrow \mathbf{x}^n = (\mathbf{I} - \mathbf{A}^n + \mathbf{Z})^{-1}\mathbf{y}^n = \mathbf{M}^n\mathbf{y}^n \quad (1)$$

where:

$\mathbf{x}^n$ is the vector of total resources minus imports, i.e., this represents the domestic production in the productive accounts and the sum of domestic resources for the non-productive endogenous accounts

$\mathbf{A}^n$ is the matrix of coefficients for the endogenous accounts, calculated with **$\mathbf{x}^n$**, i.e.

X_{ij} / x_j^n, with X_{ij} containing the imported inputs

Z is a matrix of technical coefficients of imports; this implies that $\mathbf{A}^n - \mathbf{Z}$ is a matrix of domestic coefficients (no total coefficients) for the endogenous accounts

y^n is the vector of final demand of the endogenous accounts (all except households), including exports minus imports of finished products

Matrix **Z** in (1) has the following elements: For the productive accounts,

$$z_{i,j} = \frac{X_{i,j} - X^D_{i,j}}{x^n_i} \qquad (2)$$

where $X^D_{i,j}$ represents the payments made[1] by the productive account *i* to the productive account *j*, (with *j* defined for both the productive and non-productive accounts). For the *s* endogenous non-productive accounts, the elements of Z take the form

$$z_{s,s} = \frac{Z_s}{x^n_s} \text{ and } z_{s,j} = 0 \text{ if } s \neq j \qquad (3)$$

where z_s is the value of imports made by the account *s*, and zero otherwise.

2.3. Effects of sectorial impacts on employment and GHG emissions

By denoting **e** as a vector of employed workers per monetary unit (in this case millions of euros) of uses or resources in a sector, and **c** as the vector of domestic pollution directly and indirectly incorporated in the manufacture of each unit of production and service *i* demanded by the exogenous accounts, it is possible to obtain

$$\mathbf{b = e' M} \qquad (4)$$

$$\mathbf{c = s' M} \qquad (5)$$

with each element j of **b** showing the employment s generated by a unitary impact (million euros) in sector *j*, and where **s** is the vector of the intensities of domestic emissions in production[2].

3. Results

For the evaluation of the efficiency of public spending and the identification of areas of greater potential for higher economic growth and employment, the aforementioned

[1] X^D is estimated from the domestic input-output table (INE, 2015a).

[2] Employment data are estimated from the EPA (Encuesta de Población Activa, *Workforce Survey,* by the Spanish National Statistics Office, INE (INE, 2015b*).* Emissions data are obtained from National Emissions Accounts, INE, 2015c). Regarding embodied emissions, these require ad-hoc estimates. Environmental Accounts data correspond to emissions directly generated by the production processes of each of the economic activities.

calculations were performed, whereby the government account was taken as the exogenous variable.

This simple initial exercise should be taken as a mere qualitative and incipient indicator of this efficiency measure without following quantitative values. There is a strong restriction for this: it should be borne in mind that an investment in any sector by the Government means, in times of austerity and zero deficit, a withdrawal of resources from other sectors, with the consequent negative impact on growth and employment (see Guerra and Sancho, 2010).

Therefore, by maintaining a zero deficit when the public sector spends a monetary unit in a sector, it is considered that public expenditure in other sectors is reduced, and that the following four alternative criteria should be applied for the selection of the sector of reduction:

- The initial volume of public spending (the greater the volume, the greater the participation in the reduction of spending)
- The value of the backward effect if there were no restrictions (the lower the multiplier, the greater the share in the reduction)
- The ability to generate employment (the lower the capacity, the greater the participation in the reduction of spending)
- The generation of GHG emissions (the greater the volume generated, the greater the participation in the reduction of spending)

For each criterion, the sectors have been ranked and their positions have been compared from an initial estimation without the zero-deficit restriction. In order to select the most suitable sectors, it is also necessary to establish conditions for the selection based on the value of the multiplier.

For example[3], sectors have been considered whose output multiplier is greater than 1 (*condition 1*), the employment multiplier is greater than 0 (*condition 2*), and the GHG multiplier value is less than 0 (*condition 3*). Table 2 shows a summary of these changes in ranking, and indicates the number of sectors that fulfilled one, two or all three issues of condition. Table 3 includes sectors that fulfilled all conditions in each selection criterion.

[3] It is necessary to consider that, with zero-deficit restriction, backward multipliers can be negative. In GHG emissions, a negative value of multiplier is desirable.

Table 2. Percentage of changes in ranking and of sectors that satisfy conditions. Spain, 2008.

Reduction in public expenditure criteria	Multiplier of	% of sectors that change their ranking		% of sectors that fulfilled conditions		
		Any change	More than 1 position			
Initial spending	***Output***	8.2%	0.0%	0.0%	0.0%	0.0%
	Employment	12.3%	2.7%	19.2%		
	GHG emissions	19.2%	4.1%	39.7%		
Initial Backward Effect	***Output***	0.0%	0.0%	8.2%	8.2%	5.5%
	Employment	0.0%	0.0%	53.4%		
	GHG emissions	11.0%	0.0%	75.3%		
Generation of Employment	***Output***	17.8%	1.4%	47.9%	43.8%	37.0%
	Employment	0.0%	0.0%	71.2%		
	GHG emissions	17.8%	4.1%	76.7%		
GHG emissions embodied	***Output***	9.6%	2.7%	2.7%	2.7%	0.0%
	Employment	2.7%	0.0%	56.2%		
	GHG emissions	0.0%	0.0%	84.9%		

Source: Own elaboration

Table 3. Sectors with multiplier of output greater than 1 and employment multiplier greater than zero(shaded sectors, GHG multiplier less than 1)

Reduction in public expenditure criteria									
Backward		***Employment generation***						***GHG emissions embodied***	
1	Agriculture and livestock	**1**	Agriculture and livestock	**45**	Accommodation activities	**64**	Security and investigation, service and landscape, office administrative and support activities	**1**	Agriculture and livestock
5	Processing and preserving of meat and production of meat products	**2**	Forestry and logging	**46**	Food service activities	**65**	Public administration and defence; compulsory social security	**5**	Processing and preserving of meat and production of meat products
34	Construction	**5**	Processing and preserving of meat and production of meat products	**47**	Publishing activities	**66**	Education		

59	Advertising and market research	**6**	Manufacture of dairy products	**48**	Motion picture, video, television programme production; programming and broadcasting activities	**67**	Human health activities		
62	Employment activities	**33**	Sewerage, waste management and remediation activities	**53**	Insurance, reinsurance and pension funding, except compulsory social security	**68**	Residential care activities and social work activities without accommodation		
73	Activities of households as employers	**34**	Construction	**57**	Architectural and engineering activities; technical testing and analysis	**69**	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities		
		36	Wholesale trade	**58**	Scientific research and development	**70**	Sports activities and amusement and recreation activities		
		37	Retail trade	**59**	Advertising and market research	**71**	Activities of membership organisations		
		38	Land transport	**60**	Other professional, scientific and technical activities; veterinary activities	**73**	Other personal service activities		
		43	Warehousing and support activities for transportation	**61**	Rental and leasing activities	**73**	Activities of households as employers		
		44	Postal and courier activities	**62**	Employment activities				

Source: Own elaboration

4. Conclusions

The imposition of a zero deficit in the public budget substantially alters the response of economic sectors to major changes in Government policy. Restrictions can be implemented under various criteria, in order to choose where to invest public money; to this end, alternative rankings of target sectors are obtained, thereby facilitating the decision-making by policy makers regarding specific measures. The ability of different economic sectors to generate output or employment in combination with other aspects (such as environmental) should be used as a basis for allocating public funds, especially in times of crisis and budgetary constraints. But precisely this restriction requires the development of rules of choice to define which sectors or activities should be subject to investment or demand by the public sector. As shown in this paper, the choice of one or another criterion in a zero deficit context varies substantially the number of sectors eligible for election and their basic characterization

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