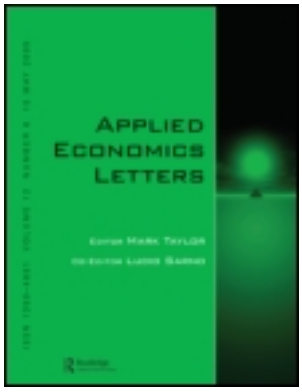

Applied Economics Letters
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rael20

Endogenization of the 'rest of the world' account in SAM linear models: an approach based on Miyazawa

Alfredo J. Mainar [a], Patricia D. Fuentes-Saguar [b] & M. Alejandro Cardenete [c]

[a] Department of Applied Economics III, University of Seville, Avda. Ramón y Cajal, 1, 41018, Seville, Spain

[b] Department of Economics, University Pablo de Olavide, Ctra. Utrera, km. 1, 41013, Seville, Spain

[c] European Comission (JRC-IPTS), Inca Garcilaso, 3, 41092, Seville, Spain

Available online: 16 Mar 2012

To cite this article: Alfredo J. Mainar, Patricia D. Fuentes-Saguar & M. Alejandro Cardenete (2012): Endogenization of the 'rest of the world' account in SAM linear models: an approach based on Miyazawa, Applied Economics Letters, 19:17, 1723-1726

To link to this article: http://dx.doi.org/10.1080/13504851.2012.667535

Applied Economics Letters, 2012, **19**, 1723–1726

Routledge
Taylor & Francis Group

Endogenization of the 'rest of the world' account in SAM linear models: an approach based on Miyazawa

Alfredo J. Mainar[a,*], Patricia D. Fuentes-Saguar[b] and M. Alejandro Cardenete[c]

[a]*Department of Applied Economics III, University of Seville, Avda. Ramón y Cajal, 1, 41018 Seville, Spain*
[b]*Department of Economics, University Pablo de Olavide, Ctra. Utrera, km. 1, 41013 Seville, Spain*
[c]*European Comission (JRC-IPTS), Inca Garcilaso, 3, 41092 Seville, Spain*

The objective of this work is to analyse the possibility of including operations with foreign countries as an endogenous variable in Social Accounting Matrix (SAM) linear models while solving the difficulties associated with this option (e.g. biased estimations of hypothetical demand shocks). The methodology proposed, based on Miyazawa models, makes it possible to estimate the influence and impact of the foreign exchange, preventing it from being overvalued. The SAM for Spain in the year 2000 has been used as the database for this work.

Keywords: Social Accounting Matrix (SAM); linear models; foreign sector; Miyazawa models

JEL Classification: D57

I. Introduction

In input–output linear models and in those models that have developed from them, in particular in Social Accounting Matrices (SAMs), the foreign sector is traditionally considered as an exogenous factor and the income generation process is described as a circular flow typical of a closed economy. However, this involves leaving aside the impact of the foreign sector on the income generation process. And it means introducing a significant bias in the resulting estimation, if we admit that imports are systematically resorted to in any production process when the direct effect and the successive-induced effects of a demand shock take place. Thus, an overvaluation of the real multiplier effects occurs which, in addition, affects the hypothetical distribution of sectors that are influential in the economic activity. The first solution that may be contemplated is the introduction of the foreign sector into the set of endogenous variables, but this entails a risk concerning the interpretation of the resulting multipliers. The inclusion of foreign relations into the circular flow and their subsequent interactions imply that those multipliers will indicate that the national economy has an influence on that of the rest of the world, something unsustainable under the small country assumption required for the analysis of the economy of a specific country or region.

Therefore, it is necessary to look for ways to introduce the interaction effects of the foreign sector into

*Corresponding author. E-mail: amainar@us.es
Note: The authors are solely responsible for the present text without any implication from the European Commission.

SAM analysis but avoiding those overvaluation risks. Such is the objective of this work, in which we propose an alternative method to develop this type of analysis and prove its validity and consistency. This work is structured as follows: first, we will describe the methodology generally used in SAM linear models, as well as the database used in this work, which is the one for the Spanish economy in the year 2000; in the following section, we will propose an alternative method for the endogenization of the foreign sector; finally, we will present the main results and conclusions.

II. Linear Multipliers Based on SAMs

A SAM is a database that collects and organizes in a square matrix the economic and social information of all the transactions made by the different economic agents within an economy in a specific moment in time. SAMs expand the information offered by input–output tables and represent the income circular flow in a square matrix. In this work, we have used the SAM for Spain in the year 2000 (SAMESP00), which can be consulted in Cardenete and Fuentes (2009).

The formulation of SAM linear models (Stone (1962) or Pyatt and Round (1979), among others) allows obtaining matrix **M**, an accounting multiplier matrix the components of which (m_{ij}) reflect the impact generated by an exogenous income unit of endogenous account j on the income of endogenous account i. The addition of the columns of the accounting multiplier matrix reveals the total effect of an exogenous shock received by an endogenous account on the rest of the economic activity (*backward linkage effect*).

As mentioned before, if the foreign sector account is considered to be exogenous, the real multiplier effect of hypothetical demand shocks becomes biased (not all the effects take place in the domestic sectors), but its simple incorporation as an endogenous variable involves the substitution of this bias by another more detrimental one, according to which the foreign sector reacts to an increase in income due to imports by intensifying its demands from the economy. We will now suggest one solution to this problem.

III. Endogenization of the 'rest of the world' Account

In this work, we propose to analyse the impact of the foreign sector account in a way that the small country assumption can be maintained and which consists in endogenizing the effect of imports only and keeping exports as an exogenous factor. Indeed, the introduction of the imports made by productive and institutional sectors as a linear function of their respective total employment or resources values, while exports remain constant, allows analysing the real influence of the foreign sector. Consequently, it is possible to avoid the overvaluation of its effects caused by the fictitious feedback (export increase due to the increase of foreign income through imports) that takes place when this variable is considered as endogenous.

This approach requires the reformulation of the usual linear model, especially of its components. First, it is necessary to specify the way in which each sector's imports, which are now taken as endogenous, will depend on the sector's total employment or resources volume. Within the context of linear models, we assume that the imports made by sector i (z_i) can be expressed as the product of the sector's total resources net of imports (x_i^n) by a fixed coefficient, h_i:

$$h_i = \frac{z_i}{x_i^n} \tag{1}$$

Therefore, the vector of coefficients $\boldsymbol{m} = \{h_i\}$ will reveal to what extent each sector's resources derive from the foreign sector and are not generated by the domestic production process. Higher values of these coefficients define sectors whose expansion, directly as a consequence of exogenous demand shocks or indirectly in the form of input, is dissipated by a high percentage through the demand of imports.

This method, which is designed to endogenize the imports, makes it necessary, in the context of using a SAM, to modify the traditional matrix of technical coefficients. The elements of the matrix (a_{ij}^n) will now show the expenditure of account i for each monetary unit of total expenditure or employment of account j, but net of imports.

Hence, we can write the usual linear model (Leontief type) as follows:

$$\boldsymbol{x^n} = \mathbf{A^n}\boldsymbol{x^n} + \mathbf{y} - \boldsymbol{z} = \mathbf{A^n}\boldsymbol{x^n} + y - \mathbf{H}\boldsymbol{x^n} \tag{2}$$

where $\boldsymbol{x^n}$ is the vector of total employment or total resources net of imports; $\mathbf{A^n}$ is the matrix of coefficients of endogenous variables calculated over $\boldsymbol{x^n}$; $\mathbf{y}$ is the matrix of exogenous variables (including exports); $\boldsymbol{z}$ is the imports vector; and $\mathbf{H}$ is the diagonal matrix with elements m_i (coefficients of imports).

From the previous expression we can easily derive a new version of the traditional Leontief inverse matrix (input–output frame):

$$x^n = (\mathbf{I} - \mathbf{A}^n + \mathbf{H})^{-1} \quad (3)$$

The elements of the inverse matrix (similar to the one used, in an input–output context, by Miyazawa (1976) to analyse the effects of endogenizing consumption in an open economy) reflect the impact ultimately generated by an exogenous income unit (even if derived from exports) of endogenous account *j* on the income of endogenous account *i*, but now showing as well the effect of the foreign sector caused by the imports required for the production processes and the generation of subsequent incomes.

IV. Main Results

The application of the above-mentioned techniques, using as database the SAM for Spain in the year 2000, is summarized in Table 1. The columns of this table show the total multipliers (*backward linkage effects*)

Table 1. Total backward linkage coefficients and resulting distributions according to endogeneity criteria and models used

	Addition by columns (*backward linkage* coefficients of each sector)			Position of each sector in the sector rankings according to the *backward linkage* effect		
	Foreign sector exogenous	Foreign sector endogenous		Foreign sector exogenous	Foreign sector endogenous	
Sector	$(\mathbf{I}-\mathbf{A})^{-1}$	$(\mathbf{I}-\mathbf{A})^{-1}$	$(\mathbf{I}-\mathbf{A}^n+\mathbf{H})^{-1}$	$(\mathbf{I}-\mathbf{A})^{-1}$	$(\mathbf{I}-\mathbf{A})^{-1}$	$(\mathbf{I}-\mathbf{A}^n+\mathbf{H})^{-1}$
1. Agriculture, livestock and forestry	5.72	9.36	5.27	6	12	5
2. Fishing	4.61	9.11	4.08	18	17	17
3. Coal	3.41	8.86	2.78	26	20	26
4. Petroleum and natural gas	1.06	10.03	0.06	30	3	30
5. Nonenergy extractive industries	3.81	9.30	3.17	23	14	23
6. Coking plants, refinery and nuclear fuels	2.81	10.21	1.98	29	1	29
7. Electric energy production and distribution	5.72	9.25	5.29	5	15	4
8. Gas production and distribution	3.26	10.03	2.49	28	2	28
9. Water collection, treatment and distribution	5.39	8.69	4.99	9	22	10
10. Food, beverages and tobacco	5.76	10.02	5.25	4	4	6
11. Textiles, leather and furs	4.41	9.58	3.81	19	10	20
12. Wood manufactures	4.65	9.57	4.07	17	11	18
13. Chemical industry	3.67	9.66	2.99	24	6	24
14. Building materials	5.29	9.02	4.85	10	18	14
15. Mining and iron and steel industry	4.24	9.60	3.62	21	8	21
16. Metal manufactures	4.91	9.21	4.41	15	16	15
17. Machinery	3.27	9.59	2.55	27	9	27
18. Vehicles	3.52	9.97	2.78	25	5	25
19. Transport elements	3.85	9.62	3.19	22	7	22
20. Other manufactures	4.88	9.31	4.35	16	13	16
21. Construction	5.96	8.86	5.60	1	19	2
22. Sale and repair of motor vehicles, automotive fuel trade	5.59	8.77	5.20	7	21	7
23. Other trades	5.92	8.35	5.60	2	25	1
24. Transport and communications	5.45	8.67	5.05	8	23	8
25. Other services	5.24	8.36	4.85	14	24	13
26. Sale-oriented services	5.85	8.07	5.55	3	26	3
27. Nonsale-oriented services	5.28	7.29	5.01	11	27	9

Source: Own elaboration.

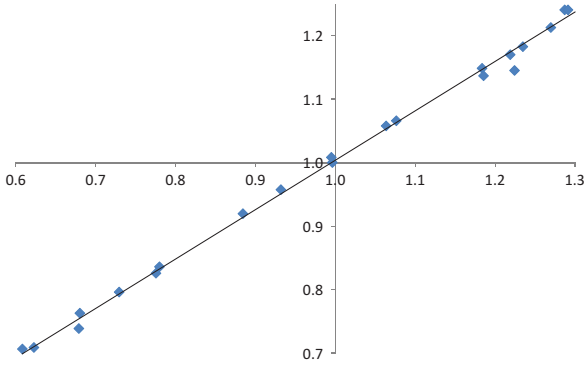

Fig. 1. Dispersion graph and regression line of *backward linkage* coefficients of sectors in ratio with the average of $(\mathbf{I} - \mathbf{A}^{n} + \mathbf{H})^{-1}$ (x-axis) and $(\mathbf{I} - \mathbf{A})^{-1}$ (y-axis) ($R^2 = 0.99$)
Source: Own elaboration.

obtained for unitary exogenous shocks of the final demand in the productive sectors of the economy. For each case, the *savings/investment* and *public sector* accounts are taken as exogenous, whereas the *sectors*, *production factors* and *private consumption* accounts are considered as endogenous. Columns 2 and 3 present the results obtained by using the usual multiplier matrix, **M**, in the case of, respectively, exogeneity and endogeneity of the foreign sector account, while on Column 4 the multipliers that correspond to matrix $(\mathbf{I} - \mathbf{A}^{n} + \mathbf{H})^{-1}$ are displayed. Columns 5–7 present the resulting sector rankings according to each criterion.

The estimations thus obtained provide two main results. First of all, the excessive increases that values in Column 3 show in relation to those in Column 2 illustrate how the simple endogenization of the foreign sector generates an overvaluation of the multiplier effect of exogenous shocks that exceeds the effect produced by the mere inclusion of an additional endogenous variable and significantly alters the real distribution of sectors according to their impact capacity (see Columns 5 and 6). Second, Column 4 proves that the suggested endogenization method eliminates the above-mentioned overvaluation and produces multipliers that are more real and that makes it possible not only to quantify the effects but also to generate rankings of those sectors with greater growth potential in the economy that are better adjusted and, at the same time, consistent with the distribution obtained before considering the foreign sector as an exogenous variable (see Columns 5 and 7). Figure 1 shows that this correlation is almost perfect and provides almost identical sectoral distributions.

V. Conclusions

The endogenization method proposed herein allows introducing the foreign sector as an endogenous variable in the analysis of SAM linear models, so that no overvaluation effects are produced due to the breaking of the small country assumption in international trade. With this method, multipliers are obtained that not only quantify the effects in a more precise manner but generate better adjusted distributions of the sectors with greater growth potential in the economy. This results in an improvement that is both quantitative and qualitative in relation to the simple inclusion of the foreign sector as an endogenous factor. The method proposed proves as well its consistency in relation to other methodologies, for it achieves an isolation of the multiplier effect of demand shocks which matches that of other techniques, and it may be used in various ways depending on the research objective.

References

Cardenete, M. A. and Fuentes Saguar, P. (2009) *Análisis Del Sector Energético Español a Través De Un Modelo De Crecimiento Sostenible*, Colección EOI Medio Ambiente, Fundación EOI, Madrid.

Miyazawa, K. (1976) *Input-Output Analysis and the Structure of Income Distribution* (*Lecture Notes in Economics and Mathematical Systems*), Vol. 116, Springer, New York.

Pyatt, G. and Round, J. (1979) Accounting and fixed price multipliers in a social accounting framework, *Economic Journal*, **89**, 850–73.

Stone, R. (1962) *A Social Accounting Matrix for 1960. A Programme for Growth*, Chapman & Hall, London.