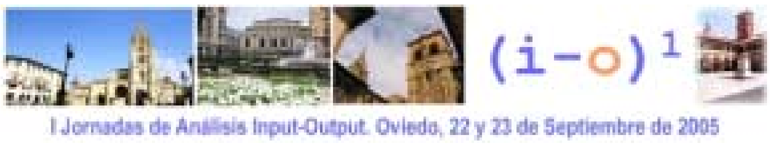

EXPLOITING SOCIAL ACCOUNTING MATRICES: WHICH METHOD?

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This paper discusses the method to treat the data included in such interesting data-bases. A causality has to be assumed between the different cells and translated into arithmetic relations reflecting recognizable propositions of economic theory.

We suggest to build on the distinction between stock and flow variables to create dynamic models of which actual SAM would be but a photogram. The main body of the model should then be a set of integro differential equations.

A prototype is being built at the University of Oviedo.

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ABSTRACT

SAMS are standardized way to structure the presentation of the most relevant data of a macroeconomy. They adopt matricial form.

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EXPLOITING SOCIAL ACCOUNTING MATRIXES: WHICH METHOD?

Social Accounting Matrixes are a standardized way to structure the presentation of the most relevant data in a macroeconomy.

They might be defined as a fully closed Leontief model where not only the production sectors but the payment and final demand sectors and their relationships have been fully detailed.

SAMs adopt a square matrix form. Therefore, they devote an individual space to the relationship between any two sectors participating in the economy.

A SAM intends to provide a complete picture of the economy at some instant of time, but, for factual reasons, SAMs today are built by synthesizing a collage of statistics, like pictures taken with a number of different cameras and some times not referring exactly to the same period. While intended to be a great unified statistical display, SAMs are often made of piecemeal information hard to synthesize.

The work done on SAMs till now belongs to the field of applied statistics rather than to Econometrics. According to the definition of Econometrics (*), they would lack the incorporation of pieces of economic theory and some type of mathematical treatment to be an econometric instrument. Current SAMs must be considered the base for construction of models rather than model themselves.

This paper discusses and suggests one possible alternative to make out of them a deductive scientific instrument.

Practical problems to extract value from SAMs.

It is necessary to develop a methodology allowing to extract hidden values from the data gathered in SAMs. But although a lot has to be done from the conceptual viewpoint, today much of the pain of the SAM´s pioneers remains practical. The data necessary to fill all the cells of a SAM come from statistical work made for a variety of purposes. This leads to the existence of voids or holes on the one hand, and on the other to overlapping information difficult to reconcile or consolidate. Part of the efficiency and usefulness of future SAMs shall have to come from the development of new statistical work made on purpose to satisfy a unifying purpose.

(*) See the definition included in the statutes of the Econometric Society.

A short digression on causality and model realism

As we have already said, SAMs are an appropriate data base to build a variety of models (1). Current SAMs do not present yet temporary series. This is not a hard conceptual problem to overcome. It "only" requires additional statistical field work.

In order to develop a method to harvest usefully the information included in a SAM, it is necessary to fill each cell of the SAM with some type of arithmetic function relating the two sectors involved in the cell. The simplest case is a relation of direct proportionality represented by a fixed coefficient, like in Leontief's static.

It is interesting to analyze the nature of these arithmetic functions- or coefficients in the simplest case.

As a classical text book on Regression Analysis (2) explains "in any system in which variable quantities change, it is of interest to examine the effects that some variables exert on others. There may in fact be a simple functional relationship between variables; in most physical processes this is the exception rather than the rule. Often, there exists a functional relationship which is too complicated to grasp to describe in simple terms. In this case we may wish to approximate to this functional relationship by some simple mathematical function, such as a polynomial, which contains the appropriate variables and which approximates to the true function…….Even where no sensible physical relationship exists between variables we may wish to relate them by some sort of mathematical equation. While the equation may be physically meaningless it may nevertheless be extremely valuable."

Whether a mathematical equation which is meaningless in the real world may be useful for real life circumstances pertains to the philosophy of science. Several authors, among them Leontief himself, seem not to share uncritically this view. In his 1970 presidential address to the American Economic Association, Leontief stated: "there is an uneasy feeling about the present state of our discipline caused not by the irrelevance of the practical problems to which the present day economists address their efforts but rather by the palpable inadequacy of the scientific means with which they try to solve them……Uncritical enthusiasm for mathematical formulation tends often to conceal the ephemeral substantive content of the argument behind the formidable front of algebraic signs…..In no other field of empirical enquiry has so massif and sophisticated statistical machinery been used with such indifferent results".

What is out of doubt is that coefficients in input-output tables are obtained by relating in a naïve way economic realities rather than through abstract mathematical creation as it happens for instance with the coefficients of a polynomial in a regression curve. Their names all bear an adjective: the name of **technical** coefficients implies the belief that there actually exists some physical or natural relationship. The **behavioural** coefficients in a SAM like the **propensity to save** refer to the existence of some statistically stable kind of psychological relation in the real world.

One can contend whether these coefficients achieve the goal of reproducing some type of reality. Among other things, the degree of realism or abstraction depends on the level of aggregation.

But the mathematical tool whose need we claim to operate SAMs, can use parameters and coefficients collected more closely from the real world economic facts than those brightly designed by the human mind in other econometric modelling.

A proposal about the method

The development of arithmetic functions can start from the classical distinction between stock and flow variables. This distinction was used by Leontief himself in his dynamic model.

We have analyzed in a different paper (3) how we think his attempt was unsuccessful since the mathematical apparatus used makes incompatible his static and dynamic models. In fact the dynamic one cannot be considered a possible representation of a process of capital accumulation.

Alternatively, we have developed elsewhere (4) a dynamic model reproducing the short term behaviour of the economy without growth. This requested the explicit introduction of time and of new stock variables like the industrial backlogs and inventory levels.

The product of this research is the creation of linear dynamic inter industry models which always present a stationary state numerically identical to the static Leontief model. The distinction between a number of selected stock variables and the number of simple linear functions that represent the change per period of time of the stock variables, suggests the use of a set of integro differential equations.

The reason for this is, that, in mathematical terms, stock variables represent integrations while the flow variables represent derivatives (the changes of the stocks over time).

Time must be the independent variable, and the equations must describe the continuous evolution of all the state variables as time passes.

On the basis of these ideas we have developed a model prototype with the following characteristics:

- It is modular in the sense that all the sectors are described by a common set of simple equations. The application of this set of equations to a particular sector implies only the adaptation of parameters. In practical terms the model uses arrays. The number of sectors can be changed easily at will provided one has the empirical information to determine the value of the parameters.

  The parameters represent realities well known by the practitioners of business in the sector implied: for instance, **average number of weeks of finished product kept in inventory** in the sector.

- The main economic realities corresponding to the stock variables of a sector are as follows:

  - Backlogs of demand received from other sectors.
  - Stocks of finished products.
  - Stocks of materials.
  - Total number of workers in the sector.
  - Price per unit of output of the sector.

- The realities corresponding the flow variables of a sector are as follows:

  - Demand received by each sector from each sector, determined by the multiplication of a Leontief technical coefficient by the production of the demanding sector.
  - Production of the period which is directly proportional to the size of the backlog.
  - Rules to make endogenous to the model the evolution of stocks: the model calculates the average of the demand above, multiplies it by a parameter describing the number of weeks of finished products which is the normal practice of the sector and after comparing the result of this calculation to the actual value of the stock, the model introduces additional demand into the backlogs to correct the size of inventories.
  - Rules to determine the amount of labour employed in the sector. The average production is divided by a parameter which describes the productivity of labour. This calculation provides an indicated value for the amount of workers in the sector and by comparing it with the actual value, the model determines the increase or decrease of the number of workers employed.

- Prices are treated as accumulative or stock variables. Each sector fixes a price for its product. The equations move the price in response to two calculations: (a) the relationship between aggregated demand of product and the actual output (b) the addition of the technical coefficients of a column multiplied by the corresponding prices in the rows determines a cost for each product and cost pressures are converted into movements of prices.

- Other more complex structures make endogenous the process of capital investment. The equations calculate the trends in production , forecast the value of future production expected. They then compare this value with the production capacity of the sector and decide whether capacity expansion is requested or not. When the answer is positive the demand is placed by the sector to the rest through a capital coefficient matrix. Initial capacity is given to the model as a parameter.

- Any movement in the economy is recorded as an accounting movement. Each sector has an independent balance sheet and a profit and loss statement.

- At the current stage of development, the model reproduces with a relevant level of detail the movements and evolution of the real economy by following the history of each sector of intermediate size.

- We are at the stage of developing the money side of the economy: the development of a balance sheet by sector implies the recording of payments and cash accumulation in each sector. This has already been programmed. The demand for financing and the behaviour of the financial system in his decision process is still at an early stage of development.

Conclusions.

While the multiple individual relations between sectors are described in the model by naïve expressions (assuming in most cases linearity), the model as a whole represents a very complex and detailed structure where each parameter or element represents a reasonable behavioural assumption about an identifiable economic reality that can be tested through statistical field research.

The introduction of non linearities in the model is very easy provided that the model is numerically computed instead of analytically solved.

A model that requests many realistic inputs finds in a SAM an excellent data base to establish the value of parameters of coefficients and allows to dynamize the SAM.

The great computing facilities existing today make it possible to play and explore, as in a laboratory work the intricacies of very complex structures both linear and non linear of the real economy. It must feed from proper SAM and give back the dynamic version of them where economic theory included in the behaviour equations can be put to trial.

Our model is a way to enhance the usefulness of a SAM by making out of them a full econometric instrument including statistical data, propositions of economic theory and mathematical treatment.

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