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Johansen's legacy to CGE modelling: Originator and guiding light for 50 years☆

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Abstract

Fifty-six years ago Norwegian economist, Leif Johansen, gave us the first CGE model. While Johansen was first, he is not the father of the whole field. CGE modelling in different styles sprang largely independently from several sources. This paper describes Johansen's model and how his style of CGE modelling took root in Australia in the 1970s and from there spread to the rest of the world. Today, thousands of economists from nearly every country are undertaking Johansen-style CGE modelling to elucidate policy questions in trade, taxation, environment, labour markets, immigration, income distribution, technology, resources, micro-economic reform and macro stabilization.

Keywords: CGE modelling; Leif Johansen

1. Introduction

Johansen (1960a) is one of those rare books that is a complete break with previous literature and the first contribution to a major branch of economics, computable general equilibrium (CGE) modelling.

CGE belongs to the economy-wide class of models, that is, those that provide industry disaggregation in a quantitative description of the whole economy. The original economy-wide model was Leontief's input–output system (Leontief, 1936, 1941). Following Leontief, the next stage of economy-wide modelling was the programming models of Sandee (1960), Manne (1963) and others. Input–output and programming models lacked clear descriptions of the

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behaviour of individual agents. In input–output modelling, the economy organized production of each commodity (the vector X) to satisfy a vector of final demands (the vector Y) with given technology specified by the input–output coefficient matrix (A). In programming models, the economy organized production to maximize a welfare function subject to Leontief's technology specification and subject to constraints on the availability of primary factors.

What Leif Johansen did was identify behaviour by individual agents. This is the defining feature of CGE models that distinguishes them from the earlier economy-wide models.[1] Households in Johansen's model maximize utility subject to their budget constraint. Industries choose inputs to minimize costs subject to production-function constraints and the need to satisfy demands for their outputs. Capitalists allocate capital between industries to maximize their returns. The overall outcome for the economy is determined by the actions of individual agents co-ordinated through price adjustments that equalize demand and supply in product and factor markets.

Johansen conception proved remarkably popular and versatile. In the 50 years since the publication of his book, CGE modelling has attracted a huge group of researchers. The GTAP[2] network alone connects 7500 CGE practitioners in 150 countries. The issues to which CGE modelling has been applied include:

the effects on

macro, welfare, industry, regional, labour-market, distributional and environmental variables

of

taxes, public consumption and social security payments; tariffs and other interferences in international trade; environmental policies; technological change; international commodity prices; interest rates; wage setting arrangements and union behaviour; mineral discoveries (the Dutch disease); immigration; micro-economic reform; and major projects.

While most of these issues have been analysed in single-country, single-period models, there are now numerous CGE models which are either multi-regional or multi-period (dynamic) or both. By going multi-regional, CGE modelling has thrown light on both intra-country and inter-country regional questions. By going dynamic, CGE modelling can broaden and deepen its answers to all the questions with which it has been confronted. It has also re-entered the forecasting arena, rather belatedly following the lead of Johansen and his colleagues (Johansen, 1974, ch. 10; Bjerkholt & Tveitereid, 1985; and Schreiner & Larsen, 1985). Early CGE modellers including Johansen (1960a, 1974), Hudson and Jorgenson (1974), Adelman and Robinson (1978) and Taylor, Bacha, Cardoso, and Lysy (1980) gave their results a real time dimension, either historical or future. The subsequent generation of modellers worked mainly in a comparative static framework. As described by Johansen in connection with projections made with his model in 1969 by the Norwegian Ministry of Finance for the period 1963–1990, forecasts generate interest and constructive feedback:

> "*Several institutions, enterprises and persons approached the Ministry of Finance to get more details or suggest alternative assumptions. There was a clear need to continue the explorations and the Ministry invited interested persons to take part in an informal working group. Some 30 persons representing organisations, research institutes, private firms and other ministries participated. This group met regularly with members of staff of the Ministry in 1970.*" [Johansen, 1974: 225-6].

[1] Definitions of CGE modelling can be found in Bergman (1985: 137) and Dixon and Parmenter (1996, chap. 1, p. 5).
[2] This is the Global Trade Analysis Project centred at Purdue. We discuss GTAP in Section 5.