

CGE applications in development economics[☆]

Lance Taylor^{*}

New School for Social Research, United States

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Abstract

This paper begins with an informal history of developing country CGE models, going on to specification and closure, and finally describes a few models with financial extensions. Sectoral detail is central to CGE analysis, but after an initial sketch of an n -sector system most of the discussion focuses on the models' "closures" or patterns of macroeconomic causality, because they strongly influence their sectoral results. Particular attention is paid to the ways in which international trade and fiscal linkages fit into applied models. © 2016 The Society for Policy Modeling. Published by Elsevier Inc. All rights reserved.

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Two planners, Leif Johansen and Hollis Chenery, were the intellectual leaders in the creation and use of computable general equilibrium (CGE) models in development economics. Their first applications were meant to be models for planning. Although that term has long since vanished from polite economic discourse I would argue that the main practical application of CGE models is to explore possible responses of the economic system to shifts in policy regarding market-based interventions (taxes, changes in the exchange rate, fiscal spending, etc.) and more direct actions such as supporting specific investment projects through an agency such as a development bank. Both Leif and Hollis accepted the need for state intervention along such lines.

A second point is that all CGE models are built in a Keynesian framework. The models themselves and the data that they rely on explicitly incorporate Keynes's postulate that income must equal expenditure. Their accounting structure has a close relationship to the subtle equilibrium model in chapter 19 of the *General Theory* (Keynes, 1936). Once their parameters have been

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^{*} Tel.: +1 212 229 5901x4908.

E-mail address: taylorl@newschool.edu

calibrated to a base year social accounting matrix or SAM, CGE models are in accounting equilibrium up to the numerical precision of the computer at hand – the “computable” part boils down to asking how macro and sectoral flow variables shift when a pre-existing equilibrium is shocked. The models never were and are not Walrasian. They are exercises in macroeconomic accounting to the core, and that is how they should be understood.

Following [Velupillai and Zambelli \(2010\)](#) one can put the foregoing more strongly. Standard CGE applications all rely on textbook real analysis, based on Zermelo-Fraenkel set theory and the axiom of choice. Using standard numerical procedures a model-builder can compute continuous approximations to comparative static and dynamic variations around a SAM. Even if it has been put together on the basis of unsupported assumptions and dubious procedures, the principal virtue of the matrix is that its accounts balance to a “good approximation” – both before and after it is perturbed. The outcomes of numerical simulations on a SAM are useful only insofar as they are “conjoined to those intangible non-formal concepts like [a model-builder’s] intuition, experience, and insight” (p. 20).

Johansen and Chenery had those virtues in abundance, but they never thought that they were replicating an Arrow–Debreu economy, an exercise which Velupillai and Zambelli argue is computationally intractable in any case. The over-simplified gist is that an entity with finite computing capacity (say a human being or even a universal Turing machine) cannot solve a problem in which the agents involved confront a continuum of choices.

Consistent macro accounting limits the degrees of freedom available to the variables included in a CGE model. The qualitative character of its results depends crucially on how the available free variables enter into the macroeconomic causal structure or “closure” that is imposed upon the numbers. This fact is both a strength and a weakness of the methodology. One thing that one learns as an applied development economist is that there can be big differences in the ways that economies appear to behave – one may have substantial reserves of underemployed or surplus labor, another may be foreign exchange constrained, a third may have to adjust to amply available foreign resources from raw material exports or foreign aid. The possibility of building such stylized facts into a CGE model and drawing quantitative implications about how they influence the economy can be provide policy insight. On the other hand, CGE models are stupid. They do what their closures tell them to do, and can easily generate economically implausible results. Navigating between informed understanding of the economy in question and dealing with the recalcitrance of the models is a constant challenge for any applied CGE economist.

Both Johansen and Chenery no doubt believed that their models would be employed by dedicated national and regional planning offices to help them guide sectoral and macroeconomic structural change. Ironically, in practice CGE modeling has come to be used for adversarial purposes, for example by the World Bank and International Monetary Fund to advocate their Washington consensus policies and on all sides of the debates about the North American Free Trade Agreement and the Doha round of WTO negotiations. How a model is closed enters centrally into this arena, because its closure can to an extent be rigged to make it generate the qualitative results that the modeler thinks it should.

Finally, the models are useful insofar as they can execute quantitative thought experiments, e.g. which “effects” will dominate responses under what sets of circumstances? In policy practice it may well turn out that the economy will be responding to forces that the model-builder did not contemplate (I can’t imagine that in 2006 US policy-makers were computer-gaming events such as those that occurred in 2007–2009). This lack of relevance is not a weakness of the methodology per se, but it suggests a degree of humility is appropriate for model-builders in the face of Keynes’s “dark forces of time and ignorance which envelop our future.”

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