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Parameter estimation for a computable general equilibrium model: a maximum entropy approach

Channing Arndt[a,*], Sherman Robinson[b], Finn Tarp[c]

[a] *Department of Agricultural Economics, Purdue University, 1145 Krannert Building, West Lafayette, IN 47907-1145, USA*

[b] *Trade and Macroeconomics Division, International Food Policy Research Institute, Washington DC, USA*

[c] *Institute of Economics, University of Copenhagen, Copenhagen, Denmark*

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Abstract

We introduce a maximum entropy approach to parameter estimation for computable general equilibrium (CGE) models. The approach applies information theory to estimating a system of non-linear simultaneous equations. It has a number of advantages. First, it imposes all general equilibrium constraints. Second, it permits incorporation of prior information on parameter values. Third, it can be applied in the absence of copious data. Finally, it supplies measures of the capacity of the model to reproduce the historical record and the statistical significance of parameter estimates. The method is applied to estimating a CGE model of Mozambique.

JEL classifications: C51; C68

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1. Introduction

Computable general equilibrium (CGE) models have become workhorses for policy analysis. Despite their popularity, CGE models are frequently criticized for

* Corresponding author. Tel.: +1-765-494-5837; fax: +1-765-496-1224.
E-mail address: arndt@agecon.purdue.edu (C. Arndt).

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resting on weak empirical foundations, particularly for estimates of behavioral parameters (Shoven and Whalley, 1992; McKitrick, 1998). The problem is not confined to CGE models, but has been recognized for complex simulation models in general (Schmalensee et al., 1998).

For developed countries, some major microeconometric exercises have been undertaken to estimate behavioral parameters, notably trade parameters. These include efforts by the IMPACT project, the US International Trade Commission, and the US Central Intelligence Agency (Goodman, 1973; Alaouze, 1976, 1977; Alaouze et al., 1977; Shiells et al., 1989; Shiells, 1991; Shiells and Reinert, 1991; Shiells et al., 1993). Despite these and other efforts, the microeconometrics literature is widely viewed as providing only spotty coverage of the parameters of interest (Hansen and Heckman, 1996; McKitrick, 1998). In addition, it is far from clear that results from microeconometric studies can be appropriately applied to the more aggregate sectoral and household representations usually present in CGE models (Hansen and Heckman, 1996; Dawkins et al., 1999). For developing countries, the lack of an empirical basis for behavioral parameters is even more severe. As a result, debate over appropriate values for behavioral parameters remains highly contentious. This is particularly true for trade parameters in CGE models employing Armington type trade assumptions.

The dearth of estimates of behavioral parameters has generally led analysts to specify functional relationships that require relatively few behavioral parameters. Hence, the ubiquity of the constant elasticity of substitution (CES) functional form in applied general equilibrium analysis. This parsimony with respect to the number of behavioral parameters comes at a cost in terms of flexibility in representing technology or preferences (Jorgenson, 1984; Uzawa, 1962; McFadden, 1963).

Direct econometric approaches to estimating CGE models have been used (Jorgenson, 1984; Jorgenson and Slesnick, 1997; McKitrick, 1998). However, lack of data, computational and conceptual difficulties in estimation, and uncertainty concerning the validity of resulting estimates have comprised formidable barriers to application of the econometric approach. Existing applications reflect these difficulties. First, econometric estimates, such as those obtained by Jorgenson (1984), are almost always obtained using annual data. The elasticities obtained are thus short run. However, many CGE analyses consider a significantly longer adjustment time frame, often 3–5 years. Short run elasticities are likely to understate the response capacity of agents over this longer time frame. Second, given the large number of parameters to be estimated, long time series data for numerous variables are required to provide sufficient degrees of freedom for estimation. In many cases, the economy is likely to have undergone structural changes over the period, which may or may not be appropriately reflected in the estimation procedure.

Finally, even those econometric estimates designed specifically to feed parameter estimates to CGE models (e.g. Jorgenson, 1984; Jorgenson and Slesnick, 1997; McKitrick, 1998) undertake estimation without imposition of the full set of general equilibrium constraints. While the estimated parameters might provide a highly plausible description of historical production and consumption data sets, the