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The Quarterly Review of Economics and Finance
48 (2008) 287–306

The QUARTERLY REVIEW of ECONOMICS and FINANCE

www.elsevier.com/locate/qref

Sensitivity analysis in applied general equilibrium models: An empirical assessment for MERCOSUR free trade areas agreements

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Received 13 December 2006; received in revised form 13 December 2006; accepted 13 December 2006
Available online 25 March 2007

Abstract

In this paper, an applied general equilibrium (AGE) model is used to assess the welfare results of alternative free trade areas (FTA) for three MERCOSUR countries, Brazil, Argentina and Uruguay. The results of the sensitivity to shocks and parameters are evaluated. In such a way, the robustness of the results to different degrees of intra-blocs trade liberalization and trade elasticities will be assessed. It is shown that welfare gains for Brazil are very robust to different degrees of trade liberalization, and allocation effects drive these gains. For Argentina and Uruguay, welfare gains depend heavily on a higher degree of liberalization, as they are connected to terms of trade effects. This paper shows that trade elasticities are important parameters driving the model's results, as welfare gains for Argentina and Uruguay in both scenarios are very sensitive to these parameters. Therefore, AGE model's results of alternative FTA for MERCOSUR countries need to consider the uncertainty about parameters and shocks.

Keywords: Applied general equilibrium model; Free trade areas; Trade

1. Introduction

While applied general equilibrium models have been used to assess the overall effects of the Uruguay Round reform (Francois, 2000), ex-ante impacts due to NAFTA (Francois & Shiells,

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1062-9769/$ – see front matter
doi:10.1016/j.qref.2006.12.018

1994), and other trade policy issues, they have been frequently criticized for resting on weak empirical foundations. While Hansen and Heckman (1996) argue that the flexibility of the general equilibrium paradigm is a virtue hard to reject and provides a rich apparatus for interpreting and processing data, it can be considered as being empirically irrelevant because it imposes no testable restrictions on market data. McKitrick (1998) has also criticized the parameter selection criteria used in most AGE models, arguing that the calibration approach leads to an over-reliance on non-flexible functional forms.

Although most of AGE modelers recognize that accurate parameters values are very important, it is not easy to find empirical estimates of key parameters, like substitution elasticities, in the literature. Most of the models take up estimates "found in the literature" or even "best guesstimates" (Deardorff & Stern, 1986). Thus, if there is a considerable uncertainty surrounding the 'right' parameters, and these are key elements in the AGE results, a consistent procedure in their evaluation is imperative.

Applied general equilibrium models at regional level are tools for impact analysis, comparable to input–output and input–output econometric models, with important similarities and differences (West, 1995). Concerns about sensitivity analysis have also garnered significant attention in the application of these models. In input–output (IO) analysis, multipliers are estimated by taking the Leontief inverse of the estimated IO coefficients. Ten Raa and Jansen (1998) argue that this procedure is biased because Leontief inverses are non-linear functions, and the function mean values differ from the value of means. They have also proposed a methodology to deal with bias and sensitivity of multipliers in IO models. More generally, the issue of uncertainty and error analysis in input–output models has occupied the attention of many analysts; Jackson (1986) has explored the role of different density functions associated with the point estimates of input coefficients while Sonis and Hewings (1992) have explored the ramifications of errors in estimates through the identification of a field of influence approach. The problem in AGE models is further compounded by the presence of a variety of parameters, some estimated with known probability distributions, others with no known distributions combined with input–output data that are provided as point estimates.

If a consistent econometric estimation for key parameters in a AGE model study is not possible, the effort should be directed to test the uncertainty surrounding these parameters in terms of their impact on the model. Robustness tests are an important step to obtain the acceptance of the model results in applied economics. The assumptions embodied in AGE models come from general equilibrium theory. However, one set of assumptions, the values of model parameters, such as elasticities, are natural candidate for sensitivity analysis. Wigle (1991) has discussed alternative approaches to evaluate model sensitivity to parameter values, while DeVuyst and Preckel (1997) have proposed a quadrature-based approach to evaluate robustness of AGE models results, and demonstrated how it could be used for an applied policy model.

The Gaussian Quadrature (GQ) approach (Arndt, 1996; DeVuyst & Preckel, 1997) was proposed to evaluate AGE model results' sensitivity to parameters and exogenous shocks. This approach views key exogenous variables (shocks or parameters) as random variables with associated distributions. Due to the randomness in the exogenous variables, the endogenous results are also random; the GQ approach produces estimates of the mean and standard deviations of the endogenous model results, thus providing an approximation of the true distribution associated with the results. The accuracy of the procedure depends on the model, the aggregation and the simulations employed. Simulations and tests with the Global Trade Analysis Project (GTAP) model have shown that the estimates of mean and standard deviations are quite accurate (Arndt