

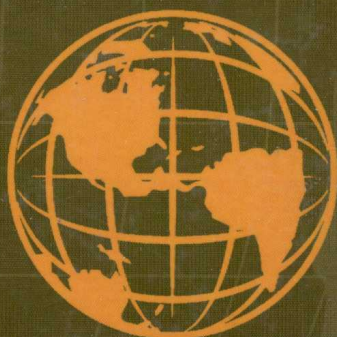


Volume 7

# FRONTIERS

*of ECONOMICS and GLOBALIZATION*

## NEW DEVELOPMENTS IN COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS FOR TRADE POLICY



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# FRONTIERS OF ECONOMICS AND GLOBALIZATION

7

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## ABOUT THE VOLUME: NEW DEVELOPMENTS IN COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS FOR TRADE POLICY

### *About the editor*

John Gilbert is a professor of economics in the Department of Economics and Finance, Jon M. Huntsman School of Business, at Utah State University. He has worked as a consultant for the World Bank, UNESCAP, ADBI, and the Peterson Institute for International Economics, and has published extensively in the area of trade theory and policy, and on the computable general equilibrium analysis of regional trading arrangements.

### *About the volume*

Computable general equilibrium (CGE) modeling is a well-established method for evaluating changes in economic systems, and has found wide application in the evaluation of international trade policy. This volume contains contributions on both the methodology of CGE and applications of those methods to the analysis of contemporary international trade policy issues. The selected applications cover a diverse range of important trade policy topics, including regional economic integration in Latin America, South and Southeast Asia, and the Pacific Rim, the impact of trade policy changes on poverty and income distribution (with applications to Southeast Asia and South Asia), immigration, liberalization of services, and agricultural trade policy. Major CGE models such as the Michigan model, FTAP, LINKAGE, and GTAP and its extensions are well represented in the applications, along with numerous custom models. CGE methods are advanced by chapters on the econometric estimation of constrained optimization models, new approaches to CGE modeling with heterogeneous firms, and new approaches to modeling a wide range of other trade-related issues including illegal immigration, services, biofuels, and economy–ecology interactions.

### *Aims and scope of the volume*

The volume presents new developments in the methodology and practice of CGE techniques as they apply to recent issues in international trade policy. The chapters contained in the volume are written by leading experts

in the field. The volume will be of interest to academic researchers working in trade policy analysis and computable/applied general equilibrium, advanced graduate students in international economics, applied researchers in multilateral organizations, and policymakers who need to work with and interpret the results of CGE analysis.

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John Gilbert  
*Editor*

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## INTRODUCTION

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Computable general equilibrium, or CGE, is a well-established numerical simulation technique for evaluating the economy-wide effects of changes in an economic system. It has become very widely used throughout the economics discipline, but is perhaps employed most frequently in the analysis of changes in international trade policy, where changes in tariffs and other taxes are often large and almost always involve multiple sectors and/or regions simultaneously. CGE methods, while certainly not without their limitations, have proved very effective at tracking the myriad of feedback and flow-through effects associated with new regional trading agreements and multilateral trade reforms, and have provided a consistent mechanism of analyzing the effects of changes in trade policy and related areas on a diverse range of economic outcomes.

CGE analysis of international trade and trade policy is an exciting and dynamic field. The purpose of this volume is to present selected new developments in the methodology and practice of CGE as they apply to recent issues in international trade policy. The volume contains 13 chapters, written by some of the leading experts in the area. The chapters will be of interest to academic researchers working in trade policy analysis and computable/applied general equilibrium, advanced graduate students in international economics, applied researchers in multilateral organizations, and policymakers who need to work with and interpret the results of CGE analysis.

Aspects of both the methodology of CGE and applications of those methods to the analysis of contemporary international trade policy issues are covered in the volume. The selected applications deal with a diverse range of important trade policy topics covering numerous regions of the globe, including regional economic integration in Latin America, South and Southeast Asia, and the Pacific Rim, the impact of trade policy changes on poverty and income distribution (with applications to Southeast and South Asia), immigration, services reform, and agricultural trade policy. Major CGE models such the Michigan model of world

production and trade, LINKAGE, FTAP, and GTAP and its extensions, are well represented in the applications, along with numerous custom models. CGE methods are advanced by chapters on the econometric estimation of constrained optimization models, new approaches to CGE modeling with heterogeneous firms, and new approaches to modeling a wide range of other trade-related issues including illegal immigration, trade in services, biofuels, and economy–ecology interactions.

The chapters in the volume are loosely arranged by topic area, although there is considerable crossover and complementarity across the works. In this introductory note I provide a very brief overview of the contributions.

Until relatively recently, CGE methods have been seen as an alternative to econometrically estimated simulation models, and in many cases one of the primary advantages of CGE is that it can be executed in situations where data are relatively thin (e.g., in the context of developing economies). As Golub, Hertel, Taheripour, and Tyner note in Chapter 6, however, the line between these two methods has become increasingly blurry with recent advances in structural econometric modeling techniques and the statistical estimation of CGE models. CGE models are essentially very large systems of nonlinear equations, and while the most common approach to parameterization in the CGE literature remains calibration, perhaps combined with separate estimation of key model parameters, recent advances have made estimation of constrained optimization problems a feasible alternative. In Chapter 1 of this volume, Torbjörn Jansson and Thomas Heckelei present some significant advances in this area. Their approach involves a combination of numerical techniques and utilization of out-of-sample information via Bayesian methods. Their proposed framework is suitable for typical empirical problems arising in trade analysis such as the estimation of trade equilibrium models in addition to a much wider class of problems, and they provide a number of demonstrations. The chapter should be of interest not only to those working with CGE trade models, but also to researchers working in numerical simulation much more generally.

The next two chapters in the volume address a common critique of CGE models: that the standard competitive Armington structure used by the most models can sometimes do a relatively poor job at predicting the changes in the trade flows resulting from a given change in trade policy. This line of argument is made most forcefully in a well-known paper by Kehoe (2003) who explored the CGE literature on NAFTA *ex post*. Further analysis along the same lines is provided by DeRosa and Gilbert (2006). In essence, the argument is that while standard structures do a good job of capturing changes in the intensive margin (changes in the quantity of existing trade), they do not capture changes in the extensive margin (entirely new trade). Empirical evidence suggests that the latter may in fact be more important (Kehoe and Ruhl, 2003).

Recent developments in the pure theory of international trade have sought to explain the extensive margin phenomenon by introducing firm heterogeneity. The most well-known examples of what has come to be known as the “new new” trade theory are the works of Eaton and Kortum (2002) and Melitz (2003). Chapters 2 and 3 present new attempts to incorporate firm heterogeneity along these lines into the CGE framework. In Chapter 2, Fan Zhai presents a model based on the Melitz (2003) framework, and examines the relative importance of the intensive and extensive margins in trade expansion following trade liberalization and a reduction in fixed trade costs. His results indicate that the extensive margin accounts for around one-third of the trade growth induced by the reduction in tariff or variable trade costs, and almost 200% in the case of reducing fixed trade costs.

In Chapter 3, Lorenzo Caliendo and Fernando Parro present an application of a heterogeneous firm model to the case of a Uruguay leaving MERCOSUR and forming a free trade agreement with the United States. Their approach, detailed further in Caliendo and Parro (2009), generalizes the Eaton and Kortum (2002) model by adding multiple sectors and countries, and incorporating trade in intermediate goods and the interaction across tradables and nontradables. Their approach has the advantage of relatively low computational and data requirements. In an interesting and timely application given recent US engagement in regional trading arrangements, they show that a free trade agreement with the United States would have positive welfare effects for Uruguay, with most of the gains coming from having access to lower cost intermediate inputs for production. This is a very promising area of future research.

While many CGE studies are concerned with the impacts of liberalization of merchandise trade, there is also a growing recognition that the liberalization of services might be equally or more important. In a very carefully constructed study presented as Chapter 4 of the volume, Philippa Dee and Ndiame Diop apply the FTAP model (an extension of the GTAP model to include a treatment of foreign direct investment) to evaluating the potential impacts of behind the border reforms in the provision of services in the Tunisia. The chapter presents a detailed discussion of the issues relating to measurement of barriers to services, and how appropriate liberalization shocks can be implemented in a CGE framework. Their results suggest that in the case of Tunisia the aggregate gains from liberalizing a subset of services would be roughly equivalent to those associated with fully eliminating barriers to its manufacturing trade, although smaller than those available from their proposed agricultural reform scenarios (involving an agreement with the EU). However, they also find that the adjustment costs associated with services liberalization in this case are considerably smaller than those required under merchandise trade reform scenarios, suggesting that, at least for Tunisia, services reform might be considered “low hanging fruit.”

The next chapter deals with an issue that might not traditionally be thought of as the domain of trade policy, but is in fact an issue of efficient movement of factor services across national boundaries. In a highly topical piece, Peter B. Dixon and Maureen T. Rimmer apply the USAGE model of the United States to the question of designing immigration policy, in particular as it relates to “imports” of low-skilled labor. They consider several scenarios, ranging from a reduction in the supply of low-skilled labor induced by tighter border security, to a fully liberalized regime under various assumptions, and complementary tax policies. They find that a tighter-border-security strategy generates a sustained reduction in the economic welfare of US households of 0.55%, equivalent to a permanent annual loss in economic welfare of about \$80 billion. By contrast, an optimally chosen liberalization policy would result in substantial economic gains. The sources of the gains are extensively decomposed in the chapter. A technical appendix sets out the details of the modeling of the labor market, and will be a useful reference to practitioners considering expanding the labor-market sides of their modeling efforts.

There is considerable debate on the effects of international trade on the environment, and the next two chapters deal with different aspects of the economy–environment interactions. In Chapter 6, Alla Golub, Thomas W. Hertel, Farzad Taheripour, and Wallace E. Tyner present an extensive survey of recent literature applying CGE methods to the analysis of biofuels policies. As they note, global biofuels production has boomed over the last decade in response to government interventions in various nations, and the complex web of linkages between biofuels and crops, livestock, and energy activities make it an area ripe for the application of general equilibrium methods. The chapter details a series of modifications to the standard CGE framework (the model builds extensively on GTAP-E, the version of GTAP designed to handle energy–environment–economy interactions) to handle biofuels, including a detailed specification of biofuels demand and supply, and demand for biofuels byproducts. Applications to the global biofuels boom, global emissions from land-use change, and the interplay between biofuels and the livestock sectors are discussed extensively, and the chapter concludes with a series of future challenges that remain. As such, the chapter both comprehensively covers the existing work in the area, and sets out a very useful map of where future contributions can be made.

In Chapter 7, David Finnoff and Arthur J. Caplan make another contribution to the trade and environment literature, presenting an interesting example of “bioeconomic” modeling. In their work, a general equilibrium ecosystem model is integrated with a CGE model of the regional and international economies. The ecosystem model is of the Great Salt Lake, and their approach accounts for the basic ecological relationships and human activities that interact within the lake’s watershed. It allows the quantification of ecosystem externalities that might occur as a

result of changes within the watershed and ecosystem, thereby identifying the degree to which certain species may be threatened. The chapter also demonstrates how international trade might be incorporated into the modeling framework. While the CGE model component in the current iteration of the model is still relatively simple, the approach is quite novel and this is a promising area for future research at the interface between international and environmental economics.

One of the most controversial aspects of international trade liberalization is the potential for adverse impacts on poverty and/or income distribution. The Doha Round of multilateral trade talks provides a recent example, where concerns over rural poverty led to demands by India and China for enhanced safeguards for developing countries in agriculture. In July 2008 the talks collapsed, once again, as negotiators failed to reach agreement on this very issue.

The effects of trade liberalization on poverty and income distribution have been an area of intense recent research in CGE and related areas. A number of applications have been surveyed in Hertel and Reimer (2005), Hertel and Winters (2005), and Gilbert (2008). As Hertel and Reimer (2005) note, CGE techniques have proved to be particularly useful in this area, in particular in combination with microsimulation models. Chapters 8–10 provide different examples of how CGE techniques can be applied to issues of poverty and household income distribution consequences of trade reform.

In Chapter 8, Anna Strutt, Thomas W. Hertel, and Susan Stone consider the implications of trade reform in Southeast Asia (ASEAN) on the economies of the Greater Mekong Subregion (GMS). They use a version of the GTAP model (Hertel, 1997) that has been modified to incorporate poverty impacts (see Hertel *et al.*, 2009). The approach employs a sequential, macro-micro modeling strategy in which results from the global trade model are passed on to a series of microsimulation models. Their results suggest that trade reform (they consider completion of ASEAN, expansion to include Japan, Korea and China, and further expansion to include Australia, New Zealand and India, i.e., ASEAN+3 and ASEAN+6) is likely to bring significant gains to the region in terms of economic welfare. Perhaps more importantly, they show that liberalization will likely lead to significant reductions in poverty in the region, perhaps as many as 320,000 people moved out of extreme poverty, with the largest share of those in Cambodia (one of the poorest countries in the GMS). Their results also suggest that poverty reduction is particularly significant in the agricultural and rural diversified stratum, suggesting a positive impact on rural poverty in the region.

Chapter 9 addresses South Asia, also one of the poorest regions of the world. John Gilbert and Reza Oladi consider the implications of regional trade reform under SAFTA. They take a somewhat different approach, using a model with multiple representative households directly built into

the model. This approach has the advantage of directly tracking the household behavior within the model, but the disadvantage (similar to the extensive margin problem) of being unable to track intra-household changes. This is mitigated by a greater number of households, and Gilbert and Oladi directly incorporate information on 43 household archetypes across the countries in the region. Their results suggest that, in contrast to the received wisdom, the distributional impacts of trade reform in South Asia are not likely to be biased against the rural poor in many of the economies. By contrast, in most of the economies the bias is against the urban non-poor, a result with significant political economy implications. Gilbert and Oladi also suggest some directions for future analysis, analyzing the theoretical implications of households with varying ability to respond to changes in factor prices.

In Chapter 10, Shikha Jha, David Roland-Holst, Songsak Sriboonchitta, and Drew Behnke provide another analysis of Southeast Asia, this time with a focus on developing agro-food markets and the emergence of China as a significant destination market for these commodities. They argue that because low-income Southeast Asia is below its agro-food potential, there is a significant opportunity for self-directed poverty reduction through regional agro-food market expansion. The analytical component of the chapter applies a version of the dynamic LINKAGE model developed at the World Bank. Scenarios cover changes in productivity, trade facilitation, and market access measures, and changes in foreign direct investment. Their results suggest that the potential effects of these changes on growth are significant, especially for the poorer economies in the GMS regions, but that they can only be fully realized if the policies are integrated and complementary.

CGE techniques have been very widely used for the *ex-ante* analysis of regional trading agreements, which have proliferated at a terrific rate over the last decade. Surveys of recent CGE literature in this area include Scollay and Gilbert (2000), Gilbert and Wahl (2002), Robinson and Thierfelder (2002), and Lloyd and MacLaren (2004). Several of the preceding chapters have considered the impact of regional trade reform in various contexts, and the next two chapters in the volume make further contributions in this area, focusing on some of the broader regionalism trends and consequences for three major economies in the Asia-Pacific region: the United States, Japan, and China.

In Chapter 11, Drusilla K. Brown, Kozo Kiyota, and Robert M. Stern present an updated version of their work on United States–Japan trade options (Brown, Kiyota and Stern, 2006). Using the Michigan model of world production and trade, the authors evaluate the welfare and sectoral employment consequences of the various free trade agreements negotiated and in process by the two economies. They also benchmark with unilateral and multilateral trade reform alternatives, which are found to be substantially superior in welfare terms, both for the economies under

study and for nonmembers. As they note, many of the recent agreements signed by these two economies are of the “hub-and-spoke variety.” They argue that the spokes emanate out in different and often overlapping directions, suggesting that the complex web of bilateral FTAs may create significant distortions of the global trading system.

In chapter 12, Robert Scollay and John Gilbert continue in a similar vein. They extend their earlier work on disentangling the many new developments in the Asia-Pacific region (Scollay and Gilbert, 2001). Their chapter focuses on the implications for China and its trading partners of China’s participation in regional trading arrangements in the Asia-Pacific region. As they note, while the “trade architecture” that will emerge in the Asia-Pacific remains very uncertain, it is clear that China will play a major role in regional trading developments. Using the GTAP model, they investigate the potential economic effects of several alternative architectures that may emerge in the region, ranging from “ASEAN+3” to a full free trade area of the Asia-Pacific, involving all members of APEC (the FTAAP). Their results suggest that the FTAAP yields a welfare outcome for China that is far superior than that offered by any other scenario. In the absence of the FTAAP, on the other hand, most of China’s East Asian partners derive the greatest welfare gain from either an ASEAN+3 arrangement or through expansion to include Australia, New Zealand, and India, indicating that there is some divergence of economic interests between China and its partners in the sequencing of preferential trade liberalization in the region.

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In the concluding chapter of the volume, Joseph F. Francois and Will Martin present a comprehensive survey of the issues relating to the measurement of the welfare effects of trade reform in computable general equilibrium models. They argue that standard CGE models understate the potential gains from trade reform for a wide variety of reasons, including poor measurement of barriers to trade, inappropriate aggregation of those barriers, missing process productivity gains and product quality/variety improvements, factor market misspecification, and gains from investment. Their challenging chapter synthesizes many of the issues raised separately in the preceding works in the volume and presents a call to action for those involved in CGE analysis. It should be required reading for all researchers active in the analysis of trade reform using CGE methods.