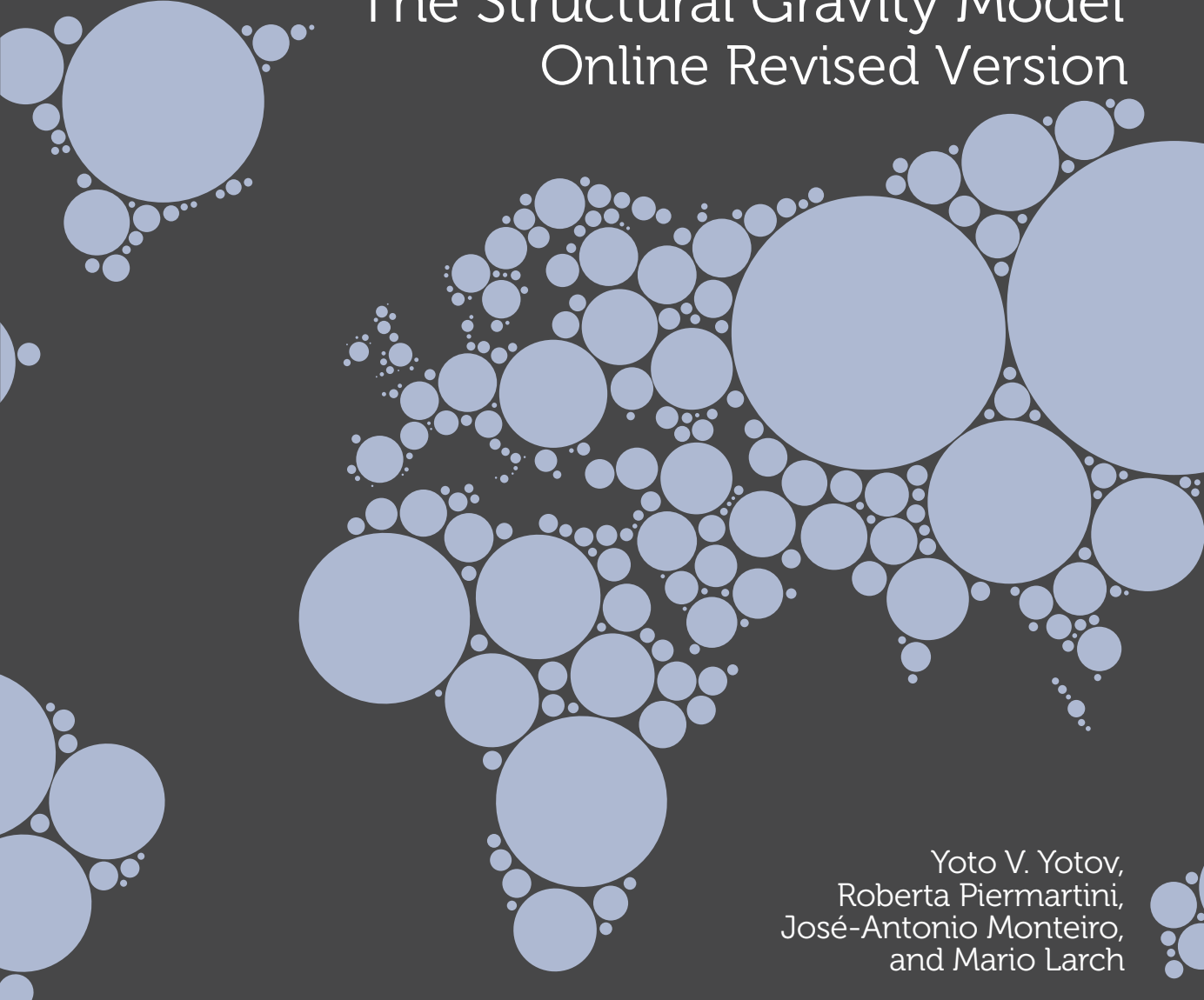


# An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model Online Revised Version



Yoto V. Yotov,  
Roberta Piermartini,  
José-Antonio Monteiro,  
and Mario Larch

**What is *An Advanced Guide to Trade Policy Analysis*?**

*An Advanced Guide to Trade Policy Analysis* aims to help researchers and policymakers update their knowledge of quantitative economic methods and data sources for trade policy analysis.

**Using this guide**

The guide explains analytical techniques, reviews the data necessary for analysis and includes illustrative applications and exercises.

**Find out more**

Website: <http://vi.unctad.org/tpa>

**An Advanced Guide to  
Trade Policy Analysis:  
The Structural Gravity Model  
Online Revised Version**



# CONTENTS

---

Authors	3
Acknowledgments	3
Disclaimer	4
Introduction	5
A. The gravity model: a workhorse of applied international trade analysis	5
B. Using this guide	6
<b>CHAPTER 1: PARTIAL EQUILIBRIUM TRADE POLICY ANALYSIS WITH STRUCTURAL GRAVITY</b>	<b>9</b>
A. Overview and learning objectives	11
B. Analytical tools	12
1. Structural gravity: from theory to empirics	12
2. Gravity estimation: challenges, solutions and best practices	17
3. Gravity estimates: interpretation and aggregation	28
4. Gravity data: sources and limitations	32
C. Applications	40
1. Traditional gravity estimates	41
2. The “distance puzzle” resolved	45
3. Regional trade agreements effects	49
D. Exercises	55
1. Estimating the effects of the WTO accession	55
2. Estimating the effects of unilateral trade policy	56

Appendices	57
Appendix A: Structural gravity from supply side	57
Appendix B: Structural gravity with tariffs	60
Appendix C: Databases and data sources links summary	63
<b>Chapter 2: General equilibrium trade policy analysis with structural gravity</b>	<b>67</b>
A. Overview and learning objectives	69
B. Analytical tools	70
1. Structural gravity: general equilibrium context	70
2. Standard approach to general equilibrium analysis with structural gravity	88
3. A general equilibrium gravity analysis with the Poisson Pseudo Maximum Likelihood (GEPPML)	95
C. Applications	102
1. Trade without borders	103
2. Impact of regional trade agreements	111
D. Exercises	117
1. Calculating the general equilibrium impacts of removing a specific border	117
2. Calculating the general equilibrium impacts of a regional trade agreement	118
Appendices	119
Appendix A: Counterfactual analysis using supply-side gravity framework	119
Appendix B: Structural gravity with sectors	121
Appendix C: Structural gravity system in changes	126
References	131

## AUTHORS

---

### **Yoto V. Yotov**

Drexel University, CESifo and ERI-BAS

### **Roberta Piermartini**

Economic Research and Statistics Division, World Trade Organization

### **José-Antonio Monteiro**

Economic Research and Statistics Division, World Trade Organization

### **Mario Larch**

University of Bayreuth, CESifo, ifo Institute, and GEP at University of Nottingham

## Acknowledgments

The authors would like to thank Michela Esposito for her comments and valuable research assistance. They also would like to thank Delina Agnosteva, James Anderson, Richard Barnett, Davin Chor, Gabriel Felbermayr, Benedikt Heid, Russell Hillberry, Lou Jing, Ma Lin, Antonella Liberatore, Andreas Maurer, Jurgen Richtering, Stela Rubinova, Serge Shikher, Costas Syropoulos, Robert Teh, Thomas Verbeet, Mykyta Vesselovsky, Joschka Wanner, Thomas Zylkin, as well as the seminar and workshop participants at the ifo Institute, the World Trade Organization, the World Bank, the U.S. International Trade Commission, Global Affairs Canada, the University of Ottawa, the Kiel Institute for the World Economy, the Tsenov Academy of Economics, and the National University of Singapore for helpful suggestions and discussions. Thanks also go to Vlasta Macku (UNCTAD Virtual Institute) for her continuous support to this project and her role in initiating this inter-organizational cooperation.

The production of this book was managed by WTO Publications. Anthony Martin has edited the text. The website was developed by Susana Olivares.

## DISCLAIMER

---

The designations employed in UNCTAD and WTO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the United Nations Conference on Trade and Development or the World Trade Organization concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers. The responsibility for opinions expressed in studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the United Nations Conference on Trade and Development or the World Trade Organization of the opinions expressed. Reference to names of firms and commercial products and processes does not imply their endorsement by the United Nations Conference on Trade and Development or the World Trade Organization, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.



# INTRODUCTION

---

## A. The gravity model: a workhorse of applied international trade analysis

Quantitative and detailed trade policy information and analysis are more necessary now than they have ever been. In recent years, globalization and, more specifically, trade opening have become increasingly contentious. It is, therefore, important for policy-makers and other trade policy stakeholders to have access to detailed, reliable information and analysis on the effects of trade policies, as this information is needed at different stages of the policy-making process.

Often referred to as the workhorse in international trade, the gravity model is one of the most popular and successful frameworks in economics. Hundreds of papers have used the gravity equation to study and quantify the effects of various determinants of international trade. There are at least five compelling arguments that, in combination, may explain the remarkable success and popularity of the gravity model.

- First, the gravity model of trade is **very intuitive**. Using the metaphor of Newton's Law of Universal Gravitation, the gravity model of trade predicts that international trade (gravitational force) between two countries (objects) is directly proportional to the product of their sizes (masses) and inversely proportional to the trade frictions (the square of distance) between them.
- Second, the gravity model of trade is a **structural model with solid theoretical foundations**. This property makes the gravity framework particularly appropriate for counterfactual analysis, such as quantifying the effects of trade policy.
- Third, the gravity model represents a **realistic general equilibrium environment** that simultaneously accommodates multiple countries, multiple sectors, and even firms. As such, the gravity framework can be used to capture the possibility that markets (sectors, countries, etc.) are linked and that trade policy changes in one market will trigger ripple effects in the rest of the world.
- Fourth, the gravity setting is a **very flexible structure** that can be integrated within a wide class of broader general equilibrium models in order to study the links between trade and labour markets, investment, the environment, etc.
- Finally, one of the most attractive properties of the gravity model is its **predictive power**. Empirical gravity equations of trade flows consistently deliver a remarkable fit of between 60 and 90 percent with aggregate data as well as with sectoral data for both goods and services.<sup>1</sup>

Capitalizing on the appealing properties of the gravity model, this *Advanced Guide to Trade Policy Analysis* complements and is best used in conjunction with the *Practical Guide to Trade Policy Analysis* published in 2012. In particular, the *Advanced Guide* presented in Chapter 3 a brief overview of the theoretical foundation of gravity models, possible estimation methods, and advanced modelling issues, such as the handling of zero-trade flows and calculation of tariff equivalents of non-tariff barriers. The *Practical Guide* also discussed data sources for gravity analysis and explains how to build a gravity database.

Chapter 1 of this *Advanced Guide* reconsiders some of these issues, including data challenges and sources, but also integrates the latest developments in the empirical gravity literature by proposing six recommendations to obtain reliable estimates of the **partial equilibrium effects** of bilateral and non-discriminatory trade policies within the same comprehensive, and theoretically-consistent econometric specification of the structural gravity model.

In addition, unlike the *Practical Guide*, which only presented in Chapter 5 what Computable General Equilibrium models are and when they should be used, Chapter 2 of this *Advanced Guide* offers a deep analysis of the structural relationships underlying the general equilibrium gravity system, and how they can be exploited to make trade policy inferences. In particular, Chapter 2 presents standard procedures to perform counterfactual analysis with the structural gravity model and outlines the latest methods developed in the literature to obtain theory-consistent **general equilibrium effects** of trade policy with a simple procedure that can be performed in most statistical software packages. Chapter 2 further shows how the structural gravity model presented in this *Advanced Guide* can be integrated within a larger class of general equilibrium models, such as a dynamic gravity model.

## B. Using this Guide

This *Advanced Guide* is targeted at economists with advanced training and experience in applied research and analysis. In particular, on the economics side, advanced knowledge of international trade theory and policy is required, while on the empirical side, the prerequisite is familiarity with work on databases and with the use of STATA software. The reader with limited experience with STATA may wish to first review the applications and complete the exercises proposed in the *Practical Guide to Trade Policy Analysis*.

The Guide comprises two chapters. Both chapters start with a brief introduction providing an overview of the contents and setting out the learning objectives. Each chapter is further divided into two main parts. The first part introduces a number of theoretical concepts and analytical tools, and explains their economic logic. The first part of Chapter 1 also includes a discussion on data sources. The second part of both chapters describes how the analytical tools can be applied in practice, showing how data can be processed to analyse the effects of the trade policies on trade flows output, expenditures, real GDP and welfare. Each of these applications has been designed only for a pedagogical purpose.

The software used for partial and general equilibrium analysis with the structural gravity model is STATA software. While the presentation of these applications in the chapters can stand alone, the files with the corresponding STATA commands and the relevant data can be found on the *Practical Guide to Trade Policy Analysis* website: <http://vi.unctad.org/tpa>. A general folder entitled "Advanced Guide to Trade Policy Analysis" is divided into sub-folders which correspond to each chapter (e.g. "Advanced Guide to Trade Policy Analysis\Chapter1"). Within each of these sub-folders, the reader will find datasets, applications and exercises. Detailed explanations can be found in the file "readme.pdf" available on the website.

## Endnote

- 1 Head and Mayer (2014) offer representative estimates and evidence for the empirical success of gravity with aggregate data. Anderson and Yotov (2010) present and discuss sectoral gravity estimates with goods trade. Anderson et al. (2015a) demonstrate that gravity works very well with services sectoral data. Finally, Aichele et al. (2014) estimate sectoral gravity for agriculture, mining, manufacturing goods and services.