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PART I

Introduction

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Applied Methods for Trade Policy Analysis: An Overview

Joseph F. Francois and Kenneth A. Reinert

After receiving their respective Ph.D.s, the authors of this chapter both set off to work at the U.S. International Trade Commission (USITC) in Washington. In our graduate studies, we had been steeped in mainstream international economics and, consequently, naively thought of ourselves as knowing at least the basics of what was necessary for working in an applied policy environment. Our delusions proved to be short-lived. Within a few weeks of our arrival at the USITC, it became apparent that there was a broad set of tools required for our jobs that were rather different from those emphasized in academia. There was also a need to temper these tools with a sense of policy relevance. Within months of our arrival, we needed to become versed in the nuances of imperfect substitutes models, trade data nomenclature, social accounting matrices, computable general equilibrium modeling, and a host of other concepts and methods. While the standard trade models continued to provide intuition in many areas, our day-to-day professional work was often in another realm entirely. In many cases, the applied work provided new and useful insight into the significance of various theoretical issues.

The purpose of this book is to assist others in their own professional journey from standard trade theory to applied trade analysis in a policy environment. Our objective is to make life easier for the graduate student working on an applied trade topic, the government or international organization economist engaged in the quantitative analysis of trade policy, or the policy analyst trying to understand what in the world trade economists are talking about in their reports. Our success in assisting such individuals in this bridging process will justify the book's existence.

The objective of this chapter is to provide a detailed overview of the objectives of the book, and a suggested strategy for its use. Our first task is to give the reader an idea of what it is that distinguishes applied trade policy

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analysis from theoretical trade policy analysis. We do not mean to convey the notion that the two types are unconnected, nor even that the delineation between the two is clear-cut. It can be difficult to tell when one has moved from "numbers with theory" to "theory with numbers." However, we recommend that you keep such a delineation in mind. This is discussed in Section I of the chapter. Our second task is to identify and describe some of the basic frameworks of applied trade policy analysis, the foundation concepts of the field. We take up this task in Section II. Building on these basic frameworks, we move on to a set of standard applications to which these methods can be applied; the description of these applications is provided in Section III. Section IV delves into a number of important extensions to the standard applications, all of which are important and active areas of research in their own right. Finally, in Section V we turn briefly to the issue of behavioral parameters. This book is devoted to applied analysis, centred on the collection, organization, and analysis of data through the construction of applied static and dynamic models. Such research depends not only on available production and trade statistics, but also on available parameter estimates. In our view, the econometric estimation of behavioral elasticities is a very important but relatively undervalued area of study. We conclude in Section VI with some final comments on model transparency.

I What Is Applied Trade Policy Analysis?

What distinguishes applied trade policy analysis from theoretical trade policy analysis? There is no clear line of division between theoretical and applied models, but rather a continuum from "theory" to "theory with numbers" to "numbers with theory." Nevertheless, we feel that there are a set of characteristics that *tend* to distinguish applied trade policy analysis from theoretical trade policy analysis. These include (i) a *detailed policy orientation*; (ii) the formulation of models that are not merely local approximations from non-distorted base equilibria but that, in contrast, provide sensible results for *nonlocal changes in policy parameters from distorted base equilibria*; (iii) a concern for *accurate and current data* as the foundation of the modeling exercise; and (iv) *model structure determined by the data*, rather than selective use of data to fit a theoretical structure. For example, data on two-way trade often precludes homogeneous goods models, dictating instead the inclusion of *product differentiation* at the country and/or firm level in the formulation of the model.

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I.1 Detailed Policy Orientation

First, let us say a few words about what we mean by "detailed policy orientation." Many theoretical models consider trade policies, especially *ad valorem* tariffs, in the process of considering the properties of the model. The term "detailed policy orientation" as we use it here means more than a simple, theoretical consideration of *ad valorem* tariffs. It involves an analytical commitment to the sectoral and institutional details of a policy as well as a commitment to be engaged in the policymaking process with all the inherent frustrations. A concern for sectoral detail forces the researcher into the realms of trade data nomenclatures, input–output relationships, and industrial classification schemes. A concern for institutional detail requires attention to the way in which a trade measure is implemented. How are quotas allocated? Is there evidence of quota rent sharing? How do quotas and tariffs interact? Are there supporting domestic policies which must be addressed? Finally, engagement in a policymaking process requires a sensitivity to the types of information that are relevant to policymakers, a willingness to engage the public in lay explanations of models and results, and the patience to endure what often appear to the economist as mundane concerns of policymakers and the public.[1] The move from theoretical analysis to applied analysis often involves a change of professional mode from economist to public servant. The applied trade policy economist must wear more than one hat. Occasionally, when wearing the public service hat, we are asked to go beyond (or even contradict) the insights offered by formal analysis and condone purely political judgements on matters of policy. At this point, the hat should be hung back up on the rack.[2]

I.2 Nonlocal Changes from Distorted Base Equilibria

Most static applied trade policy analysis makes use of a procedure of economic analysis known as *comparative statics*. Even "dynamic" models often involve either the comparison of steady-state equilibria (comparative statics with time subscripts) or fake dynamics involving a sequence of static

1 An applied trade policy modeller was presenting the basic features of a sectorally detailed CGE trade model to a top trade official. The official's first question was "Does the model have an orange sector in it?" Reply: "I am afraid not, sir, oranges are included in the fruit sector." The official was disappointed.

2 An academic trade economist was presenting the basic features of a partial-equilibrium trade policy model for use in import relief cases to a senior U.S. trade official. At the conclusion of the presentation, the official commented, "That is all well and good, and I will certainly use it as long as it will allow me to vote the way I want to."

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equilibria. Under this approach, an initial or base equilibrium is compared to an equilibrium in which some exogenous variable, such as a trade policy variable, has been changed. In most theoretical models, the economy starts off in a nondistorted state with no tariffs, quotas, or other taxes present. From this initial, nondistorted equilibrium, an infinitesimal tariff is introduced and a new, counterfactual equilibrium is solved for using the linear approximation of differential calculus. In applied trade policy analysis, the comparative static framework is used with two differences. First, the initial or base equilibrium has built into it the relevant set of distortions due to trade policy or other government interventions. This allows for second-best welfare effects of changes in trade policies. Second, changes in trade policies are those actually under consideration. They are, therefore, nonlocal.

As a consequence of the presence of distortions in the base equilibrium, the removal of small tariffs can reduce rather than improve welfare by reallocating economic activity into other distorted sectors. Since the model is analysing a second-best world, it is not always the case that trade liberalization improves welfare. As a consequence of the nonlocal policy parameters introduced into the analysis, the functional forms chosen to describe economic behaviour matter. The economy moves far enough away from the initial equilibrium for the functional forms used to determine where the economy lands. For example, in partial equilibrium models, linear versus constant elasticity functional forms can make a big difference when considering the effects of large tariffs or quotas.

I.3 Accurate and Current Data

In trade policy analysis based on the comparative static procedure described, three things determine the result of a policy simulation: the functional forms used to describe the behaviour of the model (model structure), the base data used to describe the initial equilibrium, and the behavioural elasticities used in the functional forms. Even if the analyst chooses functional forms with care, the share and elasticity parameters of these functional forms must be filled in accurately. The share parameters are calibrated from a data set describing the initial equilibrium. In a partial equilibrium model, this data set may be quite simple. In a general equilibrium model, it may be quite complex. In either case, if we want to provide results of some merit, care must be taken to make the base data accurate. That said, policymakers are often very much concerned with the currency of model results. It will be of little use to have a base data set a decade old, ideally, it will be up to date. Unfortunately, there is sometimes a trade-off between

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accuracy and currency of data. When there is, professional judgement must be used. The last elements of the model, behavioural elasticities, are also important. Their magnitude will determine both qualitative and quantitative results of models. Unfortunately, in our view, while the field of economics is obsessed with functional forms, it does not reward research into either the estimation of base data sets or behavioral elasticities for trade policy modeling. This is part of our field's bias toward theoretical as opposed to applied modeling.

Model Structure and Data Structure Finally, we turn to the trade-off between data structure and model structure. Consider product differentiation. The classical theoretical trade models assume that imports and domestic competing goods are *perfect* substitutes in demand. In this case, the model (i) describes interindustry trade only and (ii) cannot support a number of goods that exceed the number of factors.[3] Both of these characteristics prove to be severe limitations for applied work. To get around the second limitation, it is possible to specify a specific factor for each sector. With the additional factor of labour, then the number of factors exceeds the number of sectors by one, and ten, twenty, or thirty sector models become a possibility. This, however, still does not address the first limitation. Even at high levels of disaggregation, there are both imports *and* exports in the trade data for most sectors of any economy; intraindustry trade is a widespread phenomenon. A perfect substitutes model cannot explain this and therefore resorts to explaining net imports or net exports in any sector. In essence, this sweeps the two-way trade observed in the trade data under an analytical rug, in both partial and general equilibrium frameworks. Applied homogeneous goods models, while consistent with theory, are usually inconsistent with the observed world.

One alternative to all of these difficulties is simply to recognize that imports and domestic competing goods are *imperfect* substitutes in demand. This represents product differentiation by country of origin. This idea was originally proposed by Armington (1969), who used a constant elasticity of substitution (CES) functional form to describe preferences among imports from various countries. Consequently, the combination of product differentiation by country of origin and a CES functional form for preferences has become known as the *Armington assumption*. Product differentiation by country of origin has been incorporated into both partial and general equilibrium frameworks. In the partial equilibrium framework, this assumption

3 This result goes back to Samuelson (1953).

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was utilized early on by Baldwin and Lewis (1978) and Baldwin, Mutti, and Richardson (1980). It was incorporated into a U.S. International Trade Commission Staff Study by Rousslang and Suomela (1985) which was widely circulated. In general equilibrium frameworks, the Armington assumption was used by Dervis, de Melo, and Robinson (1982); Whalley (1985); and de Melo and Robinson (1989).

The Armington assumption has been the centre of controversy.[4] Out of this controversy, a second alternative to the perfect substitutes assumption that recognizes the existence of product differentiation at the level of the firm has emerged. Appropriately, this approach is known as firm-level product differentiation. This approach has at least two origins. The first of these is the introduction of monopolistic competition into international trade theory, beginning with Krugman (1979, 1980) and Ethier (1979, 1982). The second is the incorporation of firm-level product differentiation into a model of the Canada–United States free trade agreement (CAFTA) by Brown and Stern (1989). The motivation of Brown and Stern was to minimize terms-of-trade effects inherent in the Armington structure. Norman (1990) has argued that the firm-level product differentiation approach is preferable to the country of origin or Armington approach because it locates product differentiation on the supply side. The limitation of the firm-level product differentiation approach is that the absence of firm-level data makes econometric estimation of elasticities difficult. This point has been emphasized by Winters (1990). Another limitation is that, as in the case of homogeneous goods models, models of pure firm-level product differentiation can yield indeterminate production patterns, when the number of goods exceeds the number of factors. In practice, therefore, models with firm-level product differentiation often incorporate product weights that are sector- and region-specific (see Brown, 1994). The result is that the spirit of Armington is often preserved in imperfect competition models, even when the formal Armington assumption is dropped.[5]

II Getting Started: Basic Frameworks

Suppose that you have been recently hired as an economist in the Trade Ministry of your country. Suppose further that your supervisor has given you a few weeks to sharpen your skills in the field of applied trade policy analysis

4 An overview of this controversy is provided in Francois and Shiells (1994).
5 It is possible to calibrate the demand elasticity for firm-level product differentiation from an elasticity of scale for the sector in question. The latter, though, are in short supply. For more on this see Chapter 11.

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in preparation for an upcoming project. Where should you begin? We want to suggest that you put aside for these few weeks your trade textbooks and take a look at Part II of this book. Here we cover a number of subjects which we think will be of more immediate use to you.[6]

In the classroom, we use a policy parameter t, an *ad valorem* tariff, to introduce commercial policies into our models. In your Trade Ministry, however, when you begin your first project, you will in all probability encounter a proliferation of commercial policies structured according to, perhaps, a number of different nomenclatures. No doubt, when mired in the intricacies of these commercial policies, you will long for the simple t parameter of the graduate texts. To ease the difficulty, Chapter 2 takes up the subject of quantifying commercial policies. It is only appropriate that a volume on trade policy analysis begin with the policies themselves.

Chapter 2 considers tariffs, sometimes referred to as nominal protection. The bulk of the chapter, though, deals with nontariff measures or NTMs. The chapter analyses the qualitative effects of these trade measures and their measurement. It also identifies sources of data on trade measures. Appendix 2.1 presents the UNCTAD nomenclature of trade control measures, and Appendix 2.2 provides a glossary of NTMs. The chapter is not exhaustive; if it were, it would fill the entire volume. Therefore, the reader must utilize it, and its excellent set of references, as an *entrée* into the literature on commercial policies.

In standard trade theory, we consider a move from autarky to free trade and, under certain conditions, show that welfare under free trade must be at least as great as welfare under autarky.[7] In your new role as trade economist, this will be unsatisfactory for two reasons. First, second-best considerations and terms of trade effects make welfare declines as a result of movements toward free trade a logical possibility. Second, even if welfare increases as a result of a movement towards free trade, the burning question will be, How much? In one way or another, you will have to quantify welfare effects. This brings us to Chapter 3.

Chapter 3 identifies three commonly used approaches to general equilibrium welfare evaluation in distorted open economies. These are the balance of trade function approach based on compensation measures, the direct evaluation approach using a money metric, and Marshallian surplus measures. The balance of trade function yields measures of the compensation required to maintain utility at a specified level. The equivalent variation

6 Other useful references which address commercial policy *theory* are Vousden (1990) and Helpman and Krugman (1989).
7 Dixit and Norman (1980, Chapter 3).

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version of this measure provides a money metric of welfare change. The money metric approach is different from the compensation approach in the presence of distortions and is shown to be identical with a modified version of the balance of trade function derived from the public finance literature. Diagrammatic surplus measures are derived by using Taylor series expansions to provide intuition about the source of welfare gains or losses from changes in trade policies or terms of trade.

In trade theory, once we have shown that the movement from autarky to trade cannot reduce welfare, we then turn to a set of comparative static experiments in which we consider the effects of transfers, factor supply changes, technological change, and trade policies on the endogenous variables of the system.[8] When using the linear approximation of total differentiation, there appear in the system a number of parameters that reflect the initial values of variables. The size of these initial values determines the quantitative and sometimes the qualitative results of the comparative static exercises. In applied trade models, we usually solve models in level form rather than using linearization methods.[9] Nevertheless, the system still has a (large) number of parameters reflecting initial values of variables. Since we are very concerned with the quality of both qualitative and quantitative results in applied trade policy modeling, establishing these initial values is of prime importance. In the literature on computable or applied general equilibrium modeling, these initial values are entered into the model by *calibrating* the model to what is known as a *benchmark equilibrium dataset*.[10] The benchmark equilibrium dataset serves as a description of the economy in the initial equilibrium before any policy changes have been made. How does one construct such a dataset? Recently, it has become standard practice to construct them in the form of a *social accounting matrix* or SAM, originally developed to analyze income distribution issues in developing counties.[11] Chapter 4 of this volume is an introduction to the concept of SAMs and their use as benchmark equilibrium datasets. It has circulated in recent years through a number of international organizations and has proved helpful in a number of applications.

Chapter 4 begins in a very straightforward way with simple macroeconomic SAMs which are related to familiar macroeconomic accounting identities. It then moves, step by step, to more complicated SAMs by adding institutional accounts and sectoral detail. The chapter lays out a basic meth-

8 Dixit and Norman (1980, Chapter 5).
9 On the issue of linearization versus level solution, see Hertel, Horride, and Pearson (1992).
10 On calibration and benchmark equilibrium datasets, see Shoven and Whalley (1984) and Shoven and Whalley (1992, Chapter 5).
11 See Pyatt and Round (1985).

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odology for SAM construction and consolidation which should help to simplify this tedious process for you. It then begins to describe the relationship between SAMs and general equilibrium analysis of trade policy by addressing three topics: flexible aggregation, calibration, and closure. In the case of flexible aggregation, the authors make a case for maintaining a sectorally detailed SAM which is aggregated in a different fashion for each trade policy that comes under scrutiny. This methodology is taken up in Chapter 7 (discussed later).

While international trade theory is fundamentally a general equilibrium affair, there are many circumstances in which single market or partial equilibrium modeling is both appropriate and desirable. For example, there are many highly detailed trade policies applying to specific products which will be a small portion of standard industrial classifications of the economy in question. In this case, it is simply not possible to construct a SAM for a general equilibrium model. An antidumping case on Chinese candles or Korean baseball uniforms is best addressed in a partial equilibrium framework. The partial equilibrium models of trade that we learned as undergraduates are only the starting point for the models used by applied trade policy analysts today, not in the least because of their perfect substitutes assumption. A whole menu of alternative models, solvable on spreadsheets, are utilized on a daily basis around the world. Chapter 5 provides an introduction to such models.

Chapter 5 outlines, in detail, methodological approaches for constructing simple partial equilibrium trade models. Emphasis is placed on quantifying the effects of tariffs and nontariff measures on trade, production, and national income. The chapter begins with perfect substitute models and then continues with imperfect substitute models. It takes you through the modeling of both tariffs and quotas and numerically illustrates several important concepts, including linearization errors and the implications of underlying distortions for second-best policy options. Despite its partial equilibrium emphasis, welfare measures are explicitly linked to their general equilibrium counterparts, making clear what assumptions are being made when measuring welfare in partial equilibrium. Importantly, the chapter introduces you to the implementation of applied models using spreadsheet software.

As stated in Section I, product differentiation plays an important role in distinguishing applied trade policy analysis from its theoretical counterpart. For many years, a barrier to making the intellectual transition from theoretical to applied models has been the complex model structure introduced by incorporating product differentiation in applied general equilibrium trade models. It is a long leap from a simple Jones or Dixit–Norman style model

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