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So you want to build a trade model? Available resources and critical choices

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ABSTRACT

This paper reviews recent developments in trade theory, data, and modeling to provide guidance to researchers who are building and using trade models. Our findings show that trade models have fallen behind the latest development in theory, in part because data collection has not (and arguably will not) be able to keep pace with the needs of models built to incorporate the latest theories. The direction, much less the magnitude, of the errors made due to the limitations of today's trade models is uncertain, which should be a grave concern to modelers and the policymakers who rely on these models.

1. Introduction

Effective modeling, in trade or in any other area, involves difficult choices as to what aspects of reality to highlight and what to exclude. In computable trade policy models, this process is especially difficult, as our perception of reality and the relative importance of its different aspects is currently in flux. This paper attempts to briefly review several related fronts, all crucial to building a state-of-the-art empirical trade model for policy analysis: new developments in trade theory, new data sources, appropriate modeling structures and assumptions, and availability of related parameters. While the specifics of any trade model must start with the policy questions and context it is designed to address, we hope that the updates, questions and complexities raised here will help guide the next generation of trade modelers.

We are in the midst of a classic learning cycle. New policy questions are leading to new data sets, causing a reexamination of theory and changes in the nature, scope, and emphasis of trade models. We address each in turn, starting with prior theory and its limitations, continuing to new policy questions, then examine the data sources available as raw material for the next generation of trade models. We conclude with a review of the uncertainties in the theory, gaps in the data (including parameter estimates), and other challenges inherent in designing new trade models that can guide policymakers in addressing key trade questions.

Many challenges are implicit in this effort. No data set can be judged "best" except as compared to a set of viable alternatives and in the context of a specific modeling approach. The appropriate modeling approach, in turn, is determined by the specific policy question that one is trying to address, as well as the availability and quality of the data needed. Other important decisions need to be made, such as whether to create a static or dynamic model. New theories must survive rigorous peer review and testing on "out of sample" data before being adopted as the new norm in the profession. Parameter estimation relies on econometric methods, which are constantly evolving. While one can always claim that the profession is on the verge of significant breakthroughs and change, it seems particularly true at the moment, with regards to both data and modeling methods.

As we shall see, trade models and trade data sets are only slowly evolving in response to theoretical breakthroughs that challenge the modeling orthodoxy. On the one hand, policy-relevant modeling cannot and should not try to incorporate the "flavor of the month" in trade theory. Yet to the extent to which testing new models requires different data collection and relationships among economic variables, this important vetting process is delayed.

1.1. Theoretical developments relevant to trade modeling

One can trace the origins of trade theory to David Ricardo and the principle of comparative advantage. Comparative advantage as the primary source of gains from trade continued to be the heart of theoretical trade models through 1980, the most famous of which was the Heckscher–Ohlin–Samuelson (H–O–S) model. Yet empirical trade modelers struggled with many inconsistencies. Many countries export products for which they have no basis for comparative advantage in their resource endowments, technology, or demand. Two-way trade

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(exporting and importing similar or identical products) also violates the H–O–S model implications.

Armington-based trade models start with the assumption that all countries produce and trade varieties of the same basic set of products, where each country's variety is a substitute, but not a perfect substitute, for varieties produced elsewhere. This truly innovative approach preceded the acceptance of the expansion of trade theory to monopolistically competitive microeconomic theory by more than a decade. It has served as the basis for an entire generation of empirical trade models, from pioneering efforts in the early 1980s to the Global Trade Analysis Project (GTAP) and other models today. In the Armington framework, data at odds with the prevailing H–O–S theory could be explained and recreated in a modeling framework, namely two-way trade and greater stability of trade flows in the presence of large relative price swings.

Yet the Armington approach is seen as being an increasingly limiting and restricting factor in empirical trade models today. Existing estimates of Armington trade elasticities are being attacked on both theoretical and empirical grounds. In theory, Armington-based models fail to generate the pattern of trade observed, with many bilateral flows by commodity being zeros in the data. In a world increasingly dominated by global production networks and multinational corporations, it is ever more difficult to justify a model based on the assumption that Honda Accords produced in Marysville, Ohio are perfect substitutes with Fords produced in Dearborn, Michigan, but imperfect substitutes with Honda Accords imported from Saitama, Japan!

Empirical challenges note two basic problems: 1) modeling results often depend critically on the Armington elasticities used,[2] and 2) estimates of Armington elasticities vary widely, depending on the context in which they are estimated. Indeed, the relationship between Armington elasticities and estimated gains from trade liberalization is almost proportional, as noted by Valenzuela et al. (2007). "These (Armington elasticities) are central to the welfare outcomes of trade liberalization exercises in CGE models, and they continue to be hotly debated. For the sake of illustration, consider what happens when the Armington elasticities for all countries are doubled: the estimated global welfare from full liberalization is also doubled: $176 billion instead of $86 billion."[3] If model results are highly sensitive to Armington elasticities, good estimates of those parameters become paramount to good policy modeling.

The sheer variety in the ways this second point surfaces is startling. Saito (2004) notes that Armington elasticities estimated from multilateral trade data tend to be higher than those obtained from bilateral data, with a focus on intermediate sectors. While it is hardly surprising that intermediate imports from all sources would be a better substitute for domestic inputs in that sector than imports from a single country, the author does raise the valid point that growth in outsourcing and expansion of Global Production Networks (GPN–also termed Global Value Chains or GVC) may not be fully reflected in elasticity estimates drawn from older multilateral trade data bases. McDaniel and Balistreri (2002) note that estimated Armington elasticities are quite sensitive to the level of aggregation, whether one is concerned with the short run or the long run, and whether the source is time series or cross section estimation. This uncertainly is particularly troubling for policy-relevant research. While academic modelers generally handle uncertainty through the use of sensitivity analysis (see Hertel et al., 2007), occasionally to the point of ridiculousness, policymakers prefer a single estimate, and attempts to qualify that number with something like a confidence interval are seldom appreciated. "Policymakers often utilize single figures to support policy positions. Unfortunately, acknowledging the existence of second moments in policy forums may weaken the same argument that it strengthens in academic review."[4]

Hillberry and Hummels (2013) add "Curiously there is no clear consensus on which elasticities to use. Major trade-focused CGE models draw elasticities from many different econometric studies….(which) use very different data samples, response horizons, and estimating techniques and arrive at elasticities as much as an order of magnitude different from each other."[5]

Two recent approaches have addressed many of the implications of the Armington assumption that are inconsistent with trade data. Melitz (2003) postulates fixed and variable costs associated with market entry and trade. Trade zeros occur where the fixed costs exceed the benefits of overcoming those costs. One source of fixed costs is distance, a factor assumed away in previous trade models. Gravity models, in which trade between country pairs is a function primarily of "distance" (expanded to include cultural, linguistic, political, and other sources of distance, in addition to geographic), do a surprisingly good job of predicting trade flows in both cross section and time series (the magnitude of trade persists between partners even as the product composition of trade changes over time).

The second recent approach focusses on the difference between additional exports from the same firms and additional exports from new exporters.[6] Credited to Hummels and Klenow (2005), this approach leads to some strikingly different implications. For example, in "standard" trade models, an increase in national output of an export good must be sold somewhere, thus driving down its price and worsening the terms of trade. If the additional output is generated by new firms, this need not occur.

Modelers understand these challenges. "A key challenge of the moment is to include the insights of the new new (sic) trade theory (Melitz, 2003) where the implications of heterogeneity in firms and other actors are taken into account, and extensive-margin adjustments to the range of products traded (Hummels and Klenow, 2005) are taken into account."[7] Yet progressing simultaneously on all fronts will strain both the available data and the capabilities of our models. We need to ascertain *which* of the competing theoretical advances in trade theory are vital to accurate policy-based empirical trade modeling. Before doing this, we must review the policy issues that our standard models fail to adequately address.

2. Recent policy questions

Policymakers have found that "standard" trade models have been unable to address a number of recent policy questions. After a number of years of observing trade flows growing more rapidly than global income, we experienced the "great trade collapse" as part of the great recession, in which trade flows contracted much more sharply than income (see Baldwin, 2009 and others). To at least some extent, this mystery was resolved by uncovering stronger links between credit markets and trade flows than had previously been postulated (or even allowed, in the case of most standard trade models).

The rise of GPNs also creates problems for standard trade models and policy analysis. These models do not account for the fact that much international trade is now intra-firm trade. Furthermore, the standard interpretation of bilateral trade balances (a concept of little interest to trade economists, but very important to policymakers) is severely flawed, when imported final goods contain the bulk of their value added from third country suppliers. Additional problems arise when a few key firms dominate trade in a specific commodity/sector, and these problems can be disguised when these firms operate in and export from many different countries.

[2] "…high parameter values change dramatically the conclusions of calibrated models in areas of international economics as varied as global imbalances, international risk sharing, portfolio choice and optimal monetary policy." (Imbs and Majean, 2009, p. 33).

[3] (Valenzuela et al., 2007, p. 16.)

[4] McDaniel and Balistreri, op cit., p. 12.

[5] Hillbery and Hummels, p. 1214.

[6] "Extensive margin" refers to the number of firms, while "intensive margin" is trade per firm. Ceteris paribus, increased exports of a product from country A would drive down the price of country A's exports, *if* it represented increased sales by existing companies, but not necessarily if it represented new firms entering the market. An analogy can be drawn to the decomposition of increased sales into additional same-store sales and sales at new stores.

[7] (Martin, 2011, p. 449).