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Disaggregated data and trade policy analysis: The value of linking partial and general equilibrium models

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ABSTRACT

Computable General Equilibrium (CGE) models are now routinely utilized for the evaluation of trade policy reforms, yet they are typically quite highly aggregated, which limits their usefulness to trade negotiators who are often interested in impacts at the tariff line. On the other hand, Partial Equilibrium (PE) models, which are typically used for analysis at disaggregate levels, deprive the researcher of the benefits of an economy-wide analysis, which is required to examine the overall impact of broad-based trade policy reforms. Therefore, a PE–GE, nested modeling framework has the prospect of offering an ideal tool for trade policy analysis. In this paper, we develop a PE model that captures international trade, domestic consumption and output, using Constant Elasticity of Transformation (CET) and Constant Elasticity of Substitution (CES) structures, market clearing conditions and price linkages, nested within the standard GTAP model. In particular, we extend the welfare decomposition of Huff and Hertel (2001) to this PE–GE model in order to contrast the sources of welfare gain in PE and GE analyses. To illustrate the usefulness of this model, we examine the contentious issue of tariff liberalization in the Indian auto sector, using PE, GE and PE–GE models. Both the PE and PE–GE models show that the imports of motorcycles and automobiles change drastically with both unilateral and bilateral tariff liberalization by India, but the PE model does a poor job predicting the overall size and price level in the industry, post-liberalization. On the other hand, the GE model overestimates substitution between regional suppliers due to "false competition" and underestimates the welfare gain, due to the problem of tariff averaging in the aggregated model. These findings are shown to be robust to wide variation in model parameters. We conclude that the linked model is superior to both the GE and PE counterparts.

1. Introduction

Examination of the impacts of tariff changes at a disaggregated level is important for many reasons. First, there are huge variations in tariff rates at different tariff lines for many commodities, causing serious aggregation bias in aggregate sector-based studies.[1] Second, the aggregation of sectors may result in 'false competition': two countries that do not compete in a third market at the disaggregated level (e.g., one exports engine blocks and one auto transmissions), may appear as competitors at an aggregate (auto parts) level.[2] Third, many policies are framed for specific products that are not identified among the relatively aggregated sectors. Finally, most trade policy negotiations are conducted at highly disaggregated "tariff lines",[3] which is why there has been a strong preference for Partial Equilibrium (PE) analysis (e.g. Ramos et al., 2007; Evans et al., 2007) as negotiations begin to get seriously under way.[4] As Lloyd and MacLaren (2004) note, the inability to support disaggregate analysis is a major shortcoming of CGE models. On the other hand, while comprehensive PE models may show approximate welfare measures for small exogenous changes (Kokoski and Smith, 1987), they are unable to offer a comprehensive assessment

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[1] Those interested in aggregate impacts can use a specialized technique, such as the Trade Restrictiveness Index (TRI), to account for these differences (e.g., Anderson and Neary, 1996 and Anderson, 1998), however, the appropriate index will depend on the objective in mind. For example, see Bach and Martin (2001) for an aggregation methodology that factors in expenditure, input costs and tariff revenue; Anderson and Neary (2003) for Mercantilist TRI (MTRI); and Anderson (2008) for the consequences of atheoretic tariff aggregation in trade policy modeling.

[2] Welsch (2006) finds that intra-industry specialization of the countries over the years leads to the reduction in the heterogeneity of aggregate commodity groups and hence the decline in estimated Armington elasticities.

[3] See Narayanan and Vashisht (2008) for example, for the Free Trade Agreement (FTA) that has been negotiated between India and Thailand. This involves tariff cut proposals at HS-6 level.

[4] Although there have been attempts to model, for example, as many as 500 sectors in a Computable General Equilibrium (CGE) framework by Dixon and Rimmer (2004), they are still far more aggregate than what is required for tariff line negotiations.

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of the impact of trade policy reforms on economy-wide welfare, wages, employment and other variables of interest to policy makers. These policy indicators are typically produced by Computable General Equilibrium (CGE) models (Francois et. al., 2005; Jensen and Sandrey, 2006). This paper utilizes a combined PE–GE approach to trade policy analysis, thereby permitting us to contrast the PE, GE and combined PE–GE predictions for bilateral trade flows as well as aggregate welfare and other economy-wide variables of interest.

One of the first attempts to perform a somewhat disaggregated analysis in a CGE framework was made by Basevi (1966, 1968). However, there has been a surge in research efforts aimed at linking PE and CGE models only recently. This has been common in the poverty/micro-simulation literature (Herault, 2007; Hertel et al., 2007b), in sub-regional economic modeling (Madsen and Jensen-Butler, 2004) as well as in the application of econometrics to CGE models (Han and Woodland, 2003; Hertel et al., 2007a; Bhattarai and Whalley, 1999; Arndt et al., 2002; McKitrick, 1998). More recently, authors have begun to link CGE and PE models for disaggregated trade policy analysis. In particular, Grant et al. (2007) have proposed a partial/general equilibrium (PE/GE) framework, building on the GTAP-in-GAMS global CGE model (Rutherford and Paltsev, 2000) and focusing on the treatment of tariff rate quotas, which cannot readily be aggregated for use in a normal CGE model. Our paper draws inspiration from this work; likewise implementing a PE/GE model within the GTAP modeling framework (Hertel, 1997).

We focus this paper on determining the impacts of tariff liberalization in India's automotive industry. This is an apt example for several reasons. Firstly, this is a diverse sector, not only structurally, but also in terms of the wide tariff variations across its sub-sectors.[5] Secondly, India has been actively pursuing different policies for different sub-sectors of the auto industry.[6] As a consequence there has been policy-driven structural change in the Indian auto industry over the years.[7] Thirdly, the ongoing tariff negotiations in India are sub-sector-specific, necessitating a framework wherein tariff simulations could be done at sub-sector-level.

Since the late 1990s, India has been negotiating trade agreements, covering various sectors, with East and South-East Asian countries, which are both competitors and partners in the global market for autos.[8] There is a widespread concern that the domestic auto sector is very sensitive to liberalization.[9] However, the government of India has been cutting auto tariffs, arguing that past tariff cuts have benefitted the industry in terms of better competitiveness, growth and employment (Ministry of Heavy Industries, 2006). So, tariff liberalization in this sector is a contentious issue. Further, the debate over auto sector reforms is relevant in a global context as well, with the potential for India to emerge as a global auto production hub as well as a consumer market. The latter is being fuelled by a rapidly growing middle-class, improved access to finance and a very low vehicle penetration ratio.[10] Many studies have recently assessed the impacts of FTAs being negotiated by India within a CGE framework (Weerahawa and Meilke, 2007; Kumar and Saini, 2007; Kawai and Wignaraja, 2007). However, none of them have utilized the kind of PE/GE framework offered by Grant et al. (2007) and developed in this paper.

Using a three-region, ten-sector database derived from the GTAP 6.2 (Dimaranan, 2006), MAcMap (International Trade Center, 2006 and Bouët et al., 2004) and TASTE (Horridge and Laborde, 2008) databases, we compare the results of complete tariff liberalization in the Indian auto industry, using PE/GE, PE and GE models. We find that in addition to the differences in aggregate results, both the PE and the PE/GE model show strikingly diverse results across the sub-sectors of the auto industry, which cannot be captured by the GE models. However, our simple PE model does a poor job of predicting the changes in the size and price level of the industry. Although this could be improved by building a more complex PE model, that would still not capture economy-wide effect, which is the focus of this study. Thus, we find that the PE/GE model is superior to the GE model in terms of disaggregated impact-evaluation and to the PE model in terms of endogenous determination of aggregate supply and demand. More importantly, the PE/GE model shows lower welfare loss, higher allocative efficiency gains and lower terms of trade losses, because the GE model ignores disaggregated details of trade flows and tariffs.

Apart from being among the first pieces of work developing PE/GE model to perform disaggregate analysis after Grant et al. (2007), this work uniquely contributes to the existing literature in other ways. Firstly, this is the first paper to extend welfare decomposition to the PE/GE framework. Secondly, this implementation is done in the widely-used GTAP framework, thereby aiding this large community of users in performing similar analyses, extending CGE to the tariff line. Thirdly, our auto industry example effectively shows evidence on issues such as false competition involved in the standard GE model, due to aggregation issues. Finally, the unique comparisons of the results done across the PE, PE/GE and GE models in this exercise highlight the different shortcomings of PE and GE frameworks compared to our proposed PE/GE framework.

This paper is organized as follows: Section 2 outlines the modeling framework and methodology. Section 3 discusses the data sources. Section 4 summarizes the results and Section 5 concludes.

2. Modeling framework and methodology

Fig. 1 illustrates the quantity and price transmission channels in the PE model.[11] The PE–GE model developed in this paper is an extension of the standard GTAP model (Hertel, 1997).[12] Apart from a few linking equations — which may be neutralized via appropriate use of "slack variables",[13] it is written as a separate PE "module" appended to the bottom of the GTAP model code. We follow Grant et al. (2007) in treating production of disaggregated commodities using a Constant Elasticity of Transformation (CET) function, which is conditional on the total activity level in the aggregate sector. We turn now to a discussion of the most important features of the PE model and then

[5] See Table 1 for this aspect and Goldberg(1995) for variations in US automobile tariff. The choice of India as an example is further justified by the conclusions of Anderson (2008), which emphasize that the atheoretic aggregation in a multi-country model leads to an overstatement of India's real income by thrice the global gains from free trade. Thus, aggregation is a very important issue in the context of India's tariff analysis, more so for auto sector in particular as explained herein.

[6] For example, most of the tariff policies have been more favorable to the vehicle assembly sub-sector than to the auto-component sub-sector.

[7] These have, over the years, led to "tariff-escalating" foreign investments, some of which make use of the low tariffs in auto-components sector to largely restrict their production to assembly from imported auto-components (for example, as Complete Knock Down, i.e., CKD Kits). On the other hand, there are foreign firms that also create domestic capacity in auto-component production. See Narayanan and Vashisht (2008) for more details on this aspect.

[8] Studies such as Chadha (2005), Iyer (2004) and Batra (2006) examine the prospects of existing agreements involving India, such as the Bangkok Agreement for PTAs in the Asia–Pacific region.

[9] For example, see the consultancy reports such as McKinsey (2005), ICRA (2003, 2004a,b, 2005), which have evaluated the impacts of India's FTA with countries and regions such as ASEAN, MERCOSUR and South Africa.

[10] This was around 8.5 cars per thousand Indians in 2005, according to World Development Indicators (2006).

[11] The unit of measurement for all variables explained in this section is percentage change.

[12] We summarize the standard GTAP model in Appendix 1. This model has been adapted by many studies such as Tyers and Yang (2004), to suit their particular requirements.

[13] When there are two sets of equations determining the same variable and we want different components of the variable determined by different sets of equations, we may introduce a "slack variable" in one set. When declared endogenous in some components, this variable forces the equation in which it appears, to determine itself. This makes the 'real' variable in question exogenous in the corresponding components. This ensures that the other components of this variable are determined by the other set of equations.