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NON-TARIFF BARRIERS IN COMPUTABLE GENERAL EQUILIBRIUM MODELLING

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ABSTRACT

With diminishing tariffs, the focus of trade policy makers and analysts is logically turning towards non-tariff barriers (NTBs), but there much remains to be done. It is well-know that tackling NTBs poses many challenges for the analyst because of their diverse and complex nature, and the lack of available evidence. NTBs pose also particular difficulties to computable/applied general equilibrium (CGE) modelling, traditionally more comfortable with policies whose impact can be interpreted into direct effects on prices.

This research provides a quantification of the impact of NTBs at the global level. The model we use is significantly larger than in previous studies, and to our knowledge, the first truly global one. The main focus of this research, however, is to discuss and question the various treatments of NTBs in CGE models with a specific application of the Global Trade Analysis Project (GTAP) standard model, the workhorse of trade policy CGE analysis.

We find that serious estimation and modelling efforts remain to be undertaken in order to make CGE modelling a useful policy tool to analyze NTBs. Casual policy inferences from loose specifications may indeed lead to serious analytical mistakes. We show that while using the same robust estimates of NTB incidence we obtain vastly different results under different model specifications.

Key Words: Non tariff barriers; Computable general equilibrium

JEL Classification: C68; F13

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1. INTRODUCTION AND MOTIVATION

Eight rounds of multilateral liberalization under the General Agreement on Tariffs and Trade (GATT) led to substantially lower tariff rates. In the past two decades, applied tariffs have been halved on average globally. During the same period, policymakers have started grasping the "front-stage" importance of non-tariff barriers.[1] With diminishing tariffs, the relative importance of NTBs grows, including their potential to nullify the benefits of tariff liberalization. In 2004, UNCTAD's TRAINS database sensed on average 5,620 tariff lines being subject to one type of NTB in each country. Technical measures account for 58.5 per cent of that total.

The WTO agreements already discipline important non-tariff barriers (NTBs), including the most commonly used ones – technical barriers to trade (TBT) and sanitary and phytosanitary measures (SPS). Furthermore, addressing other NTBs is part of the ongoing WTO agenda. Paragraph 16 of the Doha Ministerial Declaration sets out "to reduce or as appropriate eliminate tariffs…as well as non-tariff barriers" for non-agricultural products, and paragraph 31 sets out to do the same for environmental goods and services. So far, however, there has been little progress, the only emerging agreement having emerged being one related to export taxes and restrictions.[2]

However, as argued for example by Baldwin (2000), ongoing liberalization policy efforts to eliminate the restrictive effects of NTBs are proceeding with little economic analysis. For instance, one liberalization strategy favoured by developed countries among themselves is mutual recognition. Such liberalization could very well create two-tier market access, with most developing countries in the second tier still facing non-tariff barriers in developed country markets. There is a substantial amount of literature on individual types of NTBs, and in some instances sophisticated empirical analysis of their effect (e.g. for anti-dumping), but this information is likely to be instrument-, industry- or country-specific.

There are good reasons why global analysis of NTBs across sectors and countries is lacking. Under a common denomination NTBs group together a vast array of potentially trade-distorting policy instruments. The UNCTAD classification of NTBs – the Trade Control Measures Coding System – identifies at its most detailed level over 100 instruments[3] grouped in six categories.[4] Unlike tariffs, NTBs are not straightforwardly quantifiable and not necessarily easy to model, and information about them is hard to collect.

It should therefore be no surprise that the modelling of NTBs using general equilibrium modelling techniques is still in its early stages. With the exception of work on subsidies in agriculture, little general equilibrium work has been carried out on addressing the economics of NTBs either theoretically or empirically. The study of NTBs creates sizeable challenges for an empirical exercise that relies on vast and globally coherent data sets, and very often on strong assumptions. This means that ex ante we know relatively little about the costs and benefits of NTBs.

Thanks to advances in computer and simulation technology such as the Global Trade Analysis Project (GTAP) (Hertel, 1997), and efforts to improve data collection and availability (TRAINS being a leading example), computable general equilibrium (CGE) simulations of tariff reductions can now be carried out almost routinely. General equilibrium modelling has played an important role in the WTO multilateral negotiations, helping assess complex negotiation modalities and global interdependencies (e.g. Harrison, Tarr and Rutherford, 1996; Francois, van Meijl and van Tongeren, 2005; Anderson, Martin and van der Mensbrugghe, 2005; Polaski, 2006), but also fuelling a public debate on the direction and magnitude of estimates.[5] The same cannot be said of NTBs: and we therefore propose in this paper to shift the discussion of modelling issues from tariffs to NTBs. We hope to contribute to the limited body of literature on CGE simulations of NTBs by testing various approaches to modelling of global NTB liberalization. To our knowledge, this work is the first to offer a truly global and detailed assessment of NTBs in a CGE model, using recent econometric estimates of NTBs ad valorem equivalents (AVEs) computed by Kee, Nicita and Olarreaga (2006). We follow the path

[1] As argued in a 2005 statement of the UNCTAD Secretary General, Supachai Panitchpakdi: http://www.unctad.org/templates/webflyer.asp?docid=6369&intItemID=3549&lang=1.

[2] At the time of writing, the Chair's text of 17 July 2007 of the WTO's non-agricultural market access (NAMA) negotiations' draft modalities listed other categories of "vertical" NTBs, so-called because they relate to specific manufacturing sectors, but there was much less consensus on those.

[3] See UNCTAD (2005, annex 1) for a complete listing.

[4] These are not the categories adopted by the WTO. Efforts are now undertaken to make the UNCTAD and WTO classifications lists compatible.

[5] Adams (2005) underlines the difficulties encountered in the interpretation of results, which may have contributed to misleading arguments in such debate.

opened by the work of Andriamananjara et al. (2004), which was, however, limited to a subset of sectors.

Our main conclusion is both a word of caution to policymakers in interpreting the results of simulations of the complete removal of NTBs and a call for increased efforts to collect information and refine modelling methodologies to support policies for removing NTBs. Our current ignorance of the true costs of NTBs is also what prevents their more rational use by policymakers.

The next section presents elements that determine the analytical strategy for incorporating NTBs in CGE models. In section 3 we suggest several simulations to assess some of the issues discussed, and the results are presented in section 4. Section 5 sets out conclusions.

2. CGE MODELLING OF NTBs

NTBs generate different categories of economic effects (Beghin, 2006). The first of those effects is a cost-raising, trade-restricting effect at the border, which we call the "protection effect". Protection of local industries is, however, not necessarily the policy intention. NTBs often have other stated social or administrative objectives designed to regulate the domestic market. Meeting those objectives leads to two broad economic effects: shifting the supply curve or shifting the demand curve (Roberts, Josling and Orden, 1999). Supply-shifting effects occur when regulations are used to tackle externalities affecting international trade of goods, such as preventing the sale of products hazardous to health or creating standards to increase compatibility and interoperability. Such regulations can specify the production process (i.e. use of a certain technology), or product attributes (i.e. a maximum content of given components) required for conformity. Demand-shifting effects are required for certain types of market failures, for instance by making it compulsory to provide certain information to consumers, thus affecting their behaviour. Supply-shift effects are of particular relevance to technical regulations (TBTs) and sanitary and phytosanitary (SPS) measures. Demand-shift effects can be identified for any sort of technical regulation.

The protection effect of NTBs mentioned above is the most immediate candidate for assessment in a CGE model, *provided* that the correct impact estimates are available.[6] Protection effects are usually assessed at the border. These border effects generate a wedge either between the world price and the domestic price in the importing country or between the world price and the domestic price in the exporting country.

Protection effects also arise beyond (within) the border because NTBs do not necessarily discriminate between domestic and imported goods. Tackling those beyond-the-border effects would require a model that included increasing returns to scale and export-specific costs. Off-the-shelf models such as GTAP do not offer those features, which are not straightforward and not easy to implement.

[6] We refer the reader to Deardoff and Stern (1997) and Ferrantino (2006) for a comprehensive review and discussion. Useful discussions are also found in Maskus, Wilson and Otsuki (2000) on quantification of technical barriers to trade. Beghin and Bureau (2001) discuss sanitary and phytosanitary standards.

The assessment of the other economic effects, namely the supply-shift and demand-shift effects, in a CGE context is much more complex. The theoretical analysis by Ganslandt and Markusen (2001) offers possible solutions for the integration of demand-shift elements into CGE modelling. A major hurdle in replicating this approach and obtaining credible estimates is, however, the accessibility of relevant empirical information for plausible parameterization.[7]

Arguably, supply-shift effects also present difficult challenges before being incorporated into existing CGE models, including the need to develop appropriate functional forms to model supply functions.

2.1 *Modelling in standard GTAP*

Border effects of NTBs can operate on the import or export side of trade flows. The most common way of measuring such effects is through AVEs, the difference between world and domestic prices. Where the import side is directly affected, change in the AVEs of NTBs can be implemented in GTAP to simulate either a change in taxes affecting imports or efficiency effects representing the change in the price of imports from a particular trading partner.[8] Similarly, in some instances NTBs can be thought to behave like a tax on export, and AVEs can then be used to simulate a change in export taxes. In a pioneer effort, Andriamananjara, Ferrantino and Tsigas (2003) explored those various options in a CGE.

Andriamananjara, Ferrantino and Tsigas (2003) assume for the footwear and apparel industry that implementing a shock on an equivalent import tax variable is admissible for the purpose of representing the effect of NTBs in the sector. Doing that requires that welfare effects be interpreted carefully. One may, for instance, consider, in the context of the theory of rent seeking developed by Krueger (1974), that protection rents are generated by NTBs and are captured by domestic interests, an effect qualitatively equivalent to that of tariffs, where the rent is captured by the government tax. However, rent seeking may also generate its own costs, dissipating part of the NTB rent. Therefore, there is a need to reinterpret the CGE results since no government tax revenue and probably other forms of rent transfer are operating. This means essentially two things in the context of a general equilibrium approach: (a) the variation in government consumption due to the artificially assigned tax revenue changes will need to be either controlled or accounted for; and (b) more straightforwardly, the welfare impacts attributed to changes in the government revenue "rectangle" will have to be interpreted. It is likely that the size of such transfers will be important. Correct attribution thus implies some knowledge of how NTBs function in practice, and who captures the rent. That might still be the Government – through, for instance, certification agencies. Alternatively, it could be import-competing domestic or even foreign private operators, competing or intermediaries in the transport, logistic and border clearance chain.[9]

An alternative modelling of the protection effect through efficiency impacts is suggested by Andriamananjara, Ferrantino and Tsigas (2003). The logic behind this is that NTBs add "sand in the wheels" of trade. Liberalization of measures included in the technical chapter of UNCTAD's classification, such as SPS and TBT, can, for instance, be thought of as having an efficiency impact. Mutual recognition agreements and, to some extent, harmonization of standards will allow export of products that previously would have needed to undergo specific production processes (relative to the process needed for the domestic market) in order to meet the other partner's standard without those extra production steps, thus translating into possible efficiency gains.[10] Recourse to the efficiency approach also avoids issues related to tax revenues encountered when price taxes are used to model NTBs in GTAP. The efficiency assumption implies that the price differential calculated by the AVEs is entirely explained by the efficiency losses due to the presence of NTBs. That is unlikely to be the case, and conceptually it is not completely clear whether trade liberalization related to technical regulations is best represented by a reduction in efficiency impediments.

Finally, in some instances exporters are directly affected by the presence of NTBs. In this case, the NTB effect can be introduced as an export tax equivalent that constrains the shipment

[7] For a review of methodological issues applied to standards, see Maskus, Wilson and Otsuki (1999).

[8] The policy variables of interest in GTAP are respectively *tms* and *ams*.

[9] In the GTAP model, as long as rents remain *within* the country applying the NTB, controlling for the impact on tax revenues could be ignored since the use of a regional household as the basis for welfare analysis makes redistributive patterns of second order importance. Whether rents are collected by firms or by government matters only for their resource allocation effect, as all revenues eventually belong to the regional household.

[10] Improved certification procedures that reduce wastage could also be thought to have similar effects.

of exports. The use of export tax equivalents is relevant when economic rents are generated by export restrictions, as in the case of voluntary export restraints. Modelling export taxes is straightforward in CGE modelling and similar to import taxes. Andriamananjara, Ferrantino and Tsigas (2003) use this approach to model the impact of NTBs in apparels. As will be seen below, we also use export taxes to model NTBs but with a different purpose in mind.

2.2 *A more difficult question for CGE modelling: the cost-raising effect of NTBs*

Notwithstanding the question of modelling supply-shift effects, the use of tariff equivalents is actually not completely satisfactory even when limited to the analysis of protection effect of NTBs (i.e. the impact on foreign producers only). The border effects of NTBs should be reflected in the additional costs of production that firms have to incur in order to export to a specific market – for instance, changing manufacturing processes, as discussed earlier, or the cost of conformity certification. Then, as argued in Baldwin (2000) TBT can affect both fixed costs and variable costs. The presence of fixed costs suggests that increasing returns and imperfect competition could be necessary modelling features.

Firms could be assumed to face constant marginal costs and two types of fixed costs – one generic related to setting up production, and one specific to any destination market, representing differing TBT requirements (Baldwin and Forslid, 2006). Firms exporting to markets with TBT requirements could also face per-unit additional costs, which would be equivalent to an additional standard transport cost. Recent trade models, based on the seminal work of Melitz (2003) and where firms' heterogeneity is the salient new element, offer a way of including those cost categories. Using this framework would, moreover, enable trade modelling to address the question of the *extensive margin of trade* and the creation of trade in sectors that were not previously exporting. CGE models such as GTAP only extrapolate from existing trade data. GTAP modelling underestimates trade liberalization effects on small trade (and by construction near zero) shares (Kuiper and van Tongeren, 2006). Incorporating the Melitz framework, in addition to its usefulness in assessing the impact of technical regulations in trade, could introduce additional sources of gains from trade liberalization. Implementing that approach to estimate parameters and perform CGE modelling remains, however, in its infancy and beyond the scope of this paper.[11]

Fixed costs could be introduced via increasing returns to scale. Although this is not treated in the standard GTAP model, this can be in principle easily implemented, as discussed in Francois (1998). This augmented version of the GTAP framework does not, however, make it possible to account for export-specific fixed costs.[12]

2.3 *Demand-shift and supply-shift effects*

Focussing only on the protection effects of NTBs is likely to cause the social benefits they might provide to be disregarded. This is important from a policy point of view, since the optimal liberalization policy for NTBs will often not – unlike for tariffs – be their elimination but rather their rationalization to the social-utility-maximizing level; in other words, the desirable policy prescription is to minimize their cost-benefit ratio. One dimension of this policy problem may be the need to harmonize NTBs with those of trading partners, so as to avoid undesirable duplication costs and complexity.[13]

Although it would be desirable to investigate how one can identify and separate the cost and the welfare-enhancing dimension of NTBs, it is difficult to think of a methodology that would allow that to be done in a systematic way. Detailed information is needed; it would have to be provided by technical experts (Deardoff and Stern, 1997) and probably only for specific products or a limited range of countries.

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11 An encouraging attempt to do that, the first of its kind, has been made by Zhai (2007).

12 In addition, and independently of the possibilities of extensions of the GTAP model to account for TBTs, it might be argued that increasing returns and imperfect competition are not usual features of the agricultural sector. Agricultural production is mostly assumed to be characterized by high goods homogeneity. But such production is an important element of any analysis of NTBs in view of the importance of SPS. A step towards reconciliation between those two elements would be to introduce increasing returns to scale for processed agricultural goods. This is likely to be a quite realistic assumption, as suggested for instance by Beghin and Bureau (2001). Finally, for more homogeneous goods, only variable costs would be affected.

13 Among possible policy scenarios that could be devised without much further information, one could simulate worldwide or regional harmonization of NTBs, using countries or regions (the United States and Europe being obvious candidates) as the standard benchmark against which to harmonize. That is, however, beyond the scope of this research.

Standard models such as GTAP do not provide many ways of including demand-shift and supply-shift effects. One possible way would be to act on the elasticity parameters of the functional forms used to represent the supply and demand functions. Demand-shift effects could, for instance, be simulated through a modification of the degree of substitution between domestic and imported goods and/or among imports. Technical regulations can be thought of as increasing consumers' willingness to pay for foreign products (by imposing requirements that convey consumers' global preferences). That may be done by modifying *Armington* elasticities of substitution *among* imported goods (foreign goods not meeting the requirements would increasingly be substituted away for other foreign goods that do meet the requirements). Technical regulations can also increase the substitutability between *domestic* and *foreign* goods (e.g. fully compatible plugs). This effect could be captured by modifying the elasticity of substitution between domestic and foreign products. A similar approach has been adopted in various studies, for instance in Harrison, Tarr and Rutherford (1994). In the absence of specific estimates of elasticity, which are difficult to compute, this preference change could be simulated along a continuum to assess the sensitivity of the results. Empirical knowledge of the demand-shift effects remains too scarce to be implemented in a CGE context beyond a sensitivity analysis approach, and too scarce for robust policy recommendations to be made.[14]

2.4 Previous general equilibrium applications of the effect of non-tariff barriers

Andriamanajara et al. (2004) provide the most comprehensive study made so far of the impact of NTBs in a CGE model. They include 14 product groups and 18 regions. The study first estimates global AVEs for NTBs, using price data from Euromonitor and NTB coverage information from UNCTAD. The price effects obtained are generally very large: up to 190 per cent in the wearing apparel sector in Japan and in the bovine meat sector in China. The estimate of the price incidence in wearing apparel in the EU is 60 per cent, while the corresponding figure in Kee, Nicita and Olarreaga (2006) is 15 per cent. The study then uses its AVEs to simulate in GTAP the welfare effects of removal of the selected NTBs. Global gains are important ($90 billion), arising mostly from liberalization in Japan and Europe and in the textile and machinery sectors.

Other important works such as Gasiorek, Smith and Venables (1992) and Harrison, Tarr and Rutherford (1994) simulate the effects of harmonization of regulations in the European Union in the post-Maastricht era. The former adopt the "sand in the wheel" approach and assume that trade costs are reduced uniformly by 2.5 per cent, allowing for the characterization of short run and long run equilibrium. The latter use a similar framework, extended to endogenize the elasticity of substitution between domestic and EU goods in order to account, to some extent, for the demand-shift effect mentioned previously. Results in those two studies suggest that the impact of harmonization could reach 2.4 per cent of GDP. In a country-focused but similar computational set-up, Chemingui and Dessus (2007) assess the impact of NTBs in the Syrian Arab Republic. They introduce estimates of price effects of NTBs as regular tariffs. AVEs of NTBs are obtained in their study using the price comparison approach. Welfare gains could range between 0.4 and 4.8 per cent of GDP, depending on whether dynamic effects (associated with a technological catch-up with the rest of the world) are taken into consideration.

With the growing political interest in trade facilitation, several recent studies have attempted to assess its potential benefits, using the "sand in the wheels" approach.[15] Hertel, Walmsley and Itakura (2001) were the first to introduce an efficiency shock variable in GTAP to simulate the impact of lower non-tariff trade costs, such as customs clearance costs in the free trade agreement between Japan and Singapore. Total expected welfare gains for the agreement are worth $9 billion annually, with most of them accruing from the trade facilitation component. Fox, Francois and Londono-Kent (2003) account for the different nature of costs created by NTBs by modelling both the direct costs and the indirect transaction costs of lack of trade facilitation at the United States–Mexico border. Direct transaction costs are modelled as a usual import tax, reflecting a transfer of rent between importers and domestic agents, while indirect transaction costs are modelled as pure efficiency losses. Fox and his co-authors find indirect costs to be the major source of welfare gains. Walkenhorst and Yasui (2005) follow the same approach to estimate the gains to be expected from trade facilitation liberalization, additionally splitting the taxes between those

[14] Harrison et al. (1993) also suggest that sensitivity analysis should be carried out in CGE modelling as part of a strategy to achieve more robust and policy-relevant results. However, carrying out such analysis remains costly in terms of computing power and time.

[15] See Engman (2005) for a review, and Walkenhorst and Yasui (2005) for methodological discussion on trade facilitation.

borne by importers and those borne by exporters. They find important welfare gains of about $40 billion, with nearly 80 per cent arising from efficiency gain effects). Finally, Francois, van Meijl and van Tongeren (2005) assess the impact of trade facilitation reform related to the WTO Doha round of negotiations. They adopt the trade efficiency cost approach to simulate the impact of improvements in trade logistics. In their baseline simulation scenario, trade logistics impediments represent 1.5 per cent of value of trade. Results suggest that income effects related to trade facilitation reform could represent 0.2 per cent of GDP and two-fifth of overall reform impact.

This brief review of existing applied work reveals that they predict important welfare effects from the liberalization of NTBs. Obviously, these are likely according to the extent of the reform envisaged, but also with the functional form chosen to model them in simulation exercises. In particular, when modelled, efficiency-type effects tend to weigh heavily in the overall largely positive welfare gain results. We examine this in more detail in the experiments discussed in the next section.

3. THE EXPERIMENTS

We have discussed so far the methodological obstacles to the modelling of NTBs. This should, we think, serve as a warning sign not to interpret simulation results too hastily without being confident that they reflect accurately enough the reality of NTBs. We propose now to conduct several experiments in GTAP, highlighting some of those issues while also investigating specific aspects of large scale simulations. We also conduct what we believe is the first truly general equilibrium simulation exercise in NTB liberalization.

Our work is made possible by recent advances in the large scale estimation of AVEs for NTBs. We use estimates from Kee, Nicita and Olarreaga (2006). In a companion work (Kee, Nicita and Olarreaga, 2004) the HS 6-digit level demand elasticities for 4,625 imported goods in 117 countries are estimated. AVEs for NTBs in 104 developing and developed countries are then computed using a quantity-impact estimation strategy (the comparative advantage approach) and the import demand elasticities estimates. Because of the limited degree of freedom in the estimation work, the authors distinguish only two groups of NTBs: core NTBs (price and quantity control measures) and non-core NTBs (technical regulations and monopolistic measures) on the one hand, and estimates of agricultural domestic support on the other.

Using the AVE estimates of Kee and his co-authors in our simulation set-up is debatable for many reasons. First, the estimates are obtained using a theoretical framework not fully compatible with the GTAP framework: Kee and his co-authors use a perfect competition setting, while GTAP uses an Armington structure (imperfect substitutability on the import side). The AVEs are also estimated at a much more disaggregated level than the one considered in our simulations.[16] Not all types of NTBs are covered in the estimation procedure, and the impact of different measures is assessed jointly. Nevertheless, at this stage in the research the main scope of the experiment is illustrative. Furthermore, given the preponderance of standards-type NTBs, on which Kee and his colleagues' estimates concentrate, we can assume that the AVEs capture well the influence of the most preponderant NTB and thus provide a good rank order of magnitude of the importance of those barriers across countries and industries.

[16] We used an import-weighted aggregation procedure. This is common for data manipulations related to GTAP applications.

Table 1. Tariffs and ad valorem equivalent of NTBs, by GTAP region

Region	Code	tariff	ave_ntbs
Andean community	and	11.9	11.1
Argentina	arg	13.4	8.4
Australia and New Zealand	anz	5.6	9.3
Brazil	bra	11.6	19.8
Canada	can	2.9	3.3
CCA	cca	6.5	5.2
China	chn	13.2	9.4
EFTA	efta	4.1	3.4
East Asia	eta	4.5	10.2
EU 10	eu10	7.6	4.9
Europe 15	eu15	2.5	6.1
Hong Kong (China)	hkg	0.0	1.4
India	ind	31.7	10.0
Japan	jpn	6.9	15.5
MENA	men	15.6	13.3
Mexico	mex	14.7	17.1
Oceania	oce	3.8	6.6
Rest of Latin America	rla	8.0	6.3
CEI	rus	9.5	19.2
Rest of SADC	sadc	12.7	12.5
South-East Asia	sea	7.9	14.3
Rest of SSA	ssa	15.2	18.3
South Asia	sta	16.4	4.4
Turkey	tur	4.0	6.0
United States	usa	2.9	6.5
South Africa	zsa	6.8	1.2

Source: Kee, Nicita and Olarreaga (2006) and authors' calculations.

We derived our simulation benchmark data by computing aggregated AVEs of NTBs estimates for a 26-country, 27-sector version of GTAP database 6 release.[17] The average tariffs and AVEs of NTBs for country groups are reported in table 1.

Given the existence of multiple varieties of NTBs (even though aggregated), a major issue is to choose the appropriate policy shock to assess their impact. We note that measures directly affecting exports are significantly limited and never represent more than 3 per cent of NTBs in any sector-country combination, and we thus ignore their possible impact. Figures 1 and 2 display the share of core versus non-core NTBs in the total number of tariff lines affected by such measures for product groups and regions. The first category of NTBs can be thought of as rent-creating, and the second as technical. In terms of our earlier discussion on modelling choices in GTAP, each category would relate to either the import tariff modelling (rent-creating NTBs) or the efficiency approach (technical NTBs). Although the figures present only a relatively aggregated picture, they clearly underline the variability in the incidence of different NTBs. We thus opt first, in order to choose between the two modelling options (i.e. policy shocks), to adopt a rough rule of thumb consisting in selecting the NTB type with the highest frequency and to retain the corresponding shock for simulation. The predominance of technical measures is almost absolute. This reflects the evolution in the composition of NTBs reported at the beginning of this paper.

[17] Country groups and sectors composition have little relevance here. They are available from the authors.

In addition to this first simulation (called AMSTMS in reference to the two variable names in GTAP), we run two alternative simulations: one using exclusively the import tariff policy variable (TMS) and another using exclusively the efficiency effect policy variable (AMS). This can be seen as responding in part to sensitivity analysis concerns. But it can also be justified on grounds of NTBs' typical dominance. For instance, the welfare and distortionary impact of technical measures could be fully superseded by the impact of quotas, even if less frequent. The reverse could also be true.

Figure 1. Share in total number of tariff lines affected by NTBs of rent-creating versus technical NTBs, by GTAP sector (total = 100 per cent)

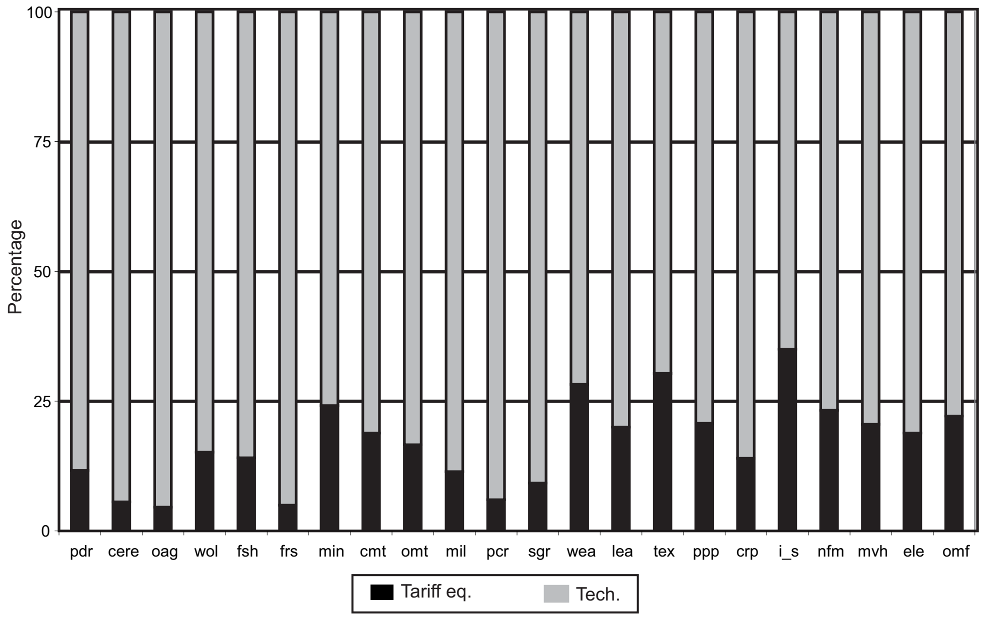
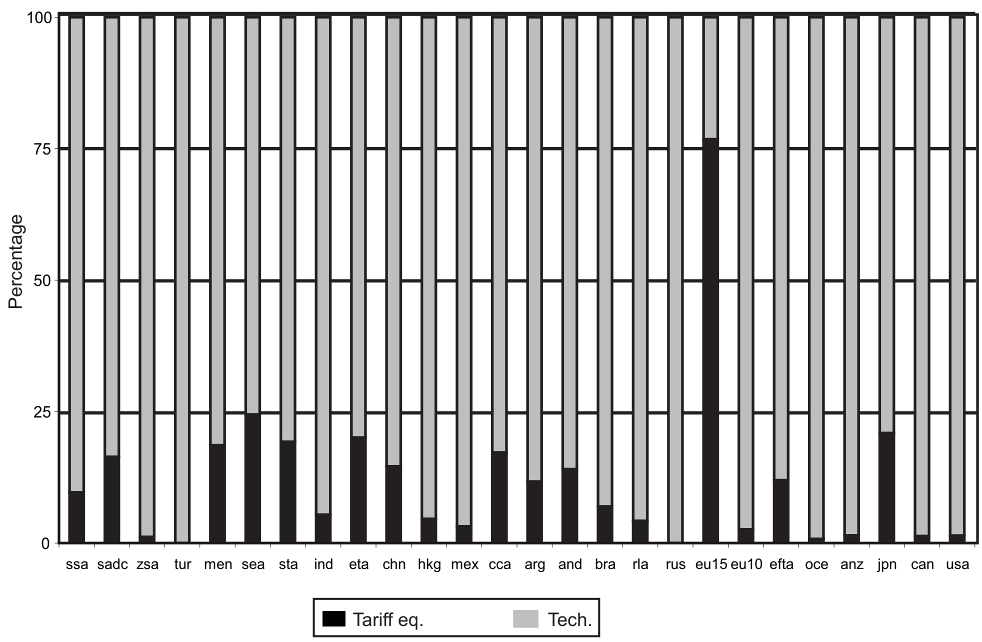


Figure 2. Share in total number of tariff lines affected by NTBs of rent-creating versus technical NTBs, by GTAP region (total = 100 per cent)



4. RESULTS

For the sake of simplicity, we opt for simulating a complete removal of NTBs.[18] Although not necessarily reflecting the optimal policy prescription, the exercise makes it possible to estimate the cost of such measures and thus to contribute to an impact analysis. In the case of standards, a complete removal of barriers could also be associated with the implementation of full mutual recognition agreements.

While often the objective of NTBs is often clear, the cost of their implementation is generally not known. That fact can influence policy decisions.[19] Of course, our approach is also limited because of data limitation. With adequate data distinguishing the discrimination effect against import from the regulatory effect to meet NTB social objectives we could proceed to a more sophisticated analysis.

4.1 Results of simulations

A general finding is the very high sensitivity of welfare results to the policy variable of choice in the simulation. This makes any policy interpretation hazardous. This was somewhat expected in the light of our discussion of previous empirical work, it being observed that one specific policy shock can have an overbearing influence on total results. Nevertheless, we expected closer results since, in theory, the "tariff equivalent" and "sand in the wheel" approaches both affect the terms of trade of the reforming country in a similar manner. But, as shown below, this would be without consideration of the technological-improvement content of the efficiency shock of removing NTBs, the latter being important.

Welfare results are reported in table 2. Equivalent variation estimates in the efficiency effect simulations (AMS and AMSTMS) are altogether of a completely different order of magnitude than for tariff like effect. The results under the mixed AMSTMS scenario are qualitatively not very different from the AMS scenario. This is explained by the predominance of the efficiency effect and also reflects the fact that the ratio of technical NTBs versus rent-creating ones is high for all countries except the European Union (figure 2). However, even in the latter case we do not see a significant difference between the two simulations.

Simulations using efficiency effects generate positive welfare effects for *all* regions. In terms of policy implications this could be an extremely interesting result, because it would mean that multilateral liberalization, which could take the form of a fully mutual recognition of technical measures, would be a *win-win* for all. This, however, contrasts quite starkly with the reality of negotiations and implementation of NTB multilateral agreements, which suggests that dismantling of unnecessary protection is a long and protracted process, with little political involvement. This means either that there is in reality not the win-win observed in the simulation, or that political forces in the eventual losing sectors are strongly resisting change (although these two simulations also show positive sectoral gains in most instances).

It is also worth noting that win-win gains are often invoked in support of the WTO trade facilitation negotiations. As we saw earlier, evidence provided by simulations would suggest that there are such gains. There is strong casual evidence for the efficiency effects of trade facilitation, which justifies the optimism concerning possible gains, and possibly the simulation method used in CGE modelling.

Efficiency effects can be expected by construction to generate positive gains altogether. First, in the GTAP framework efficiency shocks lower the price of imports, and this leads to an increase in demand at the expense of domestic goods. Also, efficiency gains increase the real production content of each single unit exported. This implies that fewer exports are required in order to meet the demand of the importing country. Because in GTAP this efficiency gain applies non-discriminatorily to all imports there are no trade diversion effects at work.[20] This should thus result in unambiguous positive welfare effects for all countries.

[18] We also run a pre-simulation that accounts for major trade policy changes that occurred after 2001, the year base of GTAP tariff data. The events in question are the EU enlargement, Agenda 2000, the accession of China to the WTO, the implementation of the rest of the GATT Uruguay round tariff commitments and the end of the Agreement on Textiles and Closing.

[19] See, for instance, the seminal work of Otsuki, Wilson and Sewadeh (2001), which evaluated the cost of aflatoxine standard protection in the EU to reducing by about 50 per cent exports of African countries ($400 million dollars) to Europe of cereal, dried fruits and preserved nuts. The risk reduction benefit of the standard is considered negligible by the authors.

[20] This is not always an unrealistic assumption: many NTBs do not discriminate regarding the origin of imports. For instance, standards or customs procedures are supposed to apply to all.

Table 2. Equivalent variation (as percentage of GDP)

Region	Code	AMSTMS	TMS	AMS	TXS
Rest of SSA	ssa	3.8	-2.5	3.9	1.9
Rest of SADC	sadc	2.4	-0.6	2.8	-0.7
Rest of SACU	sacu	0.9	1.0	0.5	-2.6
South Africa	zsa	0.0	1.2	0.0	-1.7
Turkey	tur	1.5	0.9	2.0	-0.5
MENA	men	2.0	-0.3	2.2	0.6
South-East Asia	sea	6.1	-0.3	6.1	0.9
South Asia	sta	0.9	0.6	1.4	-0.9
India	ind	2.1	0.5	1.7	0.4
East Asia	eta	5.8	-0.8	5.5	0.7
China	chn	3.0	0.9	2.5	1.0
Hong Kong (China)	hkg	4.1	1.6	3.0	2.2
Mexico	mex	4.9	-0.5	3.9	2.3
CCA	cca	2.8	0.6	2.9	-1.4
Argentina	arg	0.9	0.9	0.6	-1.6
Andean community	and	1.2	0.1	1.3	-0.1
Brazil	bra	2.4	0.0	2.3	1.4
Rest of Latin America	rla	2.1	0.4	2.1	-0.8
CEI	rus	5.7	0.0	5.7	3.3
Europe 15	eu15	1.4	0.4	1.8	0.7
EU 10	eu10	3.7	0.6	3.9	1.0
EFTA	efta	0.6	0.7	0.7	0.2
Oceania	oce	1.6	-7.6	1.7	-3.0
Australia and New Zealand	anz	1.7	1.2	1.6	-1.1
Japan	jpn	0.9	0.6	1.5	1.6
Canada	can	1.4	0.3	1.4	-1.9
United States	usa	0.9	0.0	0.9	0.4

Source: Authors' calculations.

Without the efficiency effect component of the equivalent variation we find that the welfare effects are of the same dimension under all scenarios. Thus, this component in GTAP is responsible for the fact that welfare effects are distributed vastly differently under our scenarios. Importantly, we note that for several regions this implies a change in the direction of welfare effects. What drives the efficiency gains is a pure volume factor: the efficiency gains have a multiplicative effect on the value of import base, roughly the size of the initial AVE and volume of imports in the economy. In that context, intensive economies tend to perform well. Hong Kong (China) and South-East Asian and East Asian economies are among those that benefit most from the removal of NTBs.

The welfare effects in the tariff-equivalent tax simulation (AMS) result in substantial benefits for some countries because of the existence of NTBs, and in losses due to their removal. NTBs generate significant positive terms-of-trade effects for products of interest to those countries. Those effects more than compensate for the allocative effect due to the presence of the NTB, which goes in the expected direction: higher AVEs for NTBs, that is greater positive allocative effects when the latter are removed. The result is that regions with high levels of NTBs, such as sub-Saharan Africa, South-East Asia or the Middle East and North Africa, would not necessarily benefit from a global reduction in NTB costs in this simulation framework. Again, if this were to reflect the reality, political economy implications would be important, as it would imply the existence of strong constituencies against (a globally positive) reform. Global liberalization would therefore imply some form of compensation for the losers. This said, CGE models tend to generate important terms-of-trade effects.

4.2 *A simple attempt at dealing with supply-shift effects, and further lessons on the choice of policy variables*

We saw earlier that the introduction of imperfect competition may be desirable for modelling more closely the cost impacts of NTBs. The standard GTAP offers only perfect competition specification, but can still be of use for assessing the impact of NTBs on variable costs. Variable costs due to the presence of NTBs should affect exports price in the way that an ad valorem export tax affects it, but obviously without the direct link to tax revenues. This issue has to be solved either theoretically or practically.[21] One further complication is that AVEs reflect the price effects on imports, when the relevant price for export taxes is the price prevailing in the exporting country. Fortunately, the GTAP modelling approach enables us to directly relate these two prices. We can then use estimates of import price effects to simulate export price changes.

The last column in table 2 reports the equivalent variation results of the export tax approach simulation (called TXS). Interestingly, and somewhat unexpectedly, from a magnitude point of view, welfare changes resulting from the export taxes simulation lie somewhere between those from the tariffs simulation and those from the efficiency simulation. In general, the welfare impact is positive for most countries.

The results are not reported here, but we also find that welfare effects related to changes in the terms of trade are more frequently positive and larger in the export tax reduction simulation. Those results were expected, since prices of imports in the liberalizing country are likely to fall if taxes on exports are removed in trade partners. The opposite happens with regard to the other two types of effects: import tax equivalent and efficiency. Finally, under the three types of policy, shocks lead to highly correlated allocative efficiency gains. However, the export tax shock dominates the previous simulations in respect of magnitude.

[21] The tax revenues effect can be neutralized by adjusting the tax rate on private consumption. By doing so we implicitly assume that rents are generated domestically from the application of NTBs by foreign trade partners. Controlling for this does not significantly affect the simulation results for the purpose of our exercise, and they are therefore not reported. Results can be obtained from the authors.

5. LESSONS FROM THE SIMULATIONS RESULT, AND CONCLUSIONS

The results of the simulations underline substantial differences in the measurement of protection effects, depending on whether AVEs are introduced using shocks on import tariffs or on technological change. Those differences are not surprising in the light of the very nature of a technological change in the GTAP framework.

First, the size of the differences discussed above, in terms of level and distribution, inevitably casts doubts on the appropriateness of using any technological shock to assess the impact of NTBs. In particular, the overwhelming positive welfare effects found across countries would need to be supported by a robust understanding of how NTB operate and what real efficiency gains could be made, versus impacts of different nature, such as raising costs or creating a wedge between domestic and international prices. Efficiency gains tend to be very sizeable – partly by construction – and again robust evidence and model specification should support the conclusion that efficiency effects are likely to outperform other effects such as terms of trade. As a consequence, the use of efficiency gains seems realistic only for small values of shocks, as has generally been assumed in the literature. We tend to have “sand” in the wheels, not “rocks”.

Secondly, we found that for some regions the direction of welfare effects changed depending on the assumption we made on how NTBs operate (irrespective of the level of AVEs). This is a very important cautionary tale, which derives from the general equilibrium effects that we simulated. It means that depending on whether, schematically, the price, allocative or technological efficiency effects dominate the incentives to participate in global liberalization could be reversed: obviously the political economy inferences that can be drawn would also change drastically. While we could not test that aspect, our economic intuition tells us that allocative and technological efficiency should dominate; but as our work demonstrates, this is not a foregone conclusion.

Thirdly, the difference observed between allocative effects obtained in the tariff-based simulation and those obtained in the export tax simulation can be surprising at first glance since the primary impact on the market price in the liberalizing country is exactly the same. However, the price effect is the result of the shifting of two different curves – import demand and export supply. Different effects were observed because of differences in supply-and-demand elasticities. However, differences are likely to be essentially the consequence of the interaction between the policy shocks and remaining distortions. A fall in export taxes leads to a rise in imports in the liberalizing country. Then, imports which are likely to be constrained by tariffs come closer to their undistorted level. As far as exports are concerned, they are either unconstrained by policy or in most cases subsidized. This implies that, at best, welfare effects related to changes in exports are negligible. This is further proof that the selection of a policy variable in GTAP is far from innocuous.

The results of our experiments highlight that our initial assessment of the methodological hurdles of CGE modelling must be followed up if one wants to develop a better general equilibrium assessment of the presence of NTBs. Given the latter's increasing prevalence, such work should be prioritized. While it remains to be seen whether an appropriate liberalization scenario could be designed, since elimination is not necessarily the objective, even simple assumptions could help in arriving at numbers for the (distortionary) costs of having NTBs: this would help regulatory impact assessments.

Finally, efforts to inventory and quantify NTBs should be intensified – there are strong indications that their impact is important – and modelling efforts improved to allow the inclusion of imperfect competition and beyond-the-border features.

Also, proper inclusion of NTBs in CGE models such has GTAP needs further refinements in modelling. Within the GTAP framework, a more systematic use of increasing returns to scale modelling is needed. Additional efforts should also be devoted to developing a margin-sector-like component that would allow the inclusion of cost elements specific to the country destination of exports affected by NTBs. This would extend the standard CGE modelling analysis to the extensive margin of trade. This would inevitably lead to a rethinking of the way in which AVEs are estimated, and thus additional efforts in econometric research would also be welcome.

That is the price to pay to have informative policy guidance on what could be the gains from eliminating and rationalizing NTBs. The price may seem high, but we are convinced that the benefits of good policing of NTBs are well worth it.

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