Non-tariff barriers in a non-tariff world

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Abstract

With ever diminishing tariffs, especially in developed countries' markets, the focus of trade policy makers and analysts is logically turning towards non-tariff barriers. There much remains to be done, both in terms of policy decisions to dismantle these barriers – the current WTO negotiations have hardly touched upon the subject –, and in analysing the impact of this on the economy, where arguably more has been attempted.

It is well know that tackling non-tariff barriers poses many additional challenges for the analyst because of their diverse and complex nature, and the lack of available evidence, which all make modelling their effects more complicated. This poses also particular difficulties to Computable General Equilibrium (CGE) modelling, traditionally more comfortable in dealing with policies that have direct effects on prices.

This paper contributes to fill up this analysis gap. It provides a quantification of the impact of liberalisation of non-tariff barriers (NTBs) at the global level, using recent data from the World Bank and UNCTAD. The model used is significantly larger than in previous studies, using a 27-sector and 26-region aggregation based on the GTAP 6 database. However, this research essentially focuses on methodological questions related to the treatment of NTBs in CGE models with a focus on the GTAP model. The main message is that serious modelling efforts remain to be undertaken in order to make CGE modelling a useful policy tool to analyze NTBs. A promising route that could be pursued is the one opened by recent trade models offering a treatment of the extensive margin of trade.

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I. Introduction and motivation

The eight GATT rounds of multilateral trade negotiations led to a substantial fall in tariff rates. In two decades, applied tariffs around the world have been halved. We also observe, according to available information and summarized in table 1, that in 1994 the average number of lines per country affected by any type of NTBs was around 1880. In 2004 this figure jumped to 5620. Hence tariffs decline likely have raised the relative importance of NTBs both as protection and regulatory trade instruments feeding comments that NTBs are perhaps substitutes for more traditional forms of protection.[1]

Thanks to the advances of computer and simulation technology, such as GTAP (Hertel, 1997), and commendable efforts to improve data collection and availability (such as UNCTAD's TRAINS), simulations of tariff reductions can now almost routinely be carried out. Simulation exercises have now taken a central place in the WTO multilateral negotiations, helping assess complex negotiation modalities (e.g. Harrison, Tarr and Rutherford, 1996; Francois, Meijl, Van Tongeren, 2005; Anderson, Martin and van der Mensbrugghe, 2005; Fernandez de Cordoba, Laird and Vanzetti, 2006).

Addressing NTBs is also part of the ongoing WTO agenda, and multilateral agreements regulating specific NTBs are already in place. However, as argued for instance in Baldwin (2000), policy is proceeding with little economic analysis and the ongoing liberalization process could very well ending up in a two-tier market access, with most developing countries in the second tier. Indeed, except for subsidies in agriculture very little work has been carried out on addressing the economics of NTBs either theoretically or empirically. Comparatively to the work carried out on tariffs, simulation exercises of NTB impact on the global economy have been wanting. There is substantial literature on individual types of NTBs, and in some instances sophisticated empirical analysis of their effect (such as for antidumping), but this information is likely to be instrument, industry or country specific.

[1] It is also likely that with concerns about the protectionist use of NTB rising, the monitoring of NTBs has improved, fuelling the rise in the number of NTBs identified. See UN (2006) Chapter II for a discussion.

There are of course good reasons why this is the case. Under a common denomination NTBs regroup a vast array of trade (and in some instances non trade) policy instruments. The UNCTAD classification of NTBs, the Trade Control Measures Coding System (TCMCS), identifies over 100 types of NTBs at its most detailed level,[2] grouped in six categories.[3] Unlike tariffs, NTBs are not straightforwardly quantifiable, not necessarily easy to model, and information about them is hard to collect.

It should therefore be no surprise that the modelling of NTBs in the context of general equilibrium modelling is still in its early stages. The study of NTBs indeed creates sizeable challenges for an empirical exercise that relies on vast and globally coherent datasets, and very often on strong assumptions.

We propose in this paper to discuss these issues, and contribute to the limited body of literature on computable general equilibrium (CGE) simulations of NTBs. To our knowledge, this work is the first to offer a truly global and detailed assessment of NTBs in a CGE model. However, this should not be seen as an end *per se*. We follow the path opened by Andriamananjara *et al.* (2004), but which was limited to a subset of sectors. Most importantly, we discuss and illustrate methodological issues and using recent estimates of *ad valorem equivalents* (AVEs) of NTBs computed by Kee, Nicita and Olarreaga (2004). That is, quantitative results must be interpreted with extreme caution and any practical policy conclusion would be hazardous.

The paper is organized as follows. Next section focuses on issues related to the quantification of NTBs. Section III presents elements that would determine the analytical strategy to deal with NTBs in CGE models. The experiment design and the results obtained are shown respectively in sections IV and V. The following section discusses possible alternative ways to model NTBs in a CGE framework and presents some results. Section VII concludes.

[2] See UNCTAD (2005) Annex 1 for a complete listing.
[3] These are not the categories adopted by the WTO. Some efforts are now undertaken to make the UNCTAD and WTO classifications at list compatible.

II. Quantifying NTBs: main methodological issues

Two broad groups of measurement methods of NTBs can be identified: the first one can be defined as NTB-specific, while the second one adopts a more indirect approach.[4] Methodologies that are expected to be the more reliable with NTBs include: inventory measures, price-comparison measures, and quantity-impact measures.

Detailed information collected for a country at a disaggregated level, like in the TRAINS database, enables the computation of inventory measures such as the frequency of occurrence of NTBs or their coverage. A frequency measure is for instance the share in total tariff lines containing a NTB. A coverage measure would be the percentage in total imports of imports where NTBs are present. Frequency measures can be expressed in weighted terms based on either imports or production. The obvious advantage of such measures is the relative ease with which they can be collected, in essence not much more difficult than compiling tariff schedules. Inventories of NTBs do represent valuable information that could, if updated on a regular basis, help keep track of the evolution of the relative incidence of different types of NTBs on trade flows of goods, and of the evolution of their incidence relative to tariffs. Another obvious advantage is that information can be very NTB type-specific and disaggregated at the product level. It does not have to be complete, in the sense that in order to compute these measures only the existence of an NTB needs to be reported, but it has to be reported somehow. On the other hand, these measures do not give any direct information about possible impact on price and quantities produced, consumed or exchanged.[5] They will normally need to be used to construct indicators of trade restrictiveness that in turn can be used to estimate quantity and/or price effects.

[4] We refer the reader to Deardoff and Stern (1997) and Ferrantino (2006) for a comprehensive review and discussion of the issue. 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.

[5] Although there is potentially a more direct link than one would think between the statistical measure of frequency and the economic impact of the presence of NTBs. Kee, Nicita and Olarreaga (2004) find a strong and positive correlation between the percentage of lines covered by NTBs and their measure of ad-valorem equivalent of these NTBs.

Price comparison measures (also called price wedge) can provide a direct measure of the price impact of NTBs. They allow easy computation of so-called Ad-Valorem Equivalents (AVE) also called implicit tariffs or implicit rates of protection. However, serious conceptual and data problems are likely to arise in the estimation and interpretation of tariffs equivalents. First, it is necessary to identify in the data the appropriate prices and this is likely to be problematic. While it is fairly easy to obtain information on the price paid by the importers of a good, it might become difficult to obtain the corresponding price prevailing in the domestic market especially at a fairly disaggregated level. This becomes even more difficult if data collection had to be done for a large set of countries. Other drawbacks are that the price comparison implicitly assumes perfect substitution between imported and domestic goods and that the price differential does not convey information about how the NTB operates in practice (Beghin and Bureau, 2001). Another factor is that the comparison is made in the presence of the NTB distortion (and not by comparison to a benchmark case without distortion, see Deardoff and Stern, 1997).

Quantity-impact measures should *a priori* provide precise information about the impact of an NTB on trade. However, like in the case of price comparison measures, it might be very difficult to obtain appropriate data to compute the exact quantity impact of an NTB, although it is generally believed that it is easier to come by than information on prices. An advantage of quantity-based measures is that a general approach to the measurement of the quantity effects of NTBs can be undertaken (e.g. gravity-based approach or comparative advantage approach) leading to the possibility of systematic and repeated estimation. Such an approach could ideally (with a sufficiently large dataset) include the different categories of NTBs and thus isolate the individual impact of each. Quantity measures associated with information about import demand elasticities then can be used to derive price effect estimates, and thus the computation of AVEs.[6] Obviously, such approaches are also likely to suffer from various drawbacks. The most important being certainly that of not being able to fully account for endogeneity of imports to NTB which is also be likely to appear in elasticities estimation.

[6] The most exhaustive study is Kee, Nicita and Olarreaga (2004).

Business surveys or structured interviews have also been used to obtain information on the importance of NTBs[7]. Survey investigations could be used to collect data for a specific analytical purpose. They provide information concerning the frequency of NTBs. They could also gather data on the relative importance of different measures, such as their trade restrictiveness or trade impact. However, surveys tend to be very resource-intensive. This feature is likely to constrain the scale of the investigation and the extent to which the collected information can be seen as representative of the sector or industry.

III. NTBs in GTAP: modelling and applications

NTBs can generate different kinds of economic effects. The most immediate one is the protection effect. However, NTBs have other policy objectives, beyond the protection of domestic producers. Following Roberts, Josling and Orden (1999), meeting these objectives leads to two economic effects, which are the supply-shift effect and the demand-shift effect. NTBs can indeed be used to achieve social or administrative objectives by tackling negative externalities affecting international trade of goods, such as preventing the spreading harmful diseases (supply-shifting), and market failures (demand-shifting), for instance by providing information to consumers. Supply-shift effect may be identified for non-core NTBs and remains of particular relevance for technical regulations related to sanitary and phytosanitary concerns. Demand-shift effects can be identified for any sort of technical regulation.

The protection effect of NTBs should be an easy candidate for assessment in CGE models, provided that the correct impact estimates are available. On the other hand, the assessment of the other economic effects in a CGE context may not be that straightforward. Ganslandt and Markusen (2001) theoretical analysis offers some possible solutions for the integration of demand-shift elements into CGE modelling. A major concern however, would remain the accessibility of relevant empirical information for plausible parameterisation.[8] We discuss further the demand and supply shift effects in section VI. The remainder of this section focuses on protection effects only.

[7] See for instance Walkenhorst and Fliess (2003).
[8] For a review of methodological issues applied to standards, see Maskus, Wilson and Otsuki, 2000.

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. Our experiment concentrates on these border effects. Indeed, the standard GTAP framework, which is essentially neoclassical, is a powerful tool for simulations of shocks on border measures. However, protection effects could also arise beyond (within) the border. To deal with this kind of effects, a version of the GTAP model that includes increasing returns to scale features and export specific costs would be needed. This approach is not straightforward and not easy to implement. A detailed discussion is provided in section V.

Modelling in Standard GTAP

As we just mentioned, protection/trade restrictive effects, assessed at the border, can operate either on the import or export side of trade flows. In cases where the import side is directly affected, the AVE of NTBs can be implemented in GTAP either through *tms*, which reflects a change in import taxes, or through *ams* which would represent the change in the price of imports from a particular trade partner due to efficiency changes.

When implementing the shock on *tms*, welfare effects need to be interpreted carefully. In some cases, the view may be taken that protection rents are generated by the NTB and are captured by domestic interests, an effect qualitatively equivalent to that of tariffs. This is for instance the view of Andriamananjara, Ferrantino, and Tsigas (2003) for NTBs in the footwear and apparel sectors. There is however a need to reinterpret CGE results as there is no government tax revenue but perhaps other forms of rent transfer. This means essentially two things in the context of a GE approach. First government consumption due to the artificially assigned tax revenue changes will need to be either controlled or taken into account to avoid wrongful interpretation of the results. Secondly, and more straightforwardly, welfare impacts attributed to changes in the government revenue "rectangle" will have to be interpreted with knowledge of how NTBs function in practice, and who captures this rent. This might still be the government through for instance certification agencies, or private operators

both belonging to the manufacturers competing with the imports or to intermediaries in the transport, logistic and border clearance chain.

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 as the use of a regional household as the basis for welfare analysis make 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.

Shocking the *ams* variable is an alternative that is also suggested by Andriamananjara, Ferrantino, and Tsigas (2003). The logic behind using this variable is that NTBs add "sand in the wheels" of trade. This is recognized to be a relevant simulation strategy whenever policies that only generate efficiency losses are in place. Any measure included in the technical measures chapter, such as SPS measures, could for instance fall in that category. A technological shock such as one introduced through the *ams* variable thus would have an import enhancing impact. In the context of TBTs, this would be achieved through mutual recognition agreements or harmonisation of standards as they reduce the duplication costs of compliance with differing regulations. The use of *ams* would avoid any possible modelling issues related to tax revenues generated by NTBs. The use of *ams* assumes that the price differential as calculated by the AVEs is entirely explained by efficiency losses due to the presence of NTBs. This is unlikely to be the case, and conceptually it is not fully clear whether trade liberalisation related to technical regulations are best represented by a reduction in efficiency impediments. The *ams* variable is probably more appropriate to handle trade facilitation issues and related elements. Andriamananjara, Ferrantino, and Tsigas (2003) shocked *ams* for NTBs in the miscellaneous food processing sectors.

In some instances, the export side might be directly affected by the presence of NTBs. In this case the NTB effect can be introduced as an export tax equivalent which constrains the shipment of exports. The use of export tax equivalents becomes relevant when economic rents are generated by export restrictions as in the case of voluntary export restraints (VERs). In GTAP the corresponding shock is *txs*. Andriamananjara, Ferrantino, and Tsigas (2003) shocked *txs* for NTBs in apparels.

Some Applications

The most comprehensive effort to date to assess the impact of NTBs in a CGE model is the recent work by Andriamanajara *et al.* (2004). The study includes 14 product groups and 18 country groups. They first estimate the AVEs globally for NTBs using price data from Euromonitor and NTB coverage information from UNCTAD. The price effects they obtain are generally very important, up to 190% in the wearing apparel sector in Japan and the bovine meat sector in China. For instance their estimate of the price incidence in wearing apparel in the EU is 60%, while Kee *et al.* (2004) find 15%. They then use their *ad valorem* estimates to estimate in a GTAP model the welfare effects of a removal the selected NTBs. Global gains are important ($90 bn) arising mostly from liberalisation in Japan and Europe and in the textile and machinery sectors. Other important studies like Gasiorek, Smith and Venables (1992) and Harrison, Rutherford and Tarr (1994) simulate the effects of regulations harmonisation in the EU in the post Maastricht era. They adopt the sand in the wheel approach and assume that trade costs are reduced uniformly by 2.5 percent. Their model allows for the characterization of short run and long run equilibrium. Harrison, Rutherford and Tarr use a similar framework extended to endogenize the elasticity of substitution between domestic and EU goods to account to some extent for the demand-shift effect mentioned previously. Results in these two studies suggest that the impact of harmonisation could reach 2.4 per cent of GP. In a country-focused but similar computational set-up, Chemingui and Dessus (2004) assess the impact of NTBs in Syria. 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 percent of GDP depending on whether or not dynamic effects (associated with a technological catch up with the rest of the world) are taken into consideration.

As mentioned previously the sand in the wheel approach is likely to be appropriate for assessing the impact of trade facilitation reform. With the surging political interest in such reform, several attempts have been made to simulate its effect.[9] For instance,

[9] See Walkenhorst and Yasui (2004) for a review and methodological discussion on trade facilitation.

Hertel, Walmsley and Itakura (2001) use the *ams* shock variable to simulate the impact of lower non-tariff trade costs such as customs clearance costs within the new age FTA between Japan and Singapore. Total gains are worth $US 9 billion annually with most of them not accruing from the *ams* shocking. Fox, Francois and Londono-Kent (2003) use a mixed approach by modelling both the direct costs and the indirect transaction costs of lack of trade facilitation at the US-Mexico border. They account of the different nature of costs created by NTBs. Direct transaction costs are modelled as a usual tax, reflecting a transfer of rent between importers and domestic agents, while indirect transaction costs are modelled as pure efficiency losses, using the *ams* variable. They find that indirect costs are a major source of welfare gains. Walkenhorst and Yasui (2005) follow the same approach to estimate the gains to be expected from trade facilitation liberalisation, additionally splitting the taxes between those borne by importers and those borne by exporters. They find important welfare gains, around US$40 billion (arising for nearly 80% from efficiency gain effects). 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 standard trade costs approach to simulate the impact of improvements in trade flows logistical treatment. Their benchmark framework includes increasing returns to scale in manufactures and service sectors as well as dynamic features based on capital accumulation and growth effects. In their baseline simulation scenario, trade logistical impediments represent 1.5 percent of value of trade. Results suggest that trade income effects related to trade facilitation reform could represent 0.2 percent of GDP and two-fifth of overall reform impact.

This brief review of existing applied work reveals that income-welfare effects are likely to vary not only with the extent of the reform envisaged, but also with the specific form given to it in simulation exercises.

IV. The Experiment

The main objective of the experiment is to identify and illustrate possible issues in dealing with large scale simulations involving AVEs estimates of NTBs. AVEs estimates are taken from Kee, Nicita and Olarreaga (2004). In a companion work (Kee, Nicita and Olarreaga, 2004a) they first estimate at the HS 6-digit level demand

elasticities for 4625 imported goods in 117 countries. The authors then compute the AVEs for NTBs in 104 developing and developed countries. AVEs are computed using a quantity-impact measure (estimated through the comparative advantage approach) and the import demand elasticities estimates. Using UNCTAD's classification of NTBs, their estimates are obtained by using frequency measure information about a subset of NTBs - distinguishing Core NTBs (price and quantity control measures), from Non-Core NTBs (technical regulations and monopolistic measures) - and estimates of agricultural domestic support. However, the authors distinguish only two groups of NTBs in their estimation procedure; the core and non-core are the first group and domestic support is the second group.

The use of these estimates in our simulation set-up is debatable for many reasons. For instance, AVEs are obtained using a theoretical framework not fully compatible with the GTAP framework: Kee and al. use a perfect competition setting, while GTAP uses an Armington structure. AVEs are also estimated at a much more disaggregated level than the one considered in our simulations. Not all types of NTBs are accounted for in the estimation procedure. We also have that the impact of different NTBs is assessed jointly. Even if this were not the case, issues related to the existence of multiple NTBs would appear anyway because of our aggregation procedure. Nevertheless, at this stage of research the main scope of the experiment is methodological. We do not aim at providing usable results for policy but rather highlight fundamental elements that could help make such a use plausible and desirable.

Ignoring for a moment all these probable flaws, we compute AVEs of NTBs using Kee, Nicita and Olarreaga (2004) estimates for a 26-country * 27-sector version of GTAP database 6 release. Country groups and sectors composition are reported in tables 2 and 3. We also run a pre-simulation that accounts for major events occurred after 2001, which is the year base of tariffs data. These events are the EU enlargement, the 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.

As mentioned previously, our aggregation procedure of NTBs estimates inevitably leads to the occurrence of multiple NTBs for various sectors in many countries. The

main problem is then to choose the type of shock to be used to assess the impact of NTBs. Three alternatives were discussed in section II. However, measures affecting directly exports are significantly limited and never represent more than 3% of NTBs in any sector-country combination. We then decided to ignore their possible impact. Figures 1 and 2 show the frequency of the two categories of NTBs that would correspond to either *tms* or *ams* shocks. The figures only illustrate the respective frequency by country and by sector but they clearly underline the incidence of the multiple NTBs issues. In order to choose between either shocks we adopt a rough rule of thumb that consists of picking up the type of NTBs with the highest frequency and retain the corresponding shock for simulation. The predominance of technical measures is almost absolute. This reflects the evolution in the composition of NTBs reported above.

We also run two alternative simulations: one using exclusively the *tms* shock variable and one using exclusively the *ams* shock variable. This can be seen as answering in part to sensitivity analysis concerns. But it can also be justified on grounds of NTBs typical dominance. For instance the impact of technical measures could be fully encompassed by the impact of quotas. The reverse could also be true.

V. Results

As mentioned earlier, we believe that there are too numerous generalising assumptions about this empirical exercise to confer any real policy significance at this stage. We investigate the results of three simulations, a mixed scenario involving both *ams* and *tms* policy variables of GTAP (which we call *amstms*), and two involving the use of *tms* and *ams* alone.

Turning to our scenarios, we simulate a complete removal of NTBs. We should note that this does not necessarily correspond to a desirable policy prescription, which should be, for at least an important subset of them, rationalisation and removal of non-productive discriminatory aspects. This argument is further developed in the next section. The exercise is however not meaningless, as it offers an insight into the cost of such measures and could provide one element of a cost benefit analysis. Of course this approach is 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 more sophisticated analysis.

Results of simulations

A general finding of our simulation exercise is the high level of sensitivity of welfare results to the policy variable of choice in the simulation. That is, the cost measure of implementing NTBs varies significantly depending on the policy variable chosen. This was somewhat expected in the light of previous results obtained in various existing applied works. Nevertheless, we may have expected closer results as, 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. Indeed, both a *tms* and an *ams* shock would tend to worsen the terms of trade. But, as shown below, this would be without considering the technological-improvement content of the *ams* shock, and the latter is important.

Welfare results are reported in figure 3 and map 1 and 2. Effects under scenarios involving an important shock to *ams* are altogether of a completely different order of magnitude than under *tms.* The results under the mixed *amstms* scenario are qualitatively not very different from the *ams* scenario, which is explained by the predominant presence of the *ams* shock. This reflects the fact that the ratio of technical NTBs versus rent creating ones is high for all countries except the EU (figure 2).

Looking at how the *ams* variable is introduced into GTAP (Hertel, Walmsley, Itakura, 2001), we have the following price and import equations:[10]

$$pim_{is} = \sum_k \theta_{iks} [pms_{iks} - ams_{iks}] \quad (1)$$

$$qxs_{irs} = -ams_{irs} + qim_{is} - \sigma_m [pms_{irs} - ams_{irs} - pim_{is}] \quad (2)$$

[10] If *ams irs* = *ams is* is identical for all regions *r*, which is the case in our experiment, equation (1) becomes:

$$pim_{is} = \sum_k \theta_{iks} [pms_{iks}] - ams_{is} \quad (1)'$$

Which incorporated into equation (2) gives:

$$qxs_{irs} = -ams_{is} + qim_{is} - \sigma_m [pms_{irs} - \sum_k \theta_{iks} pms_{iks}] \quad (2)'$$

Where:

σ_m: elasticity of substitution among imports of *i*
qxs_{irs}: percentage change in bilateral exports of *i* from *r* to *s*
qim_{is}: percentage change in total imports of *i* into *s*
θ_{iks}: share of imports of *i* in region *k* in the composite imports of *i* in region *s*
pms_{irs}: percentage change in price of imports of *i* from *r* in *s*
pim_{is}: percentage change in average import price of *i* in *s*
ams_{irs}: percentage change in effective price of *i* from *r* in *s* due to change in unobserved trade costs

There are two contrasting effects. On the hand, an *ams* shock lowers the price of imports (equation (1)) leading to an increase in demand for those goods at the expense of domestic ones. On the other hand, equation (2) indicates that the gain in efficiency behind the *ams* shock has increased the real production content of each single unit exported. This implies that fewer exports are required to meet the demand of the importing country. There could be a third effect which is the substitution towards exporters hit by the *ams* shock. In our experiment the *ams* shock applies uniformly to all trade partners. Thus, this should favour an overall impact leading to an increase in domestic expenditures on imports and in their shares in the reforming country.

Most importantly, the *ams* variable is akin to a technological shock. Thus when shocking *ams* the implicit assumption is made of a supply shift resulting in extra quantity produced at no extra cost. This is going to generate substantial welfare gains. Actually, without the technological component of welfare (CNT_tech), the welfare effects are of the same dimension under all scenarios. Thus, this component is responsible for the fact that welfare effects under the *ams* scenario are distributed vastly differently than under the *tms* assumption. For several regions, this implies a change in the direction of welfare effects. What drives the CNT_tech component of the welfare effects is a pure volume factor: the efficiency gains have a multiplicative effect on the value of import base. What drive the differences among countries are thus roughly the size of the *ams* shock and the initial importance of importations in their economy (figure 4). In this context, already open economies often tend to perform well. Hong Kong, South East Asia and East Asia indeed tend to appear as among the most affected by NTB costs. One possible remark here is that the *ams* shock tends to magnify already existing trade, because GTAP modelling tends to underestimate trade liberalisation effects on small trade (and by construction near

zero) shares (Kuiper and Van Tongeren, 2006). This of course relates also to the issue of modelization of the extensive margin of trade.

The *tms* welfare effects are qualitatively different, showing important welfare gains for some countries from the existing levels of NTBs (expressed as losses in the simulation). The presence of NTBs indeed involves significant positive terms of trade effects in product of interest to these countries. The presence of NTBs has strong effects on prices. These terms of trade effects (table 6) more than compensate the allocative effect of the presence of the NTB, which goes in the expected direction: higher AVEs for NTBs mean strong allocative effects. The result is that regions with high levels of NTBs such as Sub-Saharan Africa, South East Asia or Middle East and North Africa would not necessarily benefit from a global reduction in NTB costs.

Turning now to the effects on prices, each scenario shows again different results. In the *ams* scenario, returns to the mobile factors (labour and capital) are systematically positive, which is again the result of the volume effect mentioned above (figures 5 to 7). Skilled labour benefits the most. Returns to the immobile factor, land, show broad variations, with in some countries large reductions, and increases in others. This is the translation of a competition effect in importing countries, and an expansion effect in exporting countries. In importing countries, the costs associated with meeting NTBs tend therefore to provide "rents" to land, which is expected given the prevalence of SPS measures on agricultural products and products using agricultural products as inputs. On the other hand, returns to factors in the *tms* scenario are mostly influenced by the Terms of Trade effects, and factor prices fall in countries where the removal of NTB protection induces welfare losses.

Under both *tms* and *ams* scenario, exports of agricultural, agro-industrial products, leather and textile would grow healthily without the cost of meetings NTBs (figures 8 and 9). These are the sectors where the cost of NTBs is the greatest. The volume effect means that the order of magnitudes are very significantly increased in the *ams* simulation, with for instance exports of milk products more than doubling, when the maximum growth under the *tms* scenario, for sugar is only 16.7%. More sophisticated products on the other hand benefit only indirectly from this and would grow at more modest rates.

VI. Discussion

Results discussed in the previous section underline substantial differences in effects whether AVEs are introduced using shocks on import tariffs or on technological change. These differences are not surprising in the light of the very nature of a technological change in the GTAP framework. However, the size of these differences, both in level and distribution, as argued in section V, inevitably casts some doubts on the appropriateness of using any technological shock to assess the impact of NTBs. This could remain true even if this is limited to cases where technical regulations are the only type of NTBs reported. As a consequence, the use of the *ams* variable seems only realistic for small values of shocks, as generally has been assumed in the literature. We tend to have "sand" in the wheels, not "rocks". This raises the question of how much impact NTBs have on efficiency, versus impacts of different nature such as raising costs or creating a wedge between domestic and international prices. This question is relatively unstudied and thus any hypothesis regarding any of the previous should be made with the appropriate disclaimers.

As a consequence any policy conclusion from such simulation has to be interpreted with care as the issue is not only introducing a bias on the order of magnitude of results, but also in the direction of change in the structure of the economy. Something that in itself can be a problem as the experience of modelling the expected welfare benefits of the Uruguay Round has taught us.

The cost raising effect of NTBs

Even limiting the scope of the analysis to the protection effect of NTBs, tariff equivalents may not be fully satisfactory. Indeed, following the discussion of section III, NTBs (essentially Non-Core NTBs in UNCTAD classification terminology) could very well be understood as firms' production cost elements. In this context, border effects would in fact reflect the additional cost of production firms have to incur in order to export to a specific market. For instance, TBTs have cost raising effects, due to the need to conform to regulations or standards. Such standards are generally distinguished in that they specify either the production process (i.e. use of a certain

technology), or product attributes (i.e. a maximum content of given components). Then, and as argued in Baldwin (2000), TBTs can affect both fixed costs and variable costs. As a consequence, increasing returns and imperfect competition could appear to be necessary modelling features. For instance, 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. The latter would reflect the possible existence of TBTs. With regard to variable costs, firms exporting to markets characterised by the existence of TBTs could also face per-unit additional costs. In that context, these costs would be equivalent to an additional standard transport cost.

In recent models of trade based on the seminal work of Melitz (2003), and where firms' heterogeneity is the salient new element, fixed costs related to exporting are presented as "beachhead" cost. An alternative modelling strategy is presented in Ganslandt and Markusen (2001). The authors assume that TBTs impose a fixed cost of entry that takes the form of an "endogenous tax rate" on goods exported to countries using TBTs. The level of the tax rate is inversely related to the level of exports. The inclusion of fixed costs to export would enable trade modelling to deal with the extensive margin of trade. This feature, in addition to its usefulness in assessing the impact of technical regulations in trade, could introduce additional sources of gains from trade liberalization.[11]

Increasing returns to scale are not treated in the standard GTAP model. However, they could be in principle easily implemented as discussed in Francois (1998). Nevertheless, this augmented version of the GTAP framework, does not account for export specific fixed costs. 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 usually not features of agricultural sectors. Indeed, agricultural production is mostly assumed to be characterized by high goods homogeneity. But agricultural production is also likely to be concerned by technical regulations related to SPS. A step towards the reconciliation between these 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

[11] See Baldwin and Forsild (2006) for a qualification in the context of the firms' heterogeneity approach.

instance by Beghin and Bureau (2001). For more homogeneous goods, only variable costs would be affected.

Although the introduction of imperfect competition features may be desirable, the standard GTAP perfect competition set up can still be of use to assess the impact of NTBs on variable costs. In the GTAP world, this cost element would affect exports price in a similar manner that *txs* does but obviously without any direct link to tax revenues.

In order to test this approach we run simulations introducing the AVEs of NTBs as *ad valorem* export taxes. However, AVEs reflect the price effects on imports (*pms*). However imports price is not the price on which export taxes apply. The relevant price is the price prevailing in the domestic market (*pm*).

The necessary information to make the estimates the paper uses and this simulation strategy is given by the following set of equations retrieved from the standard GTAP model.

$$pms_{irs} = tms_{irs} + pcif_{irs} \quad (3)$$

and

$$pcif_{irs} = sharefob_{irs} * pfob_{irs} + sharetrn_{irs} * ptrans_{irs} \quad (4)$$

and

$$pfob_{irs} = pm_{ir} - txs_{irs} \quad (5)$$

Straightforward combination of (3), (4), (5) gives:

$$pms_{irs} = tms_{irs} + sharefob_{irs} * (pm_{ir} - txs_{irs}) + sharetrn_{irs} * ptrans_{irs} \quad (6)$$

where

pms_{irs}: percentage change in price of imports of *i* from *r* in *s*
$pfob_{irs}$: change in FOB price of commodity i supplied from r to s
$pcif_{irs}$: change in CIF price for good i shipped from region r to s
$ptrans_{irs}$: change in cost index for international transport of i from r to s
txs_{irs}: change in subsidy on exports of i from r into s
tms_{irs}: change in tax on imports of i from r into s

$sharefob_{irs}$: FOB share in value of commodity imports i from r into s at CIF prices
$sharetrn_{irs}$: transport share in value of commodity imports i from r into s at CIF prices

We can therefore see that *tms* and *txs* can be used to shock *pms* in a comparable manner. Note that *sharefob* is treated as a coefficient. With these quasi heroic assumptions, we can use estimates of import price effects to simulate export price changes. The other issue to be solved either theoretically or practically is the fiscal nature of the simulation.

Table 7 shows welfare impact of changes in export taxes. TXS columns refer to results obtained without controlling for changes in tax revenues. Tax revenues are constant for the TXS2 column results and the adjusting variable is the tax rate on private consumption. By doing so we implicitly assume that some rents are generated domestically by the application of NTBs by trade partners. Rather than insisting on the economic rationale of such assumption, we want to observe that results are pretty similar in both simulations.

Figure 10 and table 8 report welfare results obtained for the main three simulations: change in tariffs (*tms*), change in efficiency (*ams*), and change in export taxes (*txs*). 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. We also have that export taxes effects are more strongly correlated to efficiency effects than to tariffs effects.

Only cost effects affecting firms have been discussed. However, it is likely that the existence of NTBs also imply additional costs for public entities. These costs could concern both exporting and importing public authorities. They may result in a rise of general taxation or a loss in overall public services efficiency and delivery.

The demand-shift and supply-shift effects

The experiments in this paper focus exclusively on the cost of NTBs, overlooking the social benefits they might provide. As mentioned earlier in section III, this might be of particular relevance in the case of standards. This distinction is important from a

policy point of view, since the objective of international liberalization of NTBs will not in most cases be their elimination, such as for tariffs, but rationalization to optimal level. Although it might be desirable to investigate the possibility to identify these two different uses empirically, it is difficult to think of a methodology that would allow such a distinction in a systematic way. The information needed is quite specific and as underlined in Deardoff and Stern (1997) could essentially be provided by technical experts only for some particular products or processes in a limited range of countries. The standard GTAP model does not offer many alternatives to include demand-shift and supply-shift effects. We could not think of any appropriate and easily adoptable strategy to implement supply-shift effects. As to demand-shift effects, they may be accounted for by varying the degree of substitution between domestic and imported goods and/or among imports. This could be done by changing the value of the region generic elasticity of substitution between domestic and imported goods and/or of the Armington elasticities. Technical regulations could for instance increase the willingness to pay by consumers for foreign products. These regulations could guarantee the good quality either technical or sanitary of the imported product. Typically a preference would be given to products coming form the country implementing the regulation. This may be achieved by modifying Armington elasticities. Technical regulations could also increase the substitutability between domestic and foreign goods (e.g. with 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 as for instance in Harrison, Rutherford and Tarr (1994). Changes in elasticities are changes in preferences without altering the utility function structures. This preference change could be simulated along a continuum to assess the sensitivity of the results. The limit would be that all products from all countries would be treated by consumers as equally substitutable. In other words, all elasticities in the model would become equal.

In the context of a removal of the NTBs as simulated previously, the introduction of demand shift effects may not necessarily be straightforward. Besides, in order to determine an elasticity effect which could be seen as appropriate in magnitude, we would have to appropriately identify those sectors and pairs of countries characterized by demand shift effects. However, accounting for demand shift effects should undermine those obtained from the removal of the NTBs as goods form different

sources would become less substitutable. The empirical knowledge of the demand shift effects remain too scarce to be implemented in a CGE context beyond a sensitivity analysis approach, and construct robust policy recommendations thereof.

VII. Conclusions

This work is a first attempt to investigate a truly global general equilibrium modelling of the costs of NTBs. This was made possible by significant recent advances in better survey of NTBs and extensive empirical work to estimate directly comparable measures such as AVEs.

Our investigation shows that the choice of modelling assumption is a difficult issue in the case of NTBs, and perhaps less surprisingly, that the choice of the GTAP policy variable leads to vastly different interpretations. We see that the nature of technological shocks in GTAP tends to drive very powerful effects and one should therefore justify its use under very robust evidence of the friction nature of these costs.

This leads to two major observations. First, a proper inclusion of NTBs in CGE models like GTAP needs further refinements in modelling. Within the GTAP framework, a more systematically use of increasing returns to scale modelling could be desirable for non-agricultural sectors and agricultural sectors with an advanced degree of products processing. Additional efforts should also be devoted to develop a margin-sector like component that would allow including 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.

But, this would inevitably lead to rethink the way AVEs are estimated.

Another issue is the focus on the cost of NTBs and not their possible benefits. Although ways of integrating these benefits do exist and have been exploited by some authors, a major interrogation remains concerning the means to estimate them and then assess their impact properly.

Then, this paper leaves many questions unanswered which should form a sizeable future agenda for research. How to make GTAP modelling more compatible with the empirical data, including resolving issues around aggregation and compatibility of theoretical approaches underpinning the empirical and GTAP work? How to refine the GTAP modelling to better reflect the nature of NTBs, including introducing imperfect competition, and domestic effects of NTBs? Finally, what policy scenario to simulate?

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Table 1: Evolution of NTB usage by broad category

TCM Code	TCM Description	1994(%)	2004(%)
1	TARIFF MEASURES (TRQ, etc)	5.8	0.3
3	PRICE CONTROL MEASURES	7.1	1.8
4	FINANCE MEASURES	2.0	1.5
417	Refundable Deposit for sensitive products categories		0.6
5	AUTOMATIC LICENSING MEASURES	2.8	1.7
6	QUANTITY CONTROL MEASURES	49.2	34.8
617	Prior authorization for sensitive product categories	18.1	17.1
627	Quotas for sensitive product categories	0.2	0.2
637	Prohibition for sensitive product categories	2.5	6.8
7	MONOPOLISTIC MEASURES	1.3	1.5
8	TECHNICAL MEASURES	31.9	58.5
Non-Core Measures	5+617+627+637+8	55.3	84.8
Core Measures	1+3+4+6+7-(617+627+637)	44.7	15.2
Number of Countries		52	97
Total Number of Observations (Number of Tariff Lines)		97706	545078

Source: UNCTAD (2005)

Note1: Reference years are 1994 and 2004. However, as country data are not available for each single year, figures refer to the latest available. For instance, 2004 includes the latest available information over the 1995-2004 period.

Note 2: The evolution of the relative importance of NTBs categories may have been influenced by the increased country coverage between 1994 and 2004. However, a similar evolution is observed when keeping the country sample fixed.

Table 2. Sectoral aggregration

GTAP code	Sector Name	Agg code	Agg Name
pdr	Paddy rice	pdr	Rice
wht	Wheat	cere	Cereals
gro	Cereal grains nec	cere	Cereals
v_f	Vegetables, fruit, nuts	oag	Other agri.
osd	Oil seeds	oag	Other agri.
c_b	Sugar cane, sugar beet	sgr	Sugar
pfb	Plant-based fibers	oag	Other agri.
ocr	Crops nec	oag	Other agri.
ctl	Cattle,sheep,goats,horses	cmt	Meat: cattle, sheep, goats, horse
oap	Animal products nec	omt	Meat products nec
rmk	Raw milk	mil	Dairy products
wol	Wool, silk-worm cocoons	wol	Wool
frs	Forestry	fsh	Fishing
fsh	Fishing	frs	Forestry
coa	Coal	min	Minerals
oil	Oil	min	Minerals
gas	Gas	min	Minerals
omn	Minerals nec	min	Minerals
cmt	Meat: cattle,sheep,goats,horse	cmt	Meat: cattle, sheep, goats, horse
omt	Meat products nec	omt	Meat products nec
vol	Vegetable oils and fats	pcr	Processed food
mil	Dairy products	mil	Dairy products
pcr	Processed rice	pdr	Rice
sgr	Sugar	sgr	Sugar
ofd	Food products nec	pcr	Processed food
b_t	Beverages and tobacco products	pcr	Processed food
tex	Textiles	tex	Textiles
wap	Wearing apparel	wea	Wearing apparels
lea	Leather products	lea	Leather
lum	Wood products	ppp	Paper products, publishing
ppp	Paper products, publishing	ppp	Paper products, publishing
p_c	Petroleum, coal products	crp	Chemical, rubber, plastic prod.
crp	Chemical,rubber,plastic prods	crp	Chemical, rubber, plastic prod.
nmm	Mineral products nec	crp	Chemical, rubber, plastic prod.
i_s	Ferrous metals	i_s	Ferrous metals
nfm	Metals nec	nfm	Metals
fmp	Metal products	nfm	Metals
mvh	Motor vehicles and parts	mvh	Motor vehicles and parts
otn	Transport equipment nec	mvh	Motor vehicles and parts
ele	Electronic equipment	ele	Electronics
ome	Machinery and equipment nec	mvh	Motor vehicles and parts
omf	Manufactures nec	omf	Other manuf.
ely	Electricity	ser	Services
gdt	Gas manufacture, distribution	ser	Services
wtr	Water	ser	Services
cns	Construction	ser	Services
trd	Trade	tra	Trade
otp	Transport nec	trn	Transport services
wtp	Sea transport	trn	Transport services
atp	Air transport	trn	Transport services
cmn	Communication	ome	Business services
ofi	Financial services nec	ome	Business services
isr	Insurance	ome	Business services
obs	Business services nec	ome	Business services
ros	Recreation and other services	ser	Services
osg	PuPubAdmin/Defence/Health/Edu	ser	Services
dwe	Dwellings	ser	Services

Source: GTAP 6.0 database and authors

Table 3. Regional aggregation

GTAP code	GTAP Region	Agg code	Agg Region
aus	Australia	anz	Australia, New Zealand
nzl	New Zealand	anz	Australia, New Zealand
xoc	Rest of Oceania	oce	Oceania
chn	China	chn	China
hkg	Hong Kong	hkg	Hong Kong
jpn	Japan	jpn	Japan
kor	Korea	eta	East Asia
twn	Taiwan	eta	East Asia
xea	Rest of East Asia	eta	East Asia
idn	Indonesia	sea	South East Asia
mys	Malaysia	sea	South East Asia
phl	Philippines	sea	South East Asia
sgp	Singapore	eta	East Asia
tha	Thailand	sea	South East Asia
vnm	Vietnam	sea	South East Asia
xse	Rest of Southeast Asia	sea	South East Asia
bgd	Bangladesh	sta	South Asia
ind	India	ind	India
lka	Sri Lanka	sta	South Asia
xsa	Rest of South Asia	sta	South Asia
can	Canada	can	Canada
usa	United States	usa	USA
mex	Mexico	mex	Mexico
xna	Rest of North America	usa	USA
col	Colombia	and	Andean communit
per	Peru	and	Andean communit
ven	Venezuela	and	Andean communit
xap	Rest of Andean Pact	and	Andean communit
arg	Argentina	arg	Argentina
bra	Brazil	bra	Brazil
chl	Chile	rla	Rest of Latin America
ury	Uruguay	rla	Rest of Latin America
xsm	Rest of South America	rla	Rest of Latin America
xca	Central America	cca	CCA
xfa	Rest of FTAA	rla	Rest of Latin America
xcb	Rest of the Caribbean	cca	CCA
aut	Austria	eu15	Europe 15
bel	Belgium	eu15	Europe 15
dnk	Denmark	eu15	Europe 15
fin	Finland	eu15	Europe 15
fra	France	eu15	Europe 15
deu	Germany	eu15	Europe 15
gbr	United Kingdom	eu15	Europe 15
grc	Greece	eu15	Europe 15
irl	Ireland	eu15	Europe 15
ita	Italy	eu15	Europe 15
lux	Luxembourg	eu15	Europe 15
nld	Netherlands	eu15	Europe 15
prt	Portugal	eu15	Europe 15
esp	Spain	eu15	Europe 15
swe	Sweden	eu15	Europe 15
che	Switzerland	efta	EFTA

Table 3. Regional aggregation (continued)

GTAP code	GTAP Region	Agg code	Agg Region
xef	Rest of EFTA	efta	EFTA
xer	Rest of Europe	rus	CEI
alb	Albania	rus	CEI
bgr	Bulgaria	rus	CEI
hrv	Croatia	rus	CEI
cyp	Cyprus	eu15	Europe 15
cze	Czech Republic	eu10	EU 10
hun	Hungary	eu10	EU 10
mlt	Malta	eu10	EU 10
pol	Poland	eu10	EU 10
rom	Romania	eu10	EU 10
svk	Slovakia	eu10	EU 10
svn	Slovenia	eu10	EU 10
est	Estonia	eu10	EU 10
lva	Latvia	eu10	EU 10
ltu	Lithuania	eu10	EU 10
rus	Russian Federation	rus	CEI
xsu	Rest of Former Soviet Union	rus	CEI
tur	Turkey	tur	Turkey
xme	Rest of Middle East	men	MENA
mar	Morocco	men	MENA
tun	Tunisia	men	MENA
xnf	Rest of North Africa	men	MENA
bwa	Botswana	sacu	Rest of SACU
zaf	South Africa	zsa	South Africa
xsc	Rest of South African CU	sacu	Rest of SACU
mwi	Malawi	sadc	Rest of SADC
moz	Mozambique	sadc	Rest of SADC
tza	Tanzania	sadc	Rest of SADC
zmb	Zambia	sadc	Rest of SADC
zwe	Zimbabwe	sadc	Rest of SADC
xsd	Rest of SADC	sadc	Rest of SADC
mdg	Madagascar	ssa	Rest of SSA
uga	Uganda	ssa	Rest of SSA
xss	Rest of Sub-Saharan Africa	ssa	Rest of SSA

Source: GTAP 6.0 database and authors

Table 4. Tariffs and Ad Valorem Equivalent of NTBs by GTAP sector

Sector	tariff	avec core	ave dom
mil	34.8	72.3	3.1
sgr	67.4	59.3	0.0
pdr	73.4	54.9	0.6
cere	27.3	54.7	5.1
cmt	33.0	36.0	0.2
pcr	12.3	33.4	0.4
oag	8.5	33.3	1.4
omt	20.9	28.5	0.2
frs	3.4	27.1	0.0
fsh	0.9	22.8	0.0
min	1.9	17.8	0.0
tex	8.7	15.0	0.0
wol	1.3	11.9	0.0
lea	6.4	11.1	0.0
i_s	4.5	5.5	0.0
mvh	3.8	4.2	0.0
wea	8.5	4.2	0.0
ele	2.5	3.8	0.0
crp	3.6	3.5	0.0
nfm	3.7	2.6	0.0
ppp	2.2	2.5	0.0
omf	3.3	2.0	0.0

Source: Kee et al. (2005) and authors

Table 5. Tariffs and Ad Valorem Equivalen of NTBs by GTAP region

Region	Code	tariff	ave_core	ave_doms
Andean communit	and	11.9	11.1	0.1
Australia, New Zealand	anz	5.6	9.3	0.0
Argentina	arg	13.4	8.4	0.0
Brazil	bra	11.6	19.8	0.0
Canada	can	2.9	3.3	0.0
CCA	cca	6.5	5.2	0.0
China	chn	13.2	9.4	0.0
EFTA	efta	4.1	3.4	0.0
East Asia	eta	4.5	10.2	0.0
EU 10	eu10	7.6	4.9	0.0
Europe 15	eu15	2.5	6.1	0.2
Hong Kong	hkg	0.0	1.4	0.0
India	ind	31.7	10.0	0.0
Japan	jpn	6.9	15.5	0.1
MENA	men	15.6	13.3	0.0
Mexico	mex	14.7	17.1	0.0
Oceania	oce	3.8	6.6	0.0
Rest of Latin America	rla	8.0	6.3	0.0
CEI	rus	9.5	19.2	0.0
Rest of SADC	sadc	12.7	12.5	0.0
South East Asia	sea	7.9	14.3	0.0
Rest of SSA	ssa	15.2	18.3	0.0
South Asia	sta	16.4	4.4	0.0
Turkey	tur	4.0	6.0	0.0
USA	usa	2.9	6.5	0.0
South Africa	zsa	6.8	1.2	0.1

Source: Kee et al. (2005) and authors

Figure 1. Ratio of rent creating versus technical NTBs by GTAP sector (total = 100%)

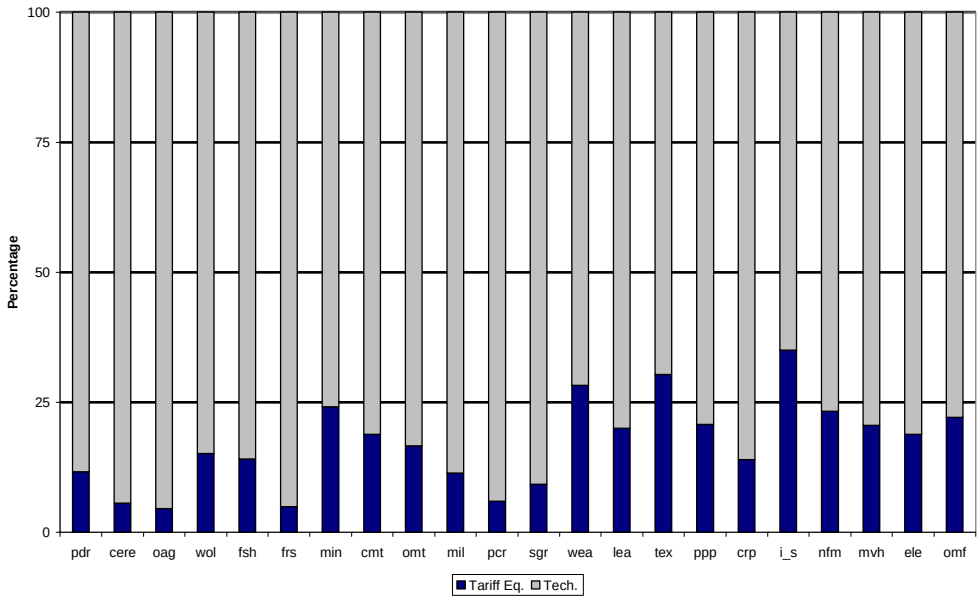


Figure 2. Ratio of of rent creating versus technical NTBs by GTAP region (total = 100%)

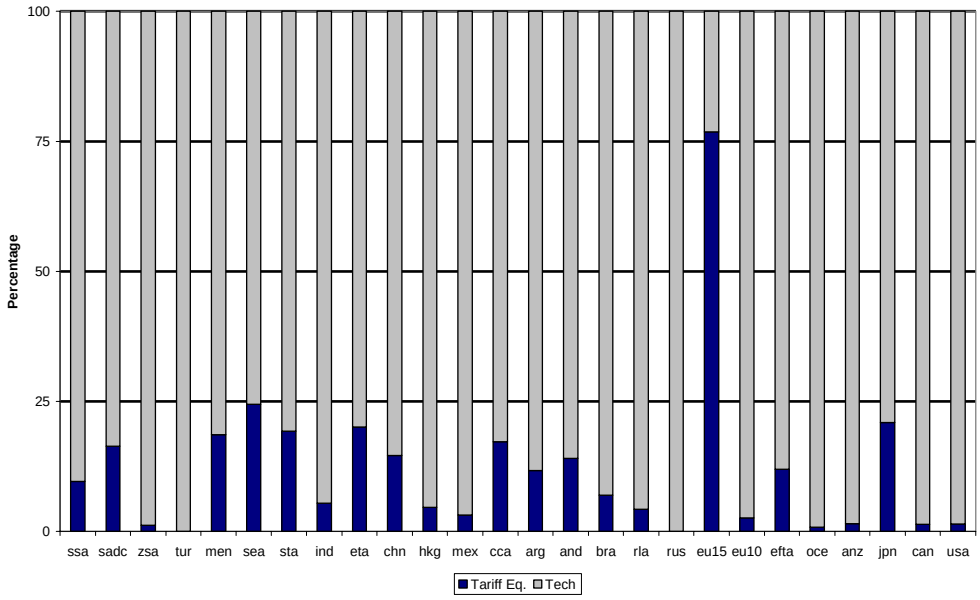


Figure 3. Equivalent variation (as % of GDP) of a complete removal of NTBs at the border

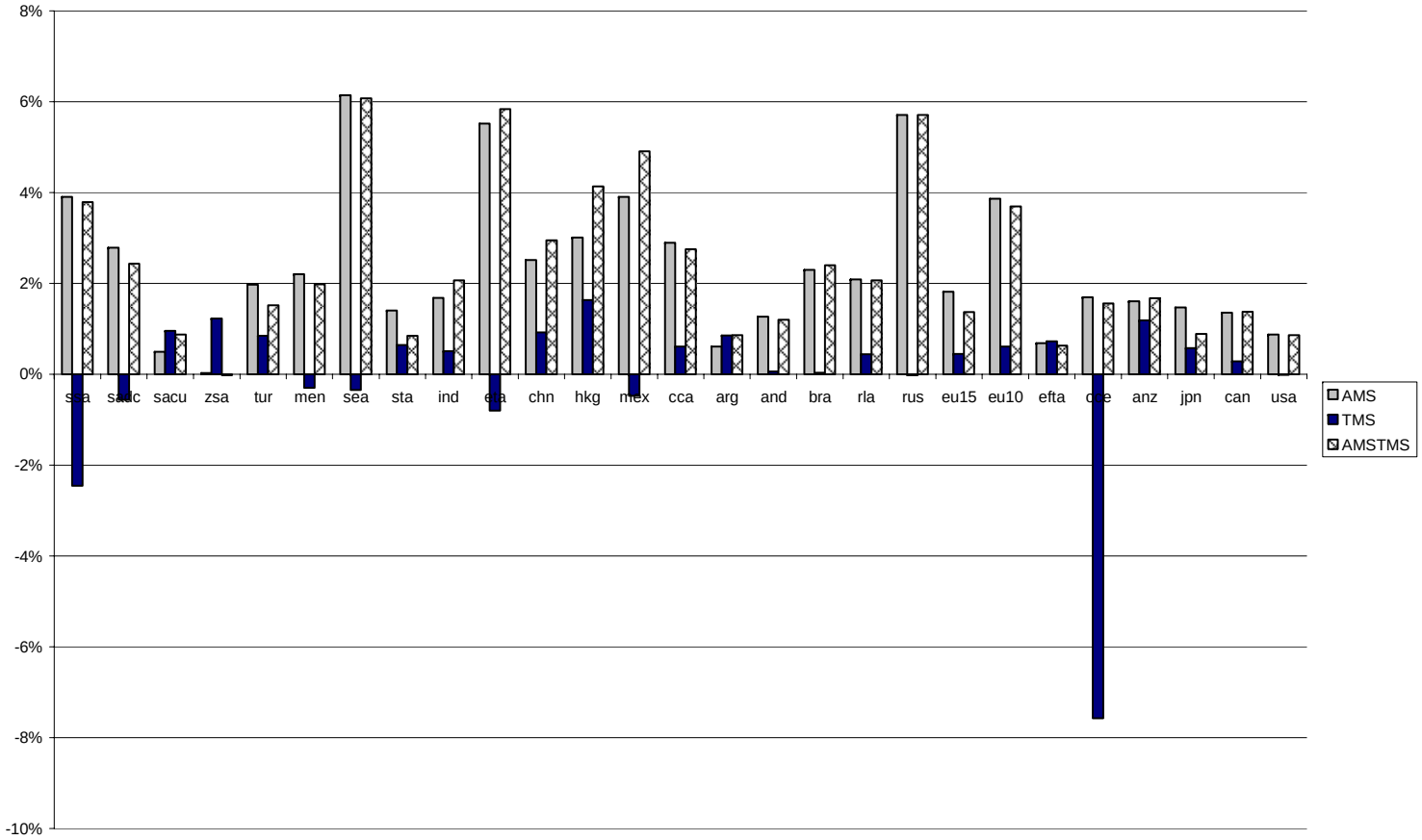


Figure 4. Technical change EV and imports as % of GDP (*ams* scenario)

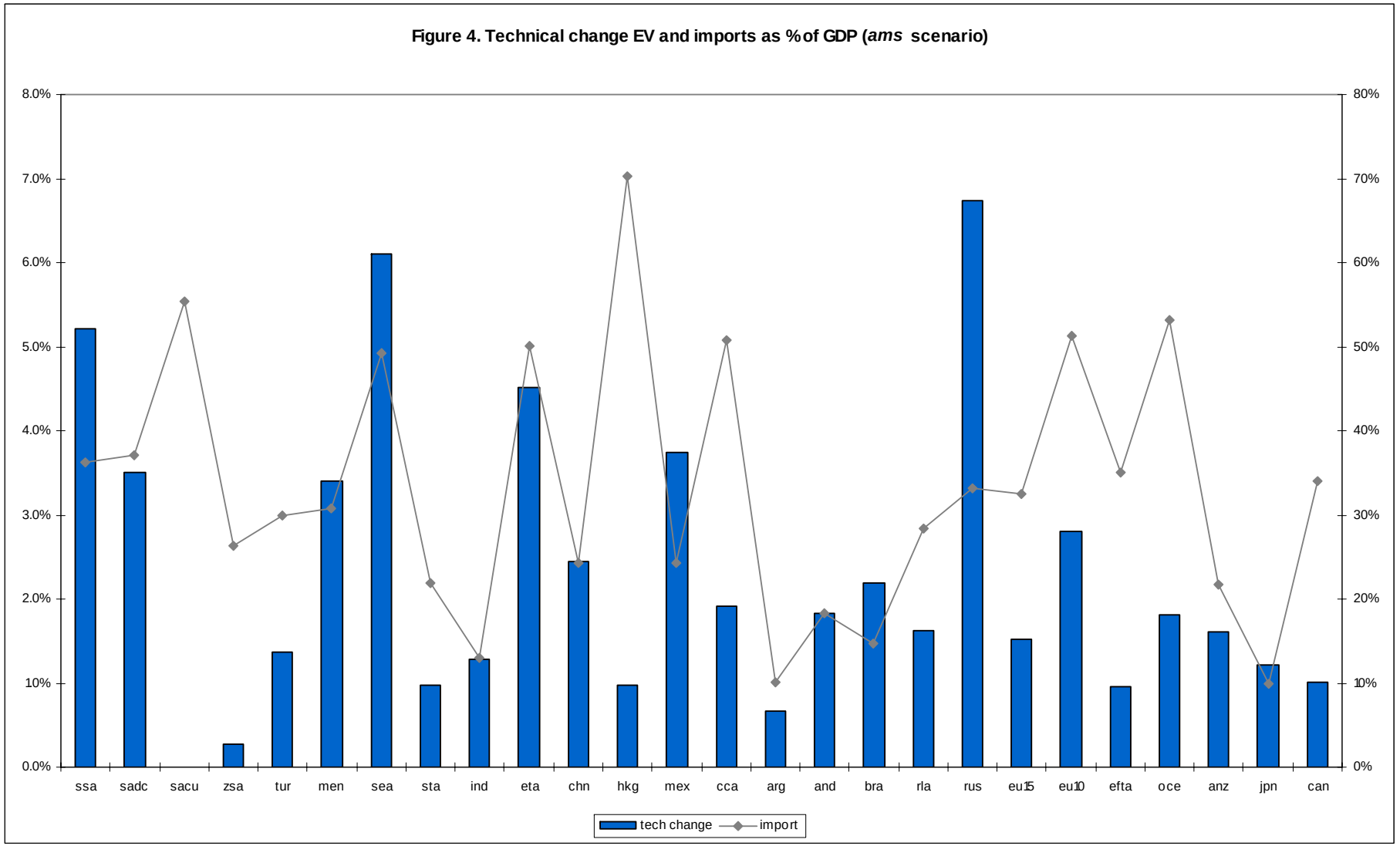


Figure 5. Variation (%) in land prices

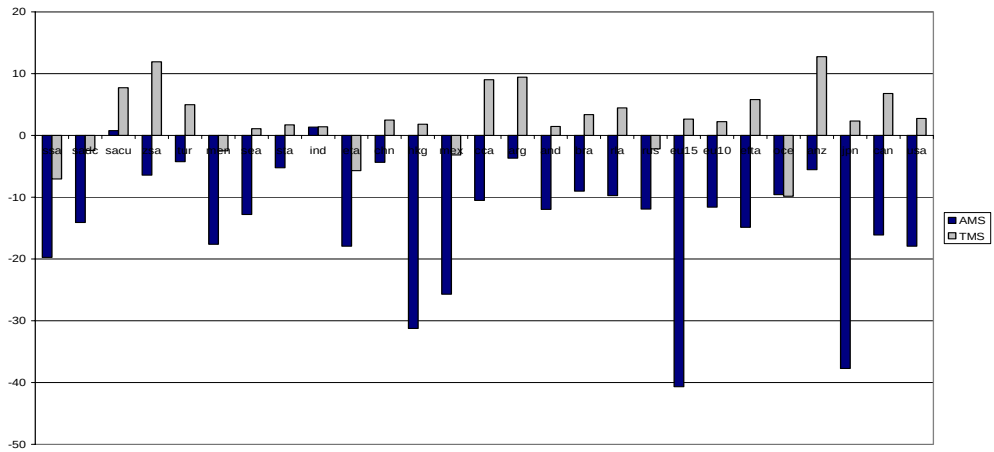


Figure 6. Variation (%) in returns to unskilled labour

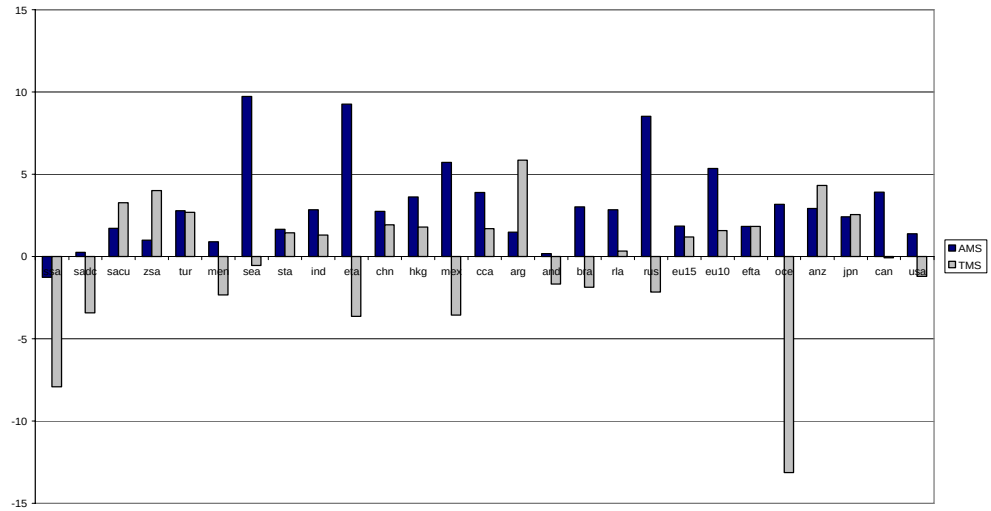


Figure 7. Variation (%) in returns to skilled labour

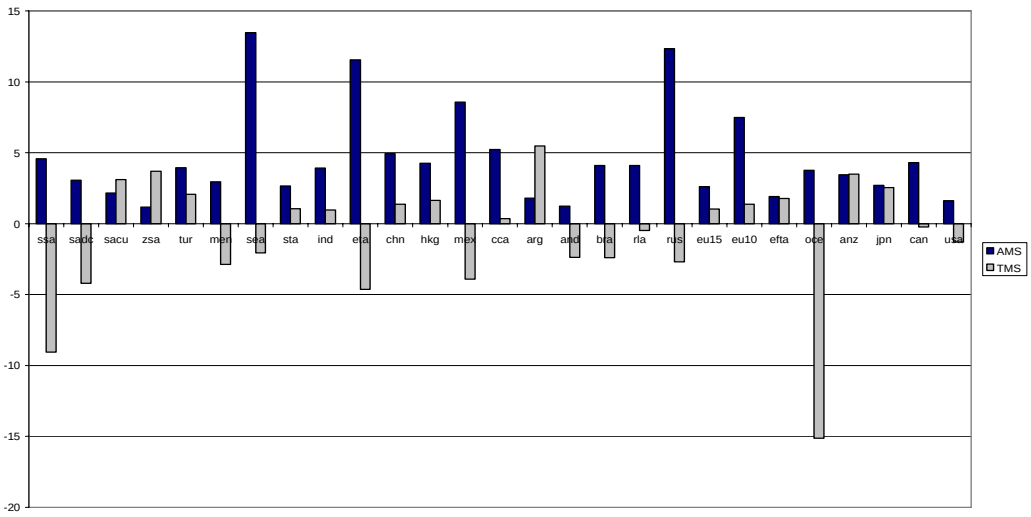


Figure 8. Percentage change of global exports value by sector

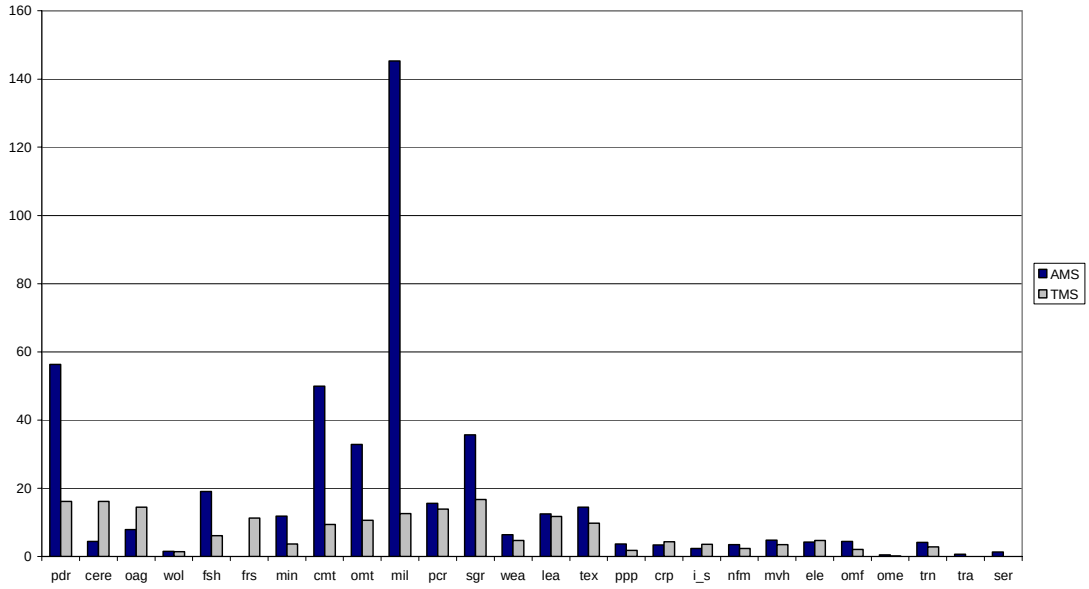


Figure 9. Percentage change of export value by country

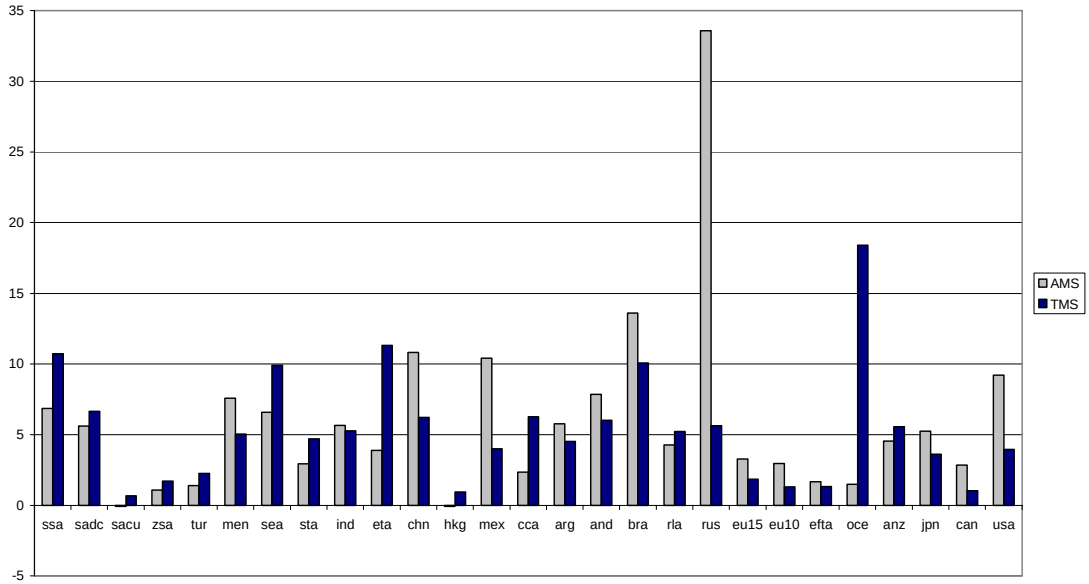


Table 6. Term of trade effects: price index of merchandise exports and imports by region in the tms scenario

Region	Code	Price of exports (change %)	Price of imports (change %)
Rest of SSA	ssa	-7.79	-0.95
Rest of SADC	sadc	-3.83	-0.36
Rest of SACU	sacu	2.64	1.09
South Africa	zsa	2.71	-0.84
Turkey	tur	1.29	-0.72
MENA	men	-2.53	-0.66
South East Asia	sea	-4.61	-1.63
South Asia	sta	-0.1	-1.57
India	ind	0.19	-1.02
East Asia	eta	-61	-1.37
China	chn	-0.78	-1.41
Hong Kong	hkg	0.92	-1.4
Mexico	mex	-3.93	-1.3
CCA	cca	-0.37	-1.19
Argentina	arg	4.42	-1.23
Andean community	and	-2.28	-1.2
Brazil	bra	-2.84	-0.52
Rest of Latin America	rla	-0.88	-0.9
CEI	rus	-3.03	-0.93
Europe 15	eu15	0.43	-0.31
EU 10	eu10	0.63	-0.28
EFTA	efta	1.19	-0.21
Oceania	oce	-12.08	-0.78
Australia, New Zealand	anz	2.74	-0.93
Japan	jpn	1.78	-1.58
Canada	can	-0.65	-1.18
USA	usa	-1.5	-1.25

Source: Authors' calculations

Table 7. Equivalent Variation (as % of GDP) in *txs*, and *txs2* scenarios

Region	Code	TXS	TXS2
Rest of SSA	ssa	1.9%	1.7%
Rest of SADC	sadc	-0.7%	-0.9%
Rest of SACU	sacu	-2.6%	-2.8%
South Africa	zsa	-1.7%	-1.8%
Turkey	tur	-0.5%	-0.6%
MENA	men	0.6%	0.3%
South East Asia	sea	0.9%	0.5%
South Asia	sta	-0.9%	-1.0%
India	ind	0.4%	0.4%
East Asia	eta	0.7%	0.6%
China	chn	1.0%	0.8%
Hong Kong	hkg	2.2%	2.0%
Mexico	mex	2.3%	2.2%
CCA	cca	-1.4%	-1.3%
Argentina	arg	-1.6%	-1.8%
Andean community	and	-0.1%	-0.2%
Brazil	bra	1.4%	1.3%
Rest of Latin America	rla	-0.8%	-0.9%
CEI	rus	3.3%	3.3%
Europe 15	eu15	0.7%	0.7%
EU 10	eu10	1.0%	0.9%
EFTA	efta	0.2%	0.1%
Oceania	oce	-3.0%	-2.9%
Australia, New Zealand	anz	-1.1%	-1.3%
Japan	jpn	1.6%	1.6%
Canada	can	-1.9%	-1.9%
USA	usa	0.4%	0.4%

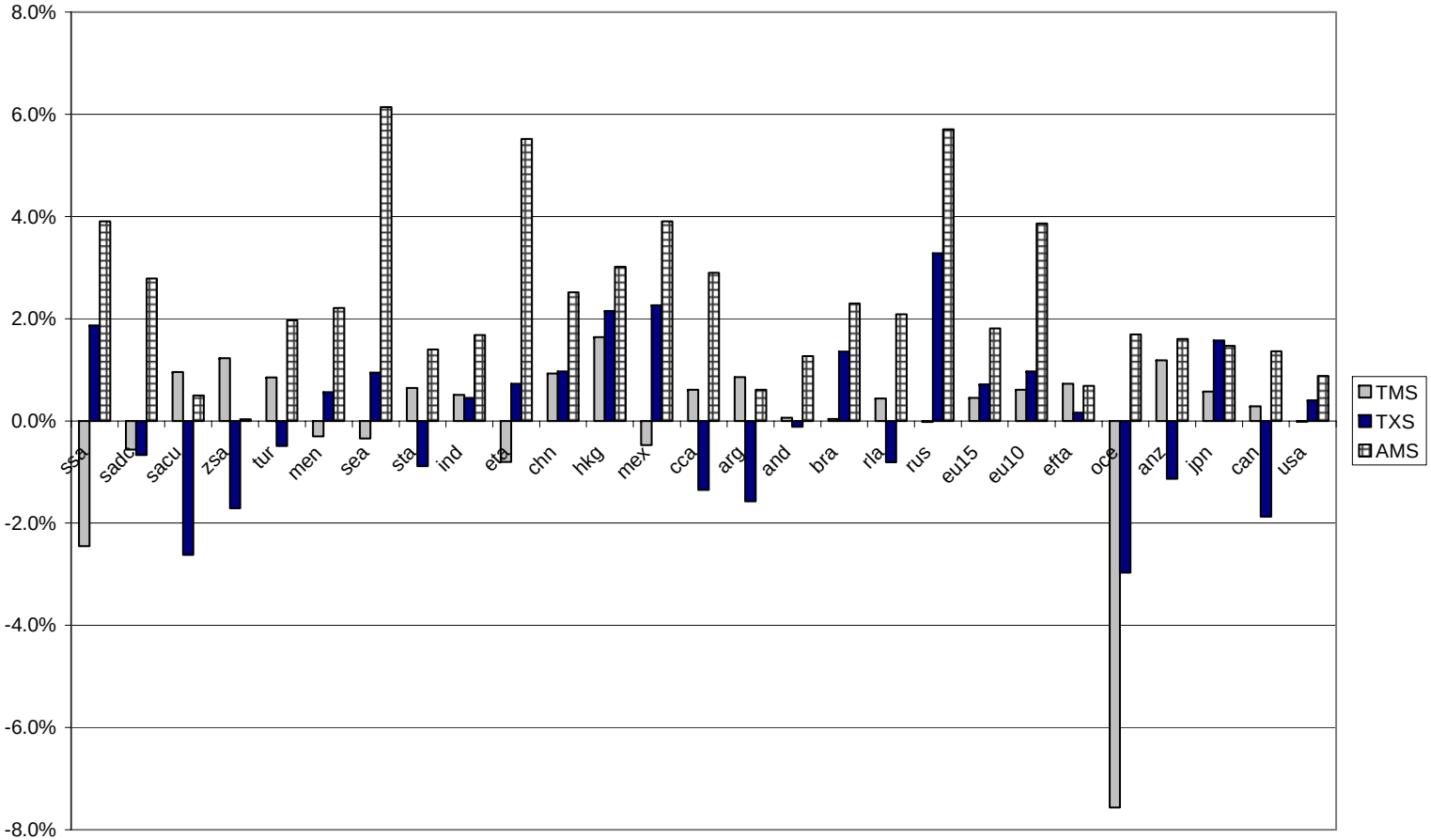
Source: Authors' calculations

Table 8. Equivalent Variation (as % of GDP) in *tms*, *txs*, and *ams* scenarios

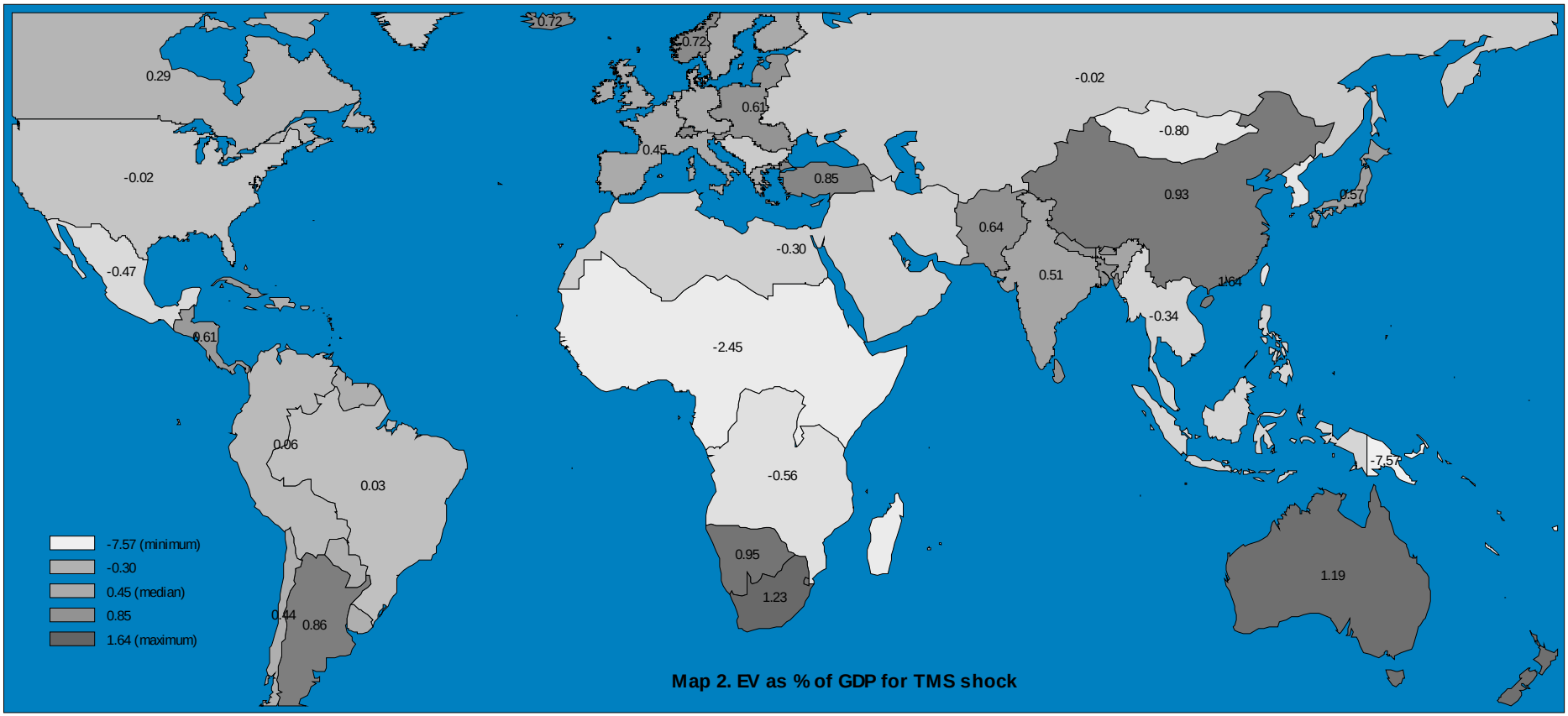
Region	Code	TMS	TXS	AMS
Rest of SSA	ssa	-2.5%	1.9%	3.9%
Rest of SADC	sadc	-0.6%	-0.7%	2.8%
Rest of SACU	sacu	1.0%	-2.6%	0.5%
South Africa	zsa	1.2%	-1.7%	0.0%
Turkey	tur	0.9%	-0.5%	2.0%
MENA	men	-0.3%	0.6%	2.2%
South East Asia	sea	-0.3%	0.9%	6.1%
South Asia	sta	0.6%	-0.9%	1.4%
India	ind	0.5%	0.4%	1.7%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

Source: Authors' calculations

Figure 10. Equivalent variation (as % of GDP) in the *tms*, *txs* and *ams* scenarios



Map 1. Equivalent Variation as share of GDP, *tms* Scenario



Map 2. EV as % of GDP for TMS shock

Map 2. Equivalent Variation as Share of GPD, *ams* Scenario